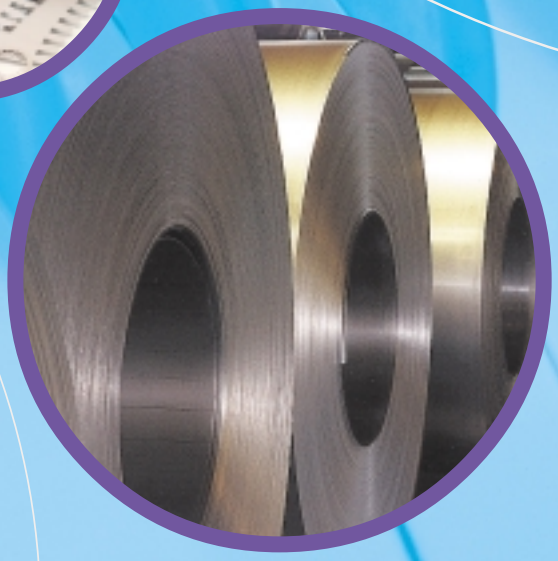
Electrical Steel
Non Oriented
Fully Processed



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Contents

Registered trademarks

SURALAC® is a trademark used to describe the insulation applied to Cogent fully processed non-oriented electrical steels.

Introduction

The range of non-oriented fully processed electrical steels is produced by Cogent Power Ltd at Surahammars Bruks AB in Sweden and Orb Electrical Steels Ltd in the UK. This publication describes that range with data relating mainly to products manufactured at Surahammars Bruks AB. These products comply with the latest specifications of the European Committee for Standardization and the International Electrotechnical Commission.

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Quality assurance

The products described in this brochure represent the latest stage in the development of non-oriented fully processed electrical steels. They are subjected to rigorous quality control procedures throughout the processing routes. The quality management systems of Orb Electrical Steels Ltd and Surahammars Bruks AB are approved by Lloyd's Register Quality Assurance Ltd to the Quality Management System Standards EN ISO 9001/9002 (respectively) applicable to the manufacture of electrical steels.

Environmental management system

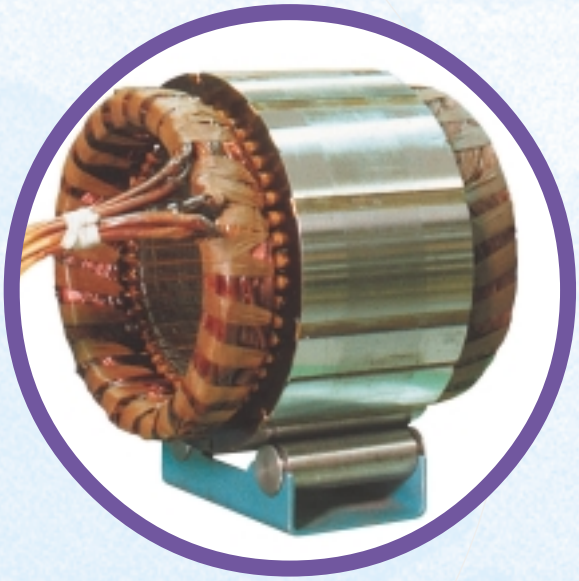
Surahammars Bruks AB and Orb Electrical Steels Ltd both recognise that the protection of the environment is a key priority of the company and this ideal is fully integrated into all aspects of the electrical steel business. Management Systems of Surahammars Bruks AB and Orb Electrical Steels Ltd have been approved by Lloyd's Register Quality Assurance to the Environmental Management System Standard EN ISO 14001 applicable to the manufacture of electrical steels.

Research and development

The Technical, Research and Development Group of Cogent, (TR&D) will provide technical leadership with expertise and innovation skills. TR&D will design and develop improved products, processes and engineering applications, working with customers in developing optimum technical solutions. TR&D specialises in the development of enhanced and new non-oriented fully processed grades, for example higher frequency grades and improved coatings.

Customer service

The Technical, Research and Development Group of Cogent Power Ltd is pleased to offer a full consultancy service which is available to customers who require specialist technical data that may not be included in this brochure.



