

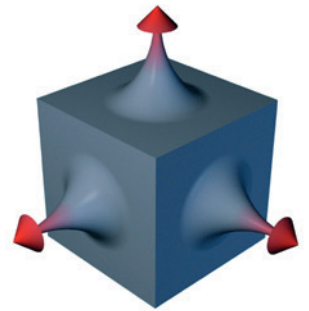


Somaloy® 1P

Material Data

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.

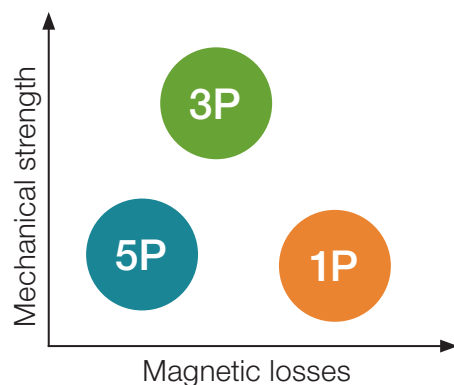


Höganäs develop and provide the Somaloy product range which comprises press-ready powder mixes. Each Somaloy product has properties that can be carefully tailored to ensure optimum performance in your specific component and application. We will help you with material selection that suits your specific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

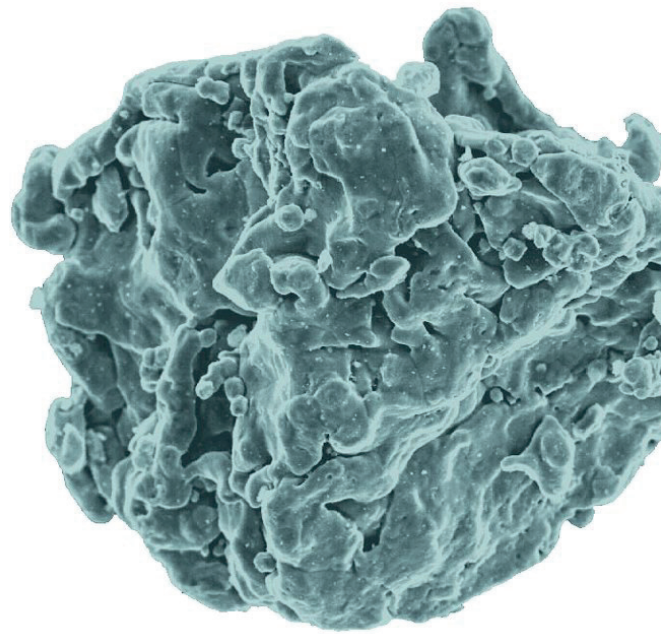
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Somaloy powder particle



Somaloy®

Product portfolio

Somaloy material	Density [g/cm ³]	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 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 material	Density [g/cm ³]	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 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

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 1P

800 MPa

General

Base material: Somaloy 700HR 1P	Additive(s): 0.4% Kenolube	Compaction: Pressure: 800 MPa Die temperature: Room temperature	Heat treatment: Atmosphere: Air Temperature: 530°C
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Mechanical properties		Standards	
Transverse rupture strength/150°C [MPa]	35/35	SS-ISO 3325	
Tensile strength/Yield strength [MPa]	10/10	SS-EN 10002-1, ISO 2740	
Compressive Strength/Yield [MPa]	510/250	ASTM E9-89a	
Young's modulus [GPa]	70	ASTM E 1876-99	
Poisson's ratio	-	0.23 ASTM E 1876-99	
Impact Energy [J]	1.8	SS-EN 10045, SS-EN 25754	

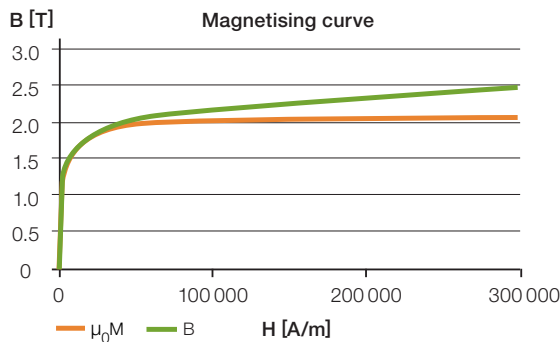
Physical properties		Standards	
Density [g/cm³]	7.45	SS-ISO 2738	
Thermal expansion [K⁻¹]	11 e-06	ASTM E 228/MPIF 35	
Thermal conductivity [W/m²K]	25	ISO 22007-2	
Resistivity [μΩm]	1000	Four point measurements on nom. size OD 55mm ID 45mm Height 5mm	

Magnetic properties		Standards	
B@4000A/m [T]	1.24	IEC 60404-4	
B@10000A/m [T]	1.53	IEC 60404-4	
H _c [A/m]	225	IEC 60404-4	
μ _r -max	-	440 IEC 60404-4	