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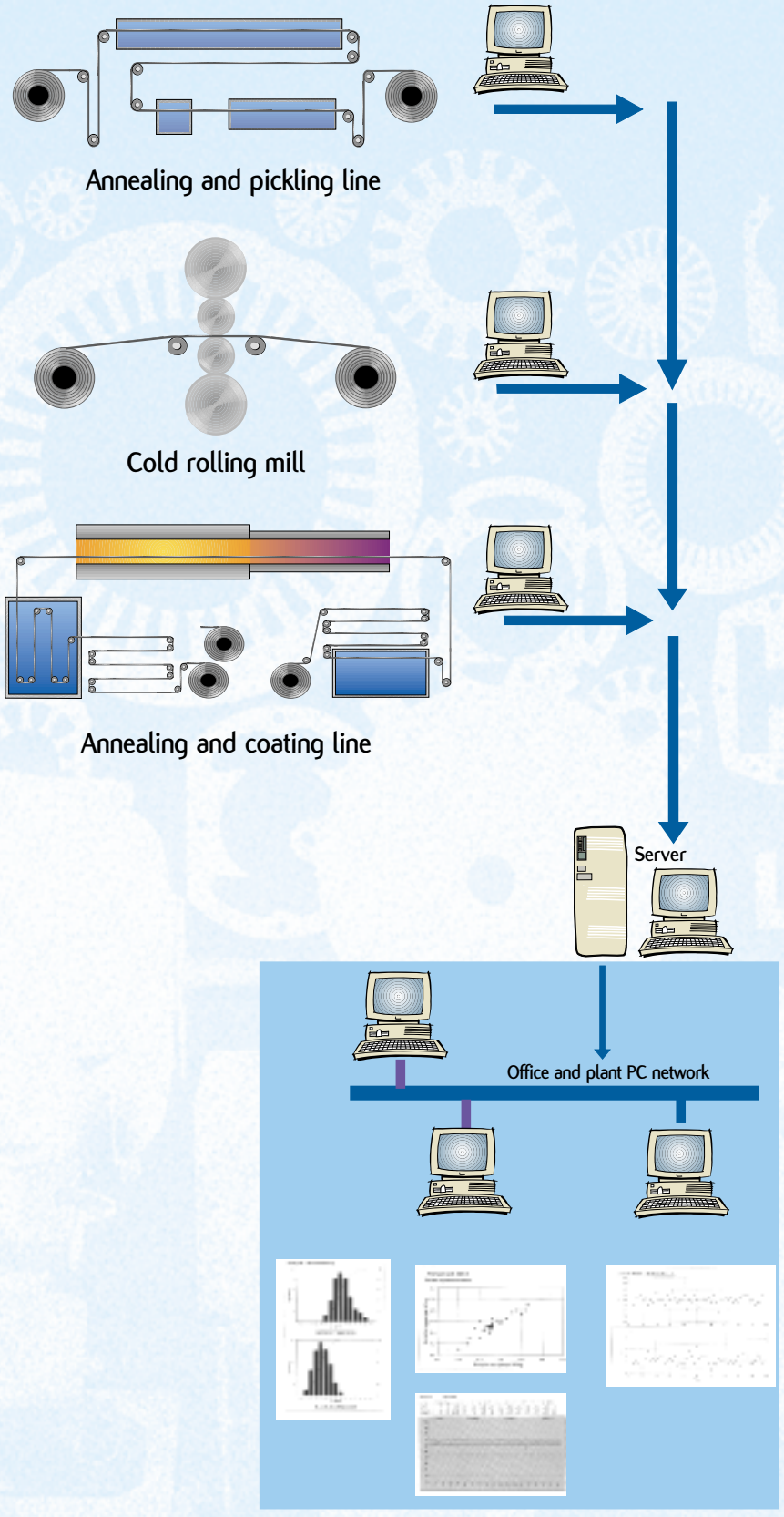
Quality logging system

Cogent Power Ltd is continuously developing processing systems to provide customers with products of enhanced quality. A part of this development is the unique, computerized, quality logging system at Surahammars Bruks AB, based on continuous monitoring of the processing variables. Large quantities of measured data for each coil are stored in a database and are available on demand in graphical or numerical form.

A computer on each production line collects and displays process information to the line operators. Parameters such as line speed, furnace temperatures and continuous strip thickness are continuously logged. Included in the system is a continuous measurement of loss along the length of the annealed strip. Although this is not an absolute and standardised method, it provides valuable information on the quality of the material.

The logged data is instantly available for users in, for example, Production, Maintenance, Quality and TR&D departments so that line performance and product quality can be analysed in order to improve the processes and products. The general structure of the system also makes it possible to collate data such as hot rolling parameters from feedstock suppliers. The flexibility of the system enables the user to perform anything from an instant check on the quality of a particular coil to a detailed analysis over a large number of coils and their processing parameters.



Guaranteed magnetic properties at 50 Hz

Cogent non-oriented fully processed electrical steels are graded according to European Standard EN 10106. A comparison with previous designations and other international standards is included on page 15.

The measurements of magnetic properties are performed on a 25 cm Epstein frame system according to the method of IEC 60404-2. Half of the sample strips are taken in the rolling direction and half in the transverse direction. Samples are not stress relief annealed after shearing. The specified values apply to aged samples for the thicknesses of 0,35 mm, 0,50 mm and 0,65 mm, and to non-aged samples for the thickness of 1,00 mm.