Powder properties		Standards	
Apparent density [g/cm³]	3.18	ISO 3923/1	
Flow [s/50g]	32	ISO 4490	
Green density [g/cm³]	7.50	ISO 3927	
Green strength [MPa]	18	ISO 3995	
Springback [%]	0.15	ISO 4492, ISO 2740	
Heat treated dim. change [%]	-0.01	ISO 4492, ISO 2740	
Total dim. change [%]	0.14	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	13441	1.57	1.59
97	0.03	0.03	27133	1.76	1.80
168	0.07	0.07	49604	1.89	1.95
299	0.14	0.14	74604	1.95	2.04
422	0.22	0.22	99604	1.97	2.10
738	0.41	0.41	124604	1.99	2.15
1199	0.65	0.65	149604	2.01	2.20
1745	0.83	0.83	189604	2.03	2.26
2538	1.02	1.02	229604	2.04	2.33
3940	1.20	1.21	279604	2.05	2.40
6952	1.39	1.40	304604	2.059	2.44

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	1.5/1.8	3.0	6.0	9.0	13	16	20	24	28	32	36	86
1.0T	4.9/5.9	10	21	32	43	56	68	82	96	110	125	307
1.5T	10/12	20	42	65	89	115	141	169	199	229	261	649

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

Loss model

K _h	0.097	K _{ep}	0.000027
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$$P_{tot} = K_h * f * B^{1.75} + K_{ep} * f^2 * B^2 + \frac{B^2 * f^2 * d^2}{1.8 * \rho * resistivity * 1000} \quad [W/kg]$$

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 1P

600 MPa

General

Base material: Somaloy 700HR 1P	Additive(s): 0.4% Kenolube	Compaction: Pressure: 600 MPa Die temperature: Room temperature	Heat treatment: Atmosphere: Air Temperature: 530°C
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Mechanical properties		Standards	
Transverse rupture strength/150°C [MPa]	34/34	SS-ISO 3325	
Tensile strength/Yield strength [MPa]	15/15	SS-EN 10002-1, ISO 2740	
Compressive Strength/Yield [MPa]	340/220	ASTM E9-89a	
Young's modulus [GPa]	80	ASTM E 1876-99	
Poisson's ratio	- 0.23	ASTM E 1876-99	
Impact Energy [J]	1.7	SS-EN 10045, SS-EN 25754	

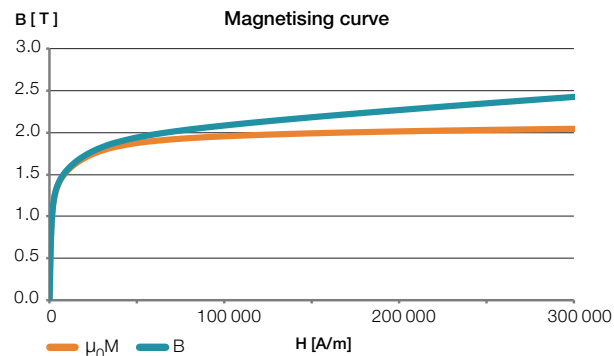
Physical properties		Standards	
Density [g/cm³]	7.35	SS-ISO 2738	
Thermal expansion [K ⁻¹]	11 e-06	ASTM E 228/MPIF 35	
Thermal conductivity [W/m·K]	30	ISO 22007-2	
Resistivity [μΩm]	900	Four point measurements on nom. size OD 55mm ID 45mm Height 5mm	

Magnetic properties		Standards	
B@4000A/m [T]	1.18	IEC 60404-4	
B@10000A/m [T]	1.45	IEC 60404-4	
H _C [A/m]	227	IEC 60404-4	
μ _r -max	450	IEC 60404-4	

Powder properties		Standards	
Apparent density [g/cm³]	3.18	ISO 3923/1	
Flow [s/50g]	32	ISO 4490	
Green density [g/cm³]	7.36	ISO 3927	
Green strength [MPa]	14	ISO 3995	
Springback [%]	0.12	ISO 4492, ISO 2740	
Heat treated dim. change [%]	-0.01	ISO 4492, ISO 2740	
Total dim. change [%]	0.11	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	13409	1.55	1.56
84	0.03	0.03	27511	1.73	1.76
146	0.06	0.06	49741	1.85	1.92
257	0.13	0.13	74741	1.91	2.00
358	0.20	0.20	99741	1.94	2.06
632	0.39	0.39	124741	1.96	2.11
1063	0.61	0.61	149741	1.97	2.16
1582	0.81	0.81	189741	1.99	2.23
2351	0.99	1.00	229741	2.00	2.29
3738	1.18	1.18	279741	2.02	2.37
6779	1.36	1.37	304741	2.022	2.40

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	6.0	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	215	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}	0.000032
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$$P_{tot} = K_h * f * B^{1.75} + K_{ep} * f^2 * B^2 + \frac{B^2 * f^2 * d^2}{1.8 * \rho * resistivity * 1000} \quad [W/kg]$$

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® 700 1P

800 MPa

General

Base material: Somaloy 700 1P	Additive(s): 0.4% Kenolube	Compaction: Pressure: 800 MPa Die temperature: Room temperature	Heat treatment: Atmosphere: Air Temperature: 530°C
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Mechanical properties		Standards	
Transverse rupture strength/150°C [MPa]	40/40	SS-ISO 3325	
Tensile strength/Yield strength [MPa]	15/15	SS-EN 10002-1, ISO 2740	
Compressive Strength/Yield [MPa]	350/230	ASTM E9-89a	
Young's modulus [GPa]	90	ASTM E 1876-99	
Poisson's ratio	- 0.23	ASTM E 1876-99	
Impact Energy [J]	2	SS-EN 10045, SS-EN 25754	

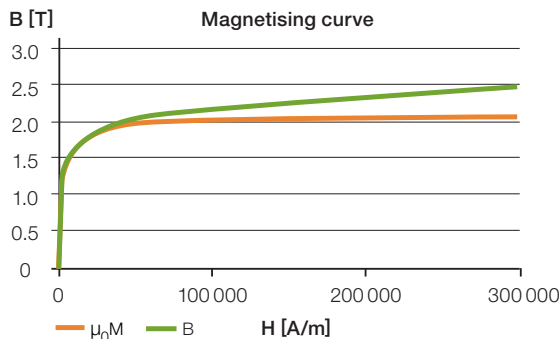
Physical properties		Standards	
Density [g/cm³]	7.45	SS-ISO 2738	
Thermal expansion [K ⁻¹]	11 e-06	ASTM E 228/MPIF 35	
Thermal conductivity [W/m²K]	25	ISO 22007-2	
Resistivity [μΩm]	400	Four point measurements on nom. size OD 55mm ID 45mm Height 5mm	

Magnetic properties		Standards	
B@4000A/m [T]	1.31	IEC 60404-4	
B@10000A/m [T]	1.56	IEC 60404-4	
H _c [A/m]	210	IEC 60404-4	
μ _r -max	540	IEC 60404-4	

Powder properties		Standards	
Apparent density [g/cm³]	3.33	ISO 3923/1	
Flow [s/50g]	29	ISO 4490	
Green density [g/cm³]	7.51	ISO 3927	
Green strength [MPa]	19	ISO 3995	
Springback [%]	0.12	ISO 4492, ISO 2740	
Heat treated dim. change [%]	-0.02	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	12249	1.59	1.60
81	0.03	0.03	26003	1.78	1.81
147	0.06	0.06	49779	1.91	1.97
249	0.13	0.13	74779	1.95	2.05
335	0.20	0.20	99779	1.98	2.11
407	0.25	0.25	124779	2.00	2.15
711	0.47	0.47	149779	2.01	2.20
1409	0.84	0.84	189779	2.03	2.26
2045	1.03	1.03	229779	2.04	2.33
3240	1.22	1.22	279779	2.05	2.40
5965	1.41	1.41	304779	2.0548	2.44

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	1.4/1.7	2.9	6	9	13	16	20	24	28	32	36	87
1.0T	4.9/5.9	9.9	20	31	43	55	68	82	96	110	126	312
1.5T	9.9/12	20	42	64	89	114	141	169	199	230	262	661

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

Loss model

K _h	0.096	K _{ep}	0.000027
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$$P_{tot} = K_h * f * B^{1.75} + K_{ep} * f^2 * B^2 + \frac{B^2 * f^2 * d^2}{1.8 * \rho * resistivity * 1000} \quad [W/kg]$$

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® 700 1P

600 MPa

General

Base material: Somaloy 700 1P	Additive(s): 0.4% Kenolube	Compaction: Pressure: 600 MPa Die temperature: Room temperature	Heat treatment: Atmosphere: Air Temperature: 530°C
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Mechanical properties		Standards	
Transverse rupture strength/150°C [MPa]	47/47	SS-ISO 3325	
Tensile strength/Yield strength [MPa]	15/15	SS-EN 10002-1, ISO 2740	
Compressive Strength/Yield [MPa]	330/200	ASTM E9-89a	
Young's modulus [GPa]	100	ASTM E 1876-99	
Poisson's ratio	- 0.23	ASTM E 1876-99	
Impact Energy [J]	2	SS-EN 10045, SS-EN 25754	

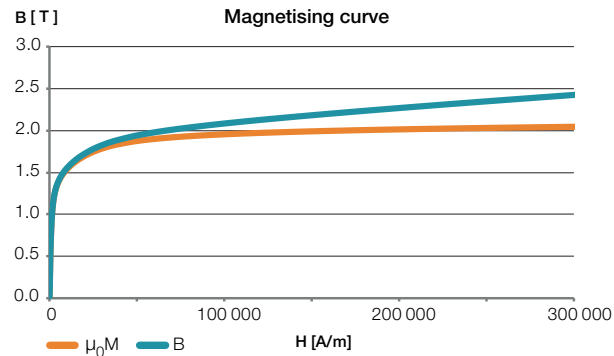
Physical properties		Standards	
Density [g/cm³]	7.39	SS-ISO 2738	
Thermal expansion [K⁻¹]	11 e-06	ASTM E 228/MPIF 35	
Thermal conductivity [W/m·K]	30	ISO 22007-2	
Resistivity [μΩm]	270	Four point measurements on nom. size OD 55mm ID 45mm Height 5mm	