Grade EN 10106	Thickness	Maximum specific total loss at 50 Hz		Minimum magnetic polarization at 50 Hz			
		$\hat{J}$ = 1,5 T	1,0 T**	$\hat{H}$= 2500	5000	10000	A/m
	mm	W/kg	W/kg	T	T	T	
M235-35A	0,35	2,35	0,95	1,49	1,60	1,70	
M250-35A	0,35	2,50	1,00	1,49	1,60	1,70	
M270-35A	0,35	2,70	1,10	1,49	1,60	1,70	
M300-35A	0,35	3,00	1,20	1,49	1,60	1,70	
M330-35A	0,35	3,30	1,30	1,49	1,60	1,70	
M700-35A*	0,35	7,00	3,00	1,60	1,69	1,77	
M250-50A	0,50	2,50	1,05	1,49	1,60	1,70	
M270-50A	0,50	2,70	1,10	1,49	1,60	1,70	
M290-50A	0,50	2,90	1,15	1,49	1,60	1,70	
M310-50A	0,50	3,10	1,25	1,49	1,60	1,70	
M330-50A	0,50	3,30	1,35	1,49	1,60	1,70	
M350-50A	0,50	3,50	1,50	1,50	1,60	1,70	
M400-50A	0,50	4,00	1,70	1,53	1,63	1,73	
M470-50A	0,50	4,70	2,00	1,54	1,64	1,74	
M530-50A	0,50	5,30	2,30	1,56	1,65	1,75	
M600-50A	0,50	6,00	2,60	1,57	1,66	1,76	
M700-50A	0,50	7,00	3,00	1,60	1,69	1,77	
M800-50A	0,50	8,00	3,60	1,60	1,70	1,78	
M940-50A	0,50	9,40	4,20	1,62	1,72	1,81	
M310-65A	0,65	3,10	1,25	1,49	1,60	1,70	
M330-65A	0,65	3,30	1,35	1,49	1,60	1,70	
M350-65A	0,65	3,50	1,50	1,49	1,60	1,70	
M400-65A	0,65	4,00	1,70	1,52	1,62	1,72	
M470-65A	0,65	4,70	2,00	1,53	1,63	1,73	
M530-65A	0,65	5,30	2,30	1,54	1,64	1,74	
M600-65A	0,65	6,00	2,60	1,56	1,66	1,76	
M700-65A	0,65	7,00	3,00	1,57	1,67	1,76	
M800-65A	0,65	8,00	3,60	1,60	1,70	1,78	
M1000-65A	0,65	10,00	4,40	1,61	1,71	1,80	
M600-100A	1,00	6,00	2,60	1,53	1,63	1,72	
M700-100A	1,00	7,00	3,00	1,54	1,64	1,73	
M800-100A	1,00	8,00	3,60	1,56	1,66	1,75	
M1000-100A	1,00	10,00	4,40	1,58	1,68	1,76	

** This grade does not appear in the standard EN 10106.*
*** The values of losses at 1,0 T are given as indicative.*

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Typical magnetic properties at 50 Hz

This data relates to products manufactured by Cogent at Surahammars Bruks AB

Grade EN 10106	Specific total loss at 50 Hz		Anisotropy of loss	Magnetic polarization at 50 Hz			Coercivity (DC)	Relative permeability at 1,5 T
	$\hat{J}$= 1,5 T W/kg	1,0 T W/kg	%	$\hat{H}$ = 2500 T	5000 T	10000 A/m T	A/m	
M235-35A	2,25	0,92	10	1,53	1,64	1,76	35	610
M250-35A	2,35	0,98	10	1,53	1,64	1,76	40	660
M270-35A	2,47	1,01	10	1,54	1,65	1,77	40	700
M300-35A	2,62	1,10	10	1,55	1,65	1,78	45	830
M330-35A	2,93	1,19	10	1,56	1,66	1,78	45	860
M700-35A*	5,50	2,53	7	1,63	1,71	1,83	100	1750
M250-50A	2,38	1,02	10	1,55	1,64	1,77	30	740
M270-50A	2,52	1,07	10	1,55	1,64	1,77	30	770
M290-50A	2,62	1,14	10	1,56	1,65	1,78	35	800
M310-50A	2,83	1,23	10	1,57	1,66	1,79	40	970
M330-50A	3,03	1,29	10	1,58	1,67	1,79	40	1000
M350-50A	3,14	1,33	9	1,58	1,67	1,79	45	1020
M400-50A	3,42	1,46	9	1,58	1,67	1,79	50	1070
M470-50A	4,05	1,79	6	1,58	1,67	1,79	60	1070
M530-50A	4,42	2,01	6	1,59	1,68	1,80	70	1100
M600-50A	5,17	2,34	6	1,63	1,72	1,83	85	1660
M700-50A	5,68	2,57	5	1,64	1,72	1,84	100	1730
M800-50A	6,60	3,05	5	1,65	1,74	1,85	100	1810
M940-50A	7,55	3,57	5	1,65	1,74	1,85	110	1850
M310-65A	2,90	1,24	9	1,56	1,65	1,77	35	800
M330-65A	3,04	1,30	8	1,56	1,66	1,78	40	850
M350-65A	3,23	1,40	8	1,58	1,67	1,79	40	990
M400-65A	3,63	1,57	7	1,58	1,68	1,79	45	1050
M470-65A	4,06	1,79	6	1,59	1,68	1,80	50	1130
M530-65A	4,35	1,90	4	1,59	1,68	1,80	60	1150
M600-65A	4,95	2,19	3	1,60	1,69	1,80	70	1210
M700-65A	5,88	2,62	3	1,64	1,73	1,84	85	1740
M800-65A	6,74	3,02	3	1,65	1,74	1,85	100	1900
M1000-65A	7,90	3,60	1	1,66	1,75	1,86	110	1980
M600-100A	5,11	2,32	3	1,59	1,68	1,80	40	950
M700-100A	6,24	2,83	1	1,59	1,69	1,80	50	980
M800-100A	7,20	3,33	0	1,60	1,69	1,80	70	1000
M1000-100A	8,89	4,05	0	1,65	1,74	1,84	85	1410

** The grade does not appear in the standard EN 10106.*

Ageing

Cogent non-oriented fully processed electrical steels are free from magnetic ageing.

Ageing, or the increase of power loss with time, is caused by an excessive carbon content in the steel. The carbon content is continuously monitored by state-of-the-art analytical equipment to ensure freedom from ageing.

Magnetic test samples are given a rapid ageing treatment by heating at 225°C ±5°C for a duration of 24 hours and cooling to ambient temperature before testing, as described in EN 10106.

All typical data refer to aged samples, except those with a thickness of 1,0 mm.

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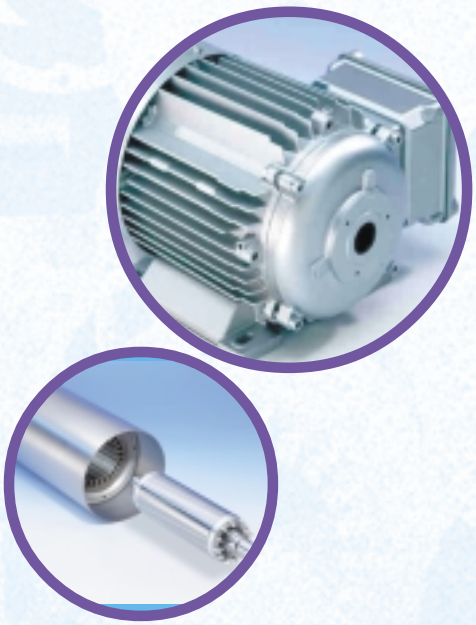
Typical specific total loss at 60 Hz, W/kg and W/lb at $\hat{J}$ = 1,5 T

This data relates to products manufactured by Cogent at Surahammars Bruks AB

Grade EN 10106	Thickness	Maximum**		Typical	
	mm	W/kg	W/lb	W/kg	W/lb
M235-35A	0,35	2,97	1,35	2,78	1,26
M250-35A	0,35	3,14	1,42	2,91	1,32
M270-35A	0,35	3,36	1,52	3,06	1,39
M300-35A	0,35	3,74	1,70	3,26	1,48
M330-35A	0,35	4,12	1,87	3,66	1,66
M700-35A*	0,35	8,66	3,93	6,81	3,09
M250-50A	0,50	3,21	1,46	3,02	1,37
M270-50A	0,50	3,47	1,57	3,20	1,45
M290-50A	0,50	3,71	1,68	3,33	1,51
M310-50A	0,50	3,95	1,79	3,59	1,63
M330-50A	0,50	4,20	1,91	3,86	1,75
M350-50A	0,50	4,45	2,02	3,99	1,81
M400-50A	0,50	5,10	2,31	4,34	1,97
M470-50A	0,50	5,90	2,68	5,11	2,32
M530-50A	0,50	6,66	3,02	5,58	2,53
M600-50A	0,50	7,53	3,42	6,53	2,96
M700-50A	0,50	8,79	3,99	7,16	3,25
M800-50A	0,50	10,06	4,56	8,27	3,75
M940-50A	0,50	11,84	5,37	9,46	4,29
M310-65A	0,65	4,08	1,85	3,77	1,71
M330-65A	0,65	4,30	1,95	3,97	1,80
M350-65A	0,65	4,57	2,07	4,21	1,91
M400-65A	0,65	5,20	2,36	4,74	2,15
M470-65A	0,65	6,13	2,78	5,29	2,40
M530-65A	0,65	6,84	3,10	5,62	2,55
M600-65A	0,65	7,71	3,50	6,39	2,90
M700-65A	0,65	8,98	4,07	7,58	3,44
M800-65A	0,65	10,26	4,65	8,64	3,92
M1000-65A	0,65	12,77	5,79	10,12	4,59
M600-100A	1,00	8,14	3,69	6,92	3,14
M700-100A	1,00	9,38	4,25	8,44	3,83
M800-100A	1,00	10,70	4,85	9,66	4,38
M1000-100A	1,00	13,39	6,07	11,90	5,40

** This grade does not appear in the standard EN 10106.*
*** The maximum loss values are given as indicative.*



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Typical physical and mechanical properties