Magnetic properties		Standards	
B@4000A/m [T]	1.25	IEC 60404-4	
B@10000A/m [T]	1.50	IEC 60404-4	
H _c [A/m]	226	IEC 60404-4	
μ _r -max	540	IEC 60404-4	

Powder properties		Standards	
Apparent density [g/cm³]	3.33	ISO 3923/1	
Flow [s/50g]	29	ISO 4490	
Green density [g/cm³]	7.38	ISO 3927	
Green strength [MPa]	16	ISO 3995	
Springback [%]	0.07	ISO 4492, ISO 2740	
Heat treated dim. change [%]	-0.01	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	12275	1.49	1.51
75	0.02	0.02	26377	1.67	1.70
123	0.05	0.05	49810	1.79	1.86
223	0.12	0.12	74810	1.86	1.95
303	0.18	0.18	99810	1.90	2.02
635	0.43	0.43	124810	1.93	2.08
875	0.58	0.58	149810	1.95	2.14
1307	0.78	0.78	189810	1.98	2.22
1935	0.96	0.96	229810	2.00	2.29
3130	1.14	1.14	279810	2.02	2.37
5898	1.31	1.32	304810	2.0326	2.42

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	1.5/1.8	3.0	6	10	13	17	21	25	29	34	38	95
1.0T	5.0/6.0	10	21	33	45	58	72	87	102	118	135	343
1.5T	10/12	21	43	67	93	120	149	180	212	246	282	730

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

Loss model

K _h	0.098	K _{ep}	0.000032
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$$P_{tot} = K_h * f * B^{1.75} + K_{ep} * f^2 * B^2 + \frac{B^2 * f^2 * d^2}{1.8 * \rho * resistivity * 1000} \quad [W/kg]$$

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]

Model is verified up to 1.5T and 5000Hz.

Somaloy® 130i 1P

800 MPa

General

Base material: Somaloy 130i 1P	Additive(s): 0.5% Kenolube	Compaction: Pressure: 800 MPa Die temperature: Room temperature	Heat treatment: Atmosphere: Air Temperature: 530°C
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Mechanical properties		Standards	
Transverse rupture strength/150°C [MPa]	33/33	SS-ISO 3325	
Tensile strength/Yield strength [MPa]	10/10	SS-EN 10002-1, ISO 2740	
Compressive Strength/Yield [MPa]	380/220	ASTM E9-89a	
Young's modulus [GPa]	60	ASTM E 1876-99	
Poisson's ratio	- 0.23	ASTM E 1876-99	
Impact Energy [J]	1.0	SS-EN 10045, SS-EN 25754	

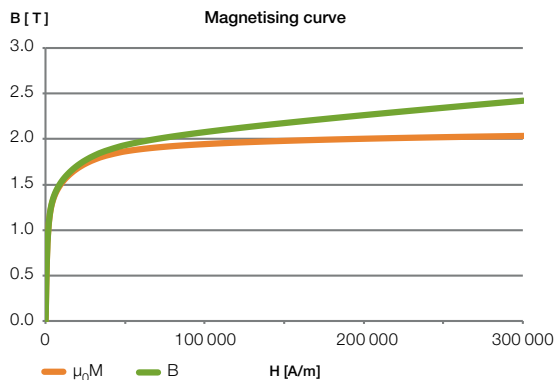
Physical properties		Standards	
Density [g/cm³]	7.35	SS-ISO 2738	
Thermal expansion [K ⁻¹]	11 e-06	ASTM E 228/MPIF 35	
Thermal conductivity [W/m·K]	22	ISO 22007-2	
Resistivity [μΩm]	8000	Four point measurements on nom. size OD 55mm ID 45mm Height 5mm	

Magnetic properties		Standards	
B@4000A/m [T]	1.04	IEC 60404-4	
B@10000A/m [T]	1.40	IEC 60404-4	
H _c [A/m]	260	IEC 60404-4	
μ _r -max	290	IEC 60404-4	

Powder properties		Standards	
Apparent density [g/cm³]	3.25	ISO 3923/1	
Flow [s/50g]	26	ISO 4490	
Green density [g/cm³]	7.41	ISO 3927	
Green strength [MPa]	16	ISO 3995	
Springback [%]	0.20	ISO 4492, ISO 2740	
Heat treated dim. change [%]	-0.03	ISO 4492, ISO 2740	
Total dim. change [%]	0.17	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	15579	1.51	1.53
138	0.03	0.04	29120	1.69	1.73
244	0.07	0.07	49706	1.82	1.88
446	0.14	0.15	74706	1.89	1.98
626	0.22	0.22	99706	1.92	2.05
1212	0.45	0.45	124706	1.95	2.11
1808	0.62	0.62	149706	1.97	2.16
2573	0.80	0.80	189706	1.99	2.23
3671	0.97	0.98	229706	2.01	2.30
5514	1.15	1.16	279706	2.03	2.38
8959	1.33	1.34	304706	2.039	2.42