Grade EN 10106	Conventional density kg/dm³	Resistivity μΩcm	Yield strength N/mm²	Tensile strength N/mm²	Young's Modulus (E) RD N/mm²	Young's Modulus (E) TD N/mm²	Hardness HV5 (VPN) –
M235-35A	7,60	59	460	580	185 000	200 000	220
M250-35A	7,60	55	455	575	185 000	200 000	215
M270-35A	7,65	52	450	565	185 000	200 000	215
M300-35A	7,65	50	370	490	185 000	200 000	185
M330-35A	7,65	44	300	430	200 000	220 000	150
M700-35A*	7,80	30	290	405	210 000	220 000	125
M250-50A	7,60	59	475	590	175 000	190 000	220
M270-50A	7,60	55	470	585	175 000	190 000	220
M290-50A	7,60	55	465	580	185 000	200 000	220
M310-50A	7,65	52	385	500	185 000	200 000	190
M330-50A	7,65	50	375	495	185 000	200 000	185
M350-50A	7,65	44	305	450	200 000	210 000	165
M400-50A	7,70	42	305	445	200 000	210 000	160
M470-50A	7,70	39	300	435	200 000	210 000	155
M530-50A	7,70	36	295	430	200 000	210 000	150
M600-50A	7,75	30	285	405	210 000	220 000	125
M700-50A	7,80	25	285	405	210 000	220 000	125
M800-50A	7,80	23	300	415	210 000	220 000	130
M940-50A	7,85	18	300	415	210 000	220 000	130
M310-65A	7,60	59	465	590	175 000	190 000	220
M330-65A	7,60	55	460	585	185 000	205 000	220
M350-65A	7,60	52	375	490	185 000	205 000	185
M400-65A	7,65	44	310	450	185 000	205 000	165
M470-65A	7,65	42	305	445	185 000	205 000	160
M530-65A	7,70	39	300	425	190 000	210 000	145
M600-65A	7,75	36	300	420	190 000	210 000	140
M700-65A	7,75	30	290	395	210 000	220 000	125
M800-65A	7,80	25	300	405	210 000	220 000	130
M1000-65A	7,80	18	295	400	210 000	220 000	125
M600-100A	7,60	52	365	480	185 000	200 000	180
M700-100A	7,65	44	305	440	185 000	200 000	160
M800-100A	7,70	39	300	425	185 000	200 000	145
M1000-100A	7,80	30	290	390	190 000	210 000	125

RD represents the rolling direction.
TD represents the transverse direction.

Values for **Yield strength** (0,2% proof strength)
and **Tensile strength** are given for the rolling direction.
Values for the transverse direction are approximately 5% higher.

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Dimensions, ranges and tolerances

Dimensions

Cogent non-oriented fully processed electrical steels are supplied as slit coils or cut sheet in the following thicknesses and widths:

Thickness mm	Max. width for slit coils and sheets mm	Maximum sheet length mm
0,35	1170	3500
0,50	1250	3500
0,65	1250	3500
1,00	1250	3500

Minimum sheet length 400 mm

Coil width standard tolerances[1)]

Over mm	Up to and including mm	Width tolerance mm
10	150	0/+0,2
150	300	0/+0,3
300	600	0/+0,5
600	1000	0/+1,0
1000	1250	0/+1,5

Coil width special tolerances

Over mm	Up to and including mm	Width tolerance mm
10	300	±0,08
300	600	±0,20
600	1250	±0,30

Cut length tolerances[1)]

Over mm	Up to and including mm	Length tolerance mm
400	3500	0/ +0,5 % (max. 6 mm)

Alternative tolerances

These may be possible for specific orders.

Internal coil diameter

Internal coil diameter is nominally 508 mm.

Maximum coil weight and OD[1)]

Maximum coil weight is 20 tonnes or 20,0 kg per mm coil width. Maximum coil outside diameter is 1850 mm.

Thickness tolerance and other geometric characteristics

Cogent non-oriented fully processed electrical steels meet all the requirements on thickness tolerance and other characteristics such as edge camber and flatness as specified in the standards EN 10106 and IEC 60404-8-4.

Typical thickness variation

Nominal thickness mm	Deviation from nominal thickness %	Difference in thickness parallel to rolling direction[2)] %	Difference in thickness, at right angle to rolling direction[3)] µm
0,35	+2/ -5	3	7
0,50	+2/ -5	3	10
0,65	+2/ -5	3	13
1,00	+2/ -5	3	20

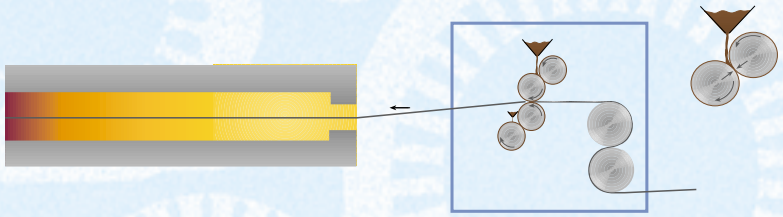
1) A nomogram on page 27 shows the coil weight as a function of outside diameter and strip width.
2) Within a sheet or a 2 m length of strip (according to EN 10106).
3) Measured at least 30 mm from the edges (according to EN 10106).

Coatings

The surface of Cogent non-oriented fully processed electrical steel is clean, smooth and has a very thin layer of oxide. To improve surface insulation resistance, grades are normally supplied with insulating coatings. Coatings have differing properties and the thickness can be varied, normally ranging from 1 to 3 µm.

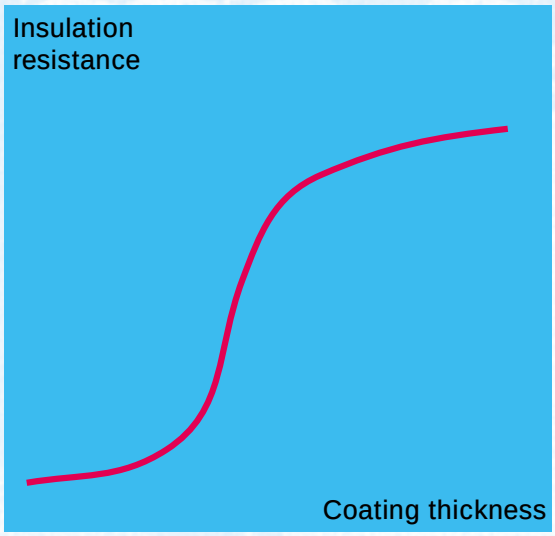
All coatings have excellent adherence and will withstand normal punching operations. Cogent coatings provide some corrosion resistance and have only a marginal effect on stacking factor.

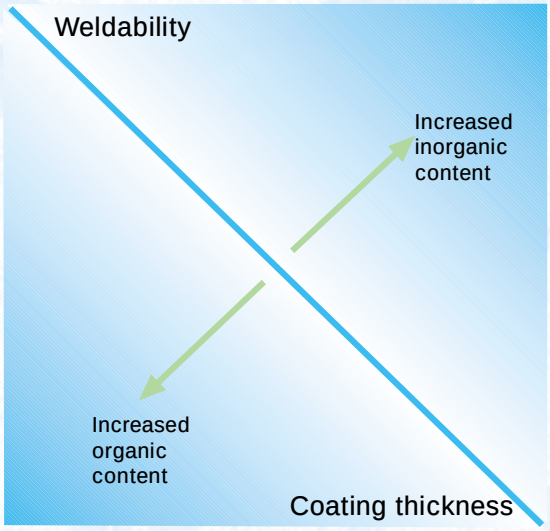
The schematic diagrams below provide an indication of how coating properties are related and how they depend upon thickness and type of coating.

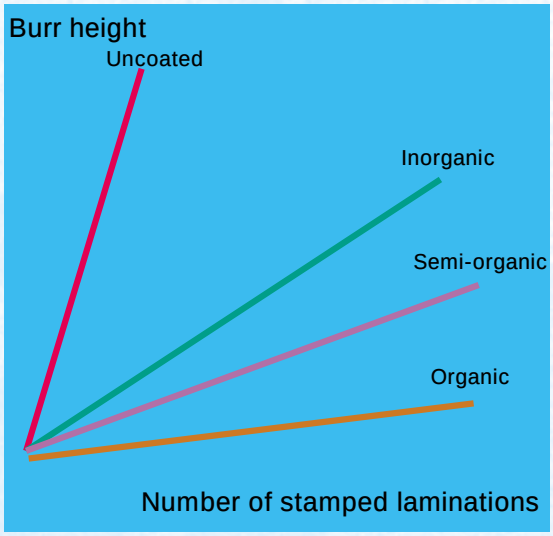


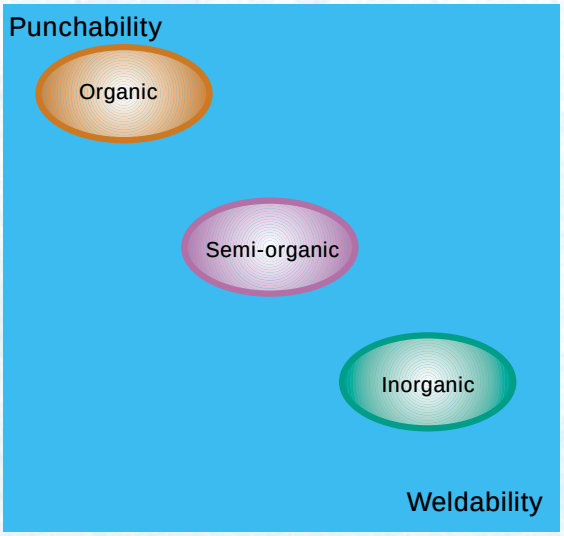
Principles of roll coating. Coating thickness depends on pressure between two rolls.

Coating properties









SURALAC® Coatings

Designation	SURALAC 1000			SURALAC 3000		SURALAC 5000		SURALAC 7000		
Type	Organic			Organic with fillers		Semi-organic		Inorganic		
Description	Organic synthetic resin			Organic synthetic resin with inorganic fillers		Organic resin with phosphates and sulphates		Inorganic phosphate based coating with inorganic fillers and some organic resin		
Previous designation	C-3			C-6		S-3		C-4 / C-5		
Class acc ASTM A976	C-3			C-6		-		C-4 / C-5 [1]		
Thickness range, per side	0,7 - 6 µm			3,5 - 6 µm		0,7 - 1,2 µm		0,7 - 3,5 µm		
Standard thickness	2,5 µm			6 µm		1,2 µm		1,5 µm		
Colour	Clear to brown			Grey		Brown to grey		Grey		
Temperature capability in air (continuous)	180 °C			180 °C		200 °C		230 °C		
Temperature capability in inert gas (intermittent)	450 °C			500 °C		500 °C		850 °C		
Withstands:										
Stress relief annealing[2]	–			–		–		YES		
Burn-out repair	–			YES		–		YES		
Aluminium casting	YES			YES		YES		YES		
Chemical resistance:										
Stamping lubricants [3]	YES			YES		YES		YES		
Transformer oils	YES			YES		YES		YES		
Freon	YES			YES		YES		YES		
Typical pencil hardness	8 - 9 H			8 - 9 H		8 - 9 H		9 H		
Typical thickness, µm per side	0,7	2,5	6	3,5	6	0,7	1,2	0,7	1,5	3,5
Typical welding [4]	good	spec	spec	spec	spec	exc	exc	exc	good	mod
Typical punching [4]	exc	exc	good	good	mod	good	exc	good	good	mod
Surface insulation resistance (Franklin ASTM A717): Typical value, $\Omega \cdot cm^2$ per lamination	5	100	>200	>200	>200	5	20	5	50	>200
Typical value, Amperes per side	0,55	0,06	<0,03	<0,03	<0,03	0,55	0,25	0,55	0,11	<0,03

Please note that all data are typical, not guaranteed.