Core loss

[W/kg]	50/60 Hz	100 Hz	250 Hz	500 Hz	750 Hz	1000 Hz	2000 Hz
0.5T	1.8/2.1	3.5	9.0	18	28	39	84
1.0T	6.0/7.1	12	30	63	97	132	293
1.5T	12/15	24	62	128	198	272	608

[W/kg]	5 kHz	10 kHz	20 kHz	30kHz
0.05T	2.9	7.7	20	36
0.1T	11	29	76	134
0.2T	41	107	283	500

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

Loss model

K _h	0.118	K _{ep}	0.000014
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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.

$$P_{tot} = 91 * B^{1.90} * f^{1.40}$$

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]

Somaloy® 130i 1P

600 MPa

General

Base material: Somaloy 130i 1P	Additive(s): 0.5% Kenolube	Compaction: Pressure: 600 MPa Die temperature: Room temperature	Heat treatment: Atmosphere: Air Temperature: 530°C
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Mechanical properties		Standards	
Transverse rupture strength/150°C [MPa]	41/41	SS-ISO 3325	
Tensile strength/Yield strength [MPa]	15/15	SS-EN 10002-1, ISO 2740	
Compressive Strength/Yield [MPa]	300/210	ASTM E9-89a	
Young's modulus [GPa]	70	ASTM E 1876-99	
Poisson's ratio	- 0.23	ASTM E 1876-99	
Impact Energy [J]	1.0	SS-EN 10045, SS-EN 25754	

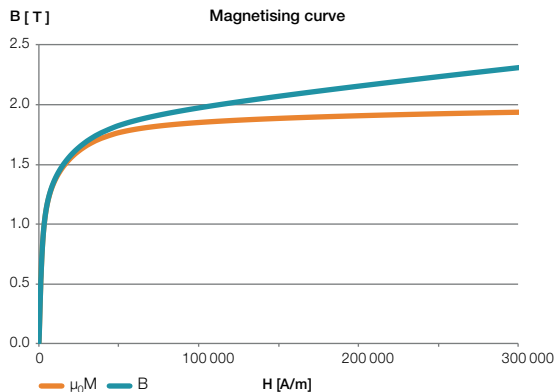
Physical properties		Standards	
Density [g/cm³]	7.22	SS-ISO 2738	
Thermal expansion [K⁻¹]	11 e-06	ASTM E 228/MPIF 35	
Thermal conductivity [W/m·K]	27	ISO 22007-2	
Resistivity [μΩm]	5900	Four point measurements on nom. size OD 55mm ID 45mm Height 5mm	

Magnetic properties		Standards	
B@4000A/m [T]	0.97	IEC 60404-4	
B@10000A/m [T]	1.30	IEC 60404-4	
H _c [A/m]	296	IEC 60404-4	
μ _r -max	270	IEC 60404-4	

Powder properties		Standards	
Apparent density [g/cm³]	3.25	ISO 3923/1	
Flow [s/50g]	26	ISO 4490	
Green density [g/cm³]	7.27	ISO 3927	
Green strength [MPa]	14	ISO 3995	
Springback [%]	0.15	ISO 4492, ISO 2740	
Heat treated dim. change [%]	-0.03	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	15940	1.43	1.45
139	0.03	0.03	29603	1.61	1.65
246	0.07	0.07	49771	1.73	1.80
434	0.14	0.14	74771	1.81	1.90
614	0.20	0.20	99771	1.85	1.98
1180	0.42	0.42	124771	1.88	2.04
1790	0.59	0.59	149771	1.91	2.10
2569	0.76	0.76	189771	1.94	2.18
3704	0.92	0.93	229771	1.96	2.25
5626	1.10	1.10	279771	1.99	2.34
9157	1.26	1.28	304771	1.997	2.38

Core loss

[W/kg]	50/60 Hz	100 Hz	250 Hz	500 Hz	750 Hz	1000 Hz	2000 Hz
0.5T	1.8/2.2	3.7	9.5	20	30	42	93
1.0T	6.2/7.5	13	32	67	104	143	327
1.5T	13/15	25	65	136	213	296	683

[W/kg]	5 kHz	10 kHz	20 kHz	30kHz
0.05T	3.1	8.3	22	40
0.1T	12	31	83	147
0.2T	43	114	306	544

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

Loss model

K _h	0.123	K _{ep}	0.000020
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$$P_{tot} = K_h * f * B^{1.75} + K_{ep} * f^2 * B^2 + \frac{B^2 * f^2 * d^2}{1.8 * \rho * resistivity * 1000} \quad [W/kg]$$

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

$$P_{tot} = 91 * B^{1.89} * f^{1.42}$$

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]

Somaloy® 500 1P

800 MPa

General

Base material: Somaloy 500 1P	Additive(s): 0.5% Kenolube	Compaction: Pressure: 800 MPa Die temperature: Room temperature	Heat treatment: Atmosphere: Air Temperature: 500°C
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Mechanical properties			Standards
Transverse rupture strength/150°C	[MPa]	50/50	SS-ISO 3325
Tensile strength/Yield strength	[MPa]	15/15	SS-EN 10002-1, ISO 2740
Compressive Strength/Yield	[MPa]	310/220	ASTM E9-89a
Young's modulus	[GPa]	110	ASTM E 1876-99
Poisson's ratio	-	0.23	ASTM E 1876-99
Impact Energy	[J]	1	SS-EN 10045, SS-EN 25754