1) SURALAC 7000 is classified as a C-5 coating however it can be used as a C-4 coating.

2) Stress relief annealing in inert or preferably in slightly oxidising atmosphere.

3) Testing includes all lubricants notified to Cogent. New lubricants may need special consideration.

4) exc= excellent, good= good, mod= moderate, spec= special precautions/techniques needed.

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HP grades

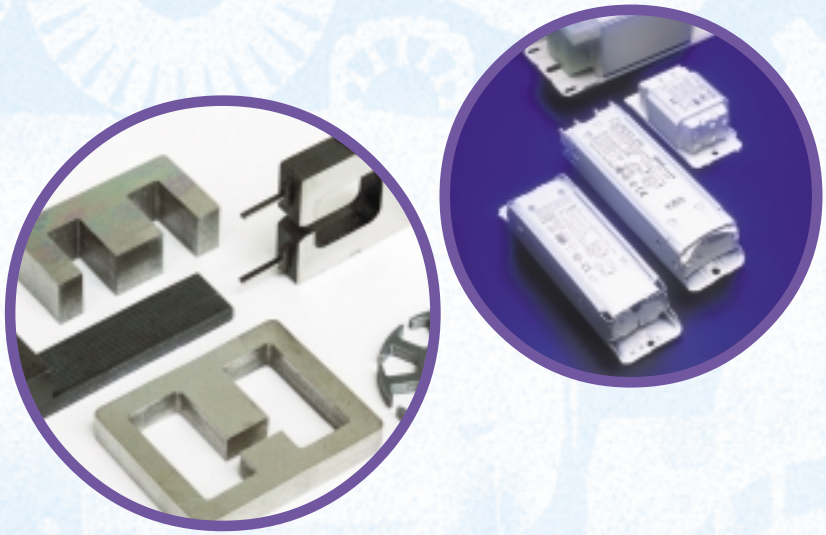
HP grades have an improved permeability compared to standard non-oriented fully processed grades, over a range of magnetic polarization from approximately 1,0 T and upwards. The improvement is particularly pronounced at about 1,5 T.

Another advantage of HP grades is a higher thermal conductivity than the comparable standard grade. HP grades are available with SURALAC® coatings as described in this brochure.

Guaranteed magnetic properties at 50 Hz

Grade	Thickness	Maximum specific total loss at 50 Hz		Minimum magnetic polarization at 50 Hz		
		$\hat{J}$=1,5 T	1,0 T *	$\hat{H}$=2500	5000	10000 A/m
	mm	W/kg	W/kg	T	T	T
M530-50HP	0,50	5,30	2,30	1,63	1,71	1,81
M600-65HP	0,65	6,00	2,60	1,63	1,72	1,82

**The values of losses at 1,0 T are given as indicative.*



Typical magnetic properties at 50 Hz

Grade	Specific total loss at 50 Hz		Anisotropy of loss	Magnetic polarization at 50 Hz			Coercivity (DC)	Relative Permeability at 1,5 T
	$\hat{J}$ = 1,5 T	1,0 T	%	$\hat{H}$=2500	5000	10000 A/m		
	W/kg	W/kg		T	T	T	A/m	
M530-50HP	4,45	2,05	6	1,66	1,74	1,84	75	2010
M600-65HP	5,00	2,24	4	1,66	1,75	1,85	75	2040

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HP grades

Typical physical and mechanical properties

Grade	Conventional density [1] kg/dm³	Resistivity µΩcm	Yield Strength N/mm²	Tensile Strength N/mm²	Young's modulus (E) RD N/mm²	Young's modulus (E) TD N/mm²	Hardness HV5 (VPN)
M530-50HP	7,80	30	285	405	210 000	220 000	125
M600-65HP	7,80	30	285	405	210 000	220 000	125

RD represents the rolling direction.
TD represents the transverse direction.

Values for **Yield strength** (0,2% proof strength) and **Tensile strength** are given for the rolling direction.

Values for the transverse direction are approximately 5% higher.

1) HP grades are non-standard, therefore conventional density is not normally specified. Densities of standard grades with the closest chemical composition are used.

Heat conductivity

The following table compares typical heat conductivity of HP grades in comparison with corresponding standard non-oriented, fully processed products.

Grade	M530-50HP	M600-65HP	M530-50A	M600-65A
Heat conductivity at 100 °C W/(mK)	42	42	36	36

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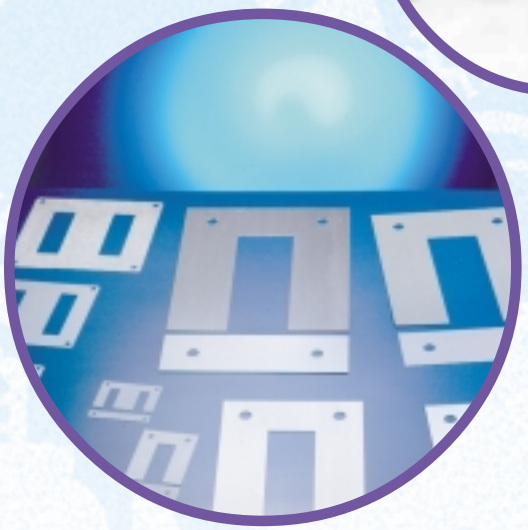
International standards

Electrical steel grades are designated according to guaranteed maximum specific total loss at a peak magnetic polarization of 1,5 T and 50 Hz.

Cogent's current grades are compared with previous designations and international standards in the table on page 15.

EN	European Standard
IEC	International Electrotechnical Commission
JIS	Japanese Industrial Standard
GOST	National Standard of the USSR
ASTM	American Society for Testing and Materials
AISI	American Iron and Steel Institute



Standards usually include other magnetic requirements (eg for minimum magnetic polarisation). Such requirements are excluded in this comparison.

European Standard EN 10106 has been implemented as National Standard in all countries of the European Union, as well as in Iceland, Norway and Switzerland.

American standards

American standards are based on US units and a test frequency of 60 Hz. There is no exact conversion of loss data from 50 Hz to 60 Hz, but these approximate relationships may be used for losses at 1,5 T:

$$\frac{\text{(W/kg at 50 Hz)}}{\text{(W/lb at 60 Hz)}} = \begin{cases} 1{,}77 \text{ (for 0,35 mm grades)} \\ 1{,}74 \text{ (for 0,50 mm grades)} \\ 1{,}70 \text{ (for 0,65 mm grades)} \\ 1{,}64 \text{ (for 1,00 mm grades)} \end{cases}$$

American standard thicknesses differ from metric standards, particularly at 0,50 mm:

EN/IEC	ASTM
0,35 mm	0,36 mm (0,0140 inch)
0,50 mm	0,47 mm (0,0185 inch)
0,65 mm	0,64 mm (0,0250 inch)

Cogent publishes separate brochures for the North American market, in appropriate units.

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Comparison of grades and standards

Core loss 1,5 T 50 Hz W/kg	Cogent grade EN 10106 (1995)	Previous grade (1987)	IEC 60404-8-4 (1998)	JIS C2552 (2000)	GOST 21427.2 (1983)	Old AISI grade	ASTM A677 (1999)	Core loss 1,5 T 60 Hz W/lb	Core loss 1,5T 50 Hz W/kg
2,35	M235-35A	(CK-27)	M235-35A5	(35A230)					
2,50	M250-35A	CK-30	M250-35A5	35A250	2413	(M-15)	(36F145)	1,45	2,58
2,70	M270-35A	CK-33	M270-35A5	35A270	2412	(M-19)	(36F155)	1,55	2,76
3,00	M300-35A	CK-37	M300-35A5	35A300	2411	(M-22)	(36F175)	1,75	3,10
3,30	M330-35A	CK-40	M330-35A5			M-36	(36F185)	1,85	3,26
7,00	M700-35A*								
2,50	M250-50A		M250-50A5	50A250					
2,70	M270-50A	CK-26	M270-50A5	50A270	2414				
2,90	M290-50A	CK-27	M290-50A5	50A290	2413	M-15	47F165	1,65	2,86
3,10	M310-50A	CK-30	M310-50A5	50A310	2412	(M-19)	47F180	1,80	3,12
3,30	M330-50A	CK-33	M330-50A5			M-27	47F190	1,90	3,30
3,50	M350-50A	CK-37	M350-50A5	50A350	(2411)	(M-36)	47F200	2,00	3,47
4,00	M400-50A	CK-40	M400-50A5	50A400	2216	M-43	(47F240)	2,40	4,17
4,70	M470-50A	CK-44	M470-50A5	50A470	(2214)	(M-45)	(47F280)	2,80	4,89
5,30	M530-50A	DK-59	M530-50A5		(2211)	M-47			
6,00	M600-50A	DK-66	M600-50A5	50A600	2112				
7,00	M700-50A	DK-70	M700-50A5	50A700	2111		47F400	4,00	7,04
8,00	M800-50A		M800-50A5	50A800	2011		(47F450)	4,50	7,92
9,40	M940-50A		M940-50A5	(50A1000)					
3,10	M310-65A		M310-65A5						
3,30	M330-65A		M330-65A5				(64F200)	2,00	3,38
3,50	M350-65A		M350-65A5			M-19	64F210	2,10	3,55
4,00	M400-65A	CK-37	M400-65A5			(M-27)	(64F235)	2,25	3,98
4,70	M470-65A	CK-40	M470-65A5			(M 43)	64F275	2,75	4,65
5,30	M530-65A	CK-44	M530-65A5			(M-45)	(64F320)	3,20	5,46
6,00	M600-65A	DK