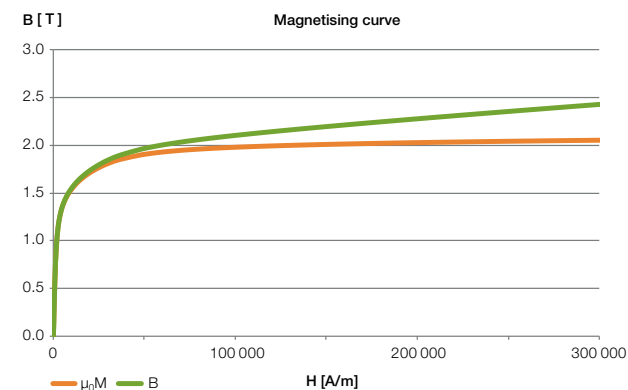
Physical properties			Standards
Density	[g/cm³]	7.37	SS-ISO 2738
Thermal expansion	[K ⁻¹]	11 e-06	ASTM E 228/MPIF 35
Thermal conductivity	[W/m²K]	23	ISO 22007-2
Resistivity	[μΩm]	70	Four point measurements on nom. size OD 55mm ID 45mm Height 5mm

Magnetic properties			Standards
B@4000A/m	[T]	1.26	IEC 60404-4
B@10000A/m	[T]	1.51	IEC 60404-4
H _c	[A/m]	270	IEC 60404-4
μ _r -max	-	500	IEC 60404-4

Powder properties			Standards
Apparent density	[g/cm³]	3.19	ISO 3923/1
Flow	[s/50g]	27	ISO 4490
Green density	[g/cm³]	7.39	ISO 3927
Green strength	[MPa]	15	ISO 3995
Springback	[%]	0.16	ISO 4492, ISO 2740
Heat treated dim. change	[%]	-0.06	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	13525	1.56	1.58
95	0.03	0.03	28841	1.75	1.78
169	0.06	0.06	50231	1.86	1.92
283	0.14	0.14	75231	1.92	2.01
420	0.23	0.23	100231	1.95	2.08
792	0.49	0.49	125231	1.97	2.13
1059	0.64	0.64	150231	1.99	2.18
1511	0.83	0.83	190231	2.01	2.25
2219	1.01	1.02	230231	2.03	2.32
3567	1.20	1.20	280231	2.05	2.40
6621	1.38	1.39	305231	2.0573	2.44

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
0.5T	1.8/2.2	3.7	8	12	16	20	25	30	34	40	45
1.0T	6.2/7.5	13	26	40	54	70	86	102	119	137	156
1.5T	13/15	26	53	82	112	143	176	211	247	284	323

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

Loss model

K _h	0.123	K _{ep}	0.000014
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$$P_{tot} = K_h * f * B^{1.75} + K_{ep} * f^2 * B^2 + \frac{B^2 * f^2 * d^2}{1.8 * \rho * resistivity * 1000} \quad [W/kg]$$

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® 500 1P

600 MPa

General			
Base material: Somaloy 500 1P	Additive(s): 0.5% Kenolube	Compaction: Pressure: 600 MPa Die temperature: Room temperature	Heat treatment: Atmosphere: Air Temperature: 500°C

Mechanical properties		Standards	
Transverse rupture strength/150°C [MPa]	55/55	SS-ISO 3325	
Tensile strength/Yield strength [MPa]	15/15	SS-EN 10002-1, ISO 2740	
Compressive Strength/Yield [MPa]	250/180	ASTM E9-89a	
Young's modulus [GPa]	120	ASTM E 1876-99	
Poisson's ratio	- 0.23	ASTM E 1876-99	
Impact Energy [J]	1	SS-EN 10045, SS-EN 25754	

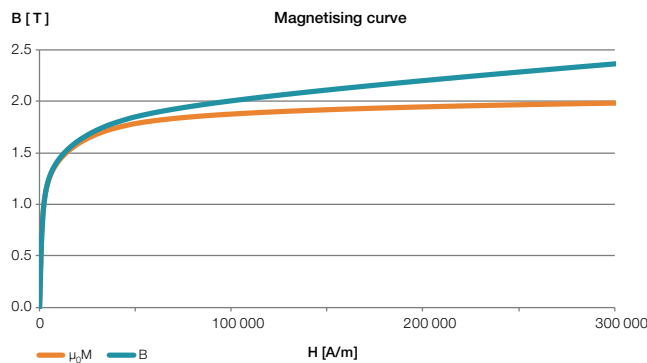
Physical properties		Standards	
Density [g/cm³]	7.22	SS-ISO 2738	
Thermal expansion [K⁻¹]	11 e-06	ASTM E 228/MPIF 35	
Thermal conductivity [W/m·K]	28	ISO 22007-2	
Resistivity [μΩm]	50	Four point measurements on nom. size OD 55mm ID 45mm Height 5mm	

Magnetic properties		Standards	
B@4000A/m [T]	1.19	IEC 60404-4	
B@10000A/m [T]	1.43	IEC 60404-4	
H _c [A/m]	280	IEC 60404-4	
μ _r -max	550	IEC 60404-4	

Powder properties		Standards	
Apparent density [g/cm³]	3.19	ISO 3923/1	
Flow [s/50g]	27	ISO 4490	
Green density [g/cm³]	7.23	ISO 3927	
Green strength [MPa]	13	ISO 3995	
Springback [%]	0.12	ISO 4492, ISO 2740	
Heat treated dim. change [%]	-0.04	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	13126	1.49	1.50
88	0.03	0.03	27541	1.66	1.70
145	0.06	0.06	49767	1.78	1.85
248	0.12	0.12	74767	1.84	1.94
347	0.19	0.19	99767	1.88	2.00
698	0.44	0.44	124767	1.90	2.06
954	0.59	0.59	149767	1.92	2.11
1396	0.78	0.78	189767	1.94	2.18
2076	0.96	0.96	229767	1.96	2.25
3384	1.13	1.14	279767	1.98	2.33
6377	1.31	1.32	304767	1.984	2.37

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
0.5T	1.9/2.3	3.9	8	12	17	22	27	32	38	43	49
1.0T	6.5/7.8	13	27	42	58	75	93	112	131	152	174
1.5T	13/16	27	56	87	120	155	193	232	274	317	363

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

Loss model

K _h	0.127	K _{ep}	0.000020
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$$P_{tot} = K_h * f * B^{1.75} + K_{ep} * f^2 * B^2 + \frac{B^2 * f^2 * d^2}{1.8 * \rho * resistivity * 1000} \quad [W/kg]$$

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]

Model is verified up to 1.5T and 5000Hz.

Somaloy® 110i 1P

800 MPa

General

Base material: Somaloy 110i 1P	Additive(s): 0.5% Kenolube	Compaction: Pressure: 800 MPa Die temperature: Room temperature	Heat treatment: Atmosphere: Air Temperature: 530°C
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Mechanical properties			Standards
Transverse rupture strength/150°C [MPa]	34/34		SS-ISO 3325
Tensile strength/Yield strength [MPa]	15/15		SS-EN 10002-1, ISO 2740
Compressive Strength/Yield [MPa]	370/260		ASTM E9-89a
Young's modulus [GPa]	70		ASTM E 1876-99
Poisson's ratio	-	0.23	ASTM E 1876-99
Impact Energy [J]	0.9		SS-EN 10045, SS-EN 25754

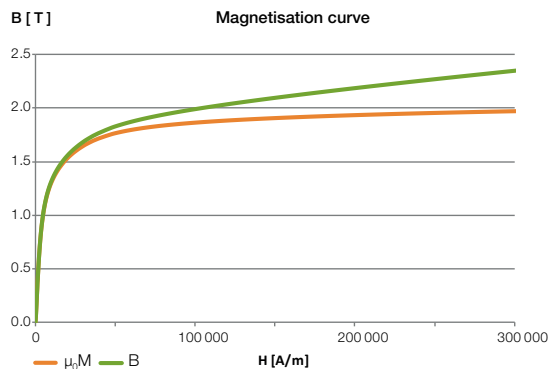
Physical properties			Standards
Density [g/cm³]	7.26		SS-ISO 2738
Thermal expansion [K ⁻¹]	11 e-06		ASTM E 228/MPIF 35
Thermal conductivity [W/m²K]	18		ISO 22007-2
Resistivity [μΩm]	7600		Four point measurements on nom. size OD 55mm ID 45mm Height 5mm

Magnetic properties			Standards
B@4000A/m [T]	0.93		IEC 60404-4
B@10000A/m [T]	1.33		IEC 60404-4
H _c [A/m]	315		IEC 60404-4
μ _r -max	-	220	IEC 60404-4

Powder properties			Standards
Apparent density [g/cm³]	3.31		ISO 3923/1
Flow [s/50g]	24		ISO 4490
Green density [g/cm³]	7.32		ISO 3927
Green strength [MPa]	14		ISO 3995
Springback [%]	0.16		ISO 4492, ISO 2740
Heat treated dim. change [%]	-0.02		ISO 4492, ISO 2740
Total dim. change [%]	0.14		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	15528	1.45	1.47
183	0.04	0.04	29109	1.64	1.68
314	0.07	0.07	49598	1.76	1.83
559	0.14	0.14	74598	1.83	1.92
776	0.21	0.21	99598	1.86	1.99
1243	0.36	0.36	124598	1.89	2.04
2204	0.61	0.61	149598	1.91	2.09
3056	0.78	0.78	189598	1.93	2.17
4249	0.95	0.95	229598	1.95	2.24
6143	1.12	1.12	279598	1.96	2.32
9507	1.29	1.30	304598	1.972	2.35

Core loss

[W/kg]	50/60 Hz	100 Hz	250 Hz	500 Hz	750 Hz	1000 Hz	2000 Hz
0.5T	2.1/2.6	4.3	11	22	33	45	95
1.0T	7.2/8.6	14	36	74	113	153	327
1.5T	15/18	29	74	151	231	314	674

[W/kg]	5 kHz	10 kHz	20 kHz	30kHz
0.05T	3.0	7.0	16	26
0.1T	12	27	61	100
0.2T	44	101	233	379

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

Loss model

K _h	0.143	K _{ep}	0.000010
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$$P_{tot} = K_h * f * B^{1.75} + K_{ep} * f^2 * B^2 + \frac{B^2 * f^2 * d^2}{1.8 * \rho * resistivity * 1000} \quad [W/kg]$$

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

$$P_{tot} = 143 * B^{1.93} * f^{1.20}$$

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]

Somaloy® 110i 1P

600 MPa

General

Base material: Somaloy 110i 1P	Additive(s): 0.5% Kenolube	Compaction: Pressure: 600 MPa Die temperature: Room temperature	Heat treatment: Atmosphere: Air Temperature: 530°C
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Mechanical properties		Standards	
Transverse rupture strength/150°C [MPa]	50/50	SS-ISO 3325	
Tensile strength/Yield strength [MPa]	20/20	SS-EN 10002-1, ISO 2740	
Compressive Strength/Yield [MPa]	280/240	ASTM E9-89a	
Young's modulus [GPa]	100	ASTM E 1876-99	
Poisson's ratio	- 0.23	ASTM E 1876-99	
Impact Energy [J]	0.9	SS-EN 10045, SS-EN 25754	

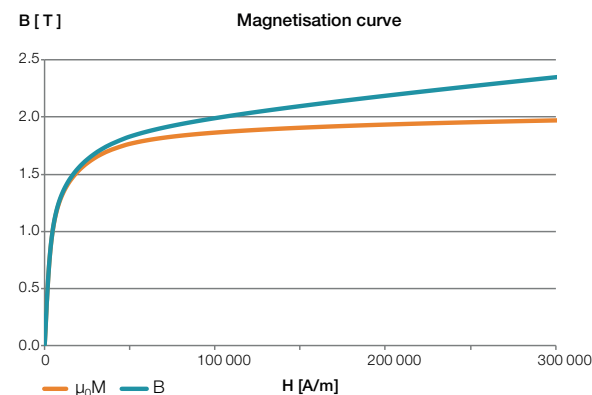
Physical properties		Standards	
Density [g/cm³]	7.10	SS-ISO 2738	
Thermal expansion [K⁻¹]	11 e-06	ASTM E 228/MPIF 35	
Thermal conductivity [W/m·K]	23	ISO 22007-2	
Resistivity [μΩm]	3100	Four point measurements on nom. size OD 55mm ID 45mm Height 5mm	

Magnetic properties		Standards	
B@4000A/m [T]	0.85	IEC 60404-4	
B@10000A/m [T]	1.23	IEC 60404-4	
H _c [A/m]	350	IEC 60404-4	
μ _r -max	210	IEC 60404-4	

Powder properties		Standards	
Apparent density [g/cm³]	3.31	ISO 3923/1	
Flow [s/50g]	24	ISO 4490	
Green density [g/cm³]	7.12	ISO 3927	
Green strength [MPa]	13	ISO 3995	
Springback [%]	0.11	ISO 4492, ISO 2740	
Heat treated dim. change [%]	-0.02	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	16243	1.41	1.43
187	0.04	0.04	29787	1.58	1.62
319	0.07	0.07	49719	1.70	1.77
571	0.14	0.14	74719	1.78	1.87
811	0.21	0.21	99719	1.82	1.94
1172	0.32	0.32	124719	1.85	2.01
2315	0.59	0.60	149719	1.88	2.06
3186	0.76	0.76	189719	1.91	2.15
4382	0.92	0.92	229719	1.93	2.22
6248	1.08	1.09	279719	1.96	2.31
9656	1.25	1.26	304719	1.967	2.35

Core loss

[W/kg]	50/60 Hz	100 Hz	250 Hz	500 Hz	750 Hz	1000 Hz	2000 Hz
0.5T	2.2/2.7	4.5	11	23	35	47	100
1.0T	7.5/9.0	15	38	77	118	161	344
1.5T	15/18	31	77	158	242	329	710

[W/kg]	5 kHz	10 kHz	20 kHz	30kHz
0.05T	3.2	7.4	17	28
0.1T	12	28	65	105
0.2T	46	106	244	399

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

Loss model

K _h	0.149	K _{ep}	0.000011
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$$P_{tot} = K_h * f * B^{1.75} + K_{ep} * f^2 * B^2 + \frac{B^2 * f^2 * d^2}{1.8 * \rho * resistivity * 1000} \quad [W/kg]$$

Model is verified up to 0.5T-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]

$$P_{tot} = 143 * B^{1.92} * f^{1.21}$$

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

f Frequency [kHz]
 B Field strength [T]

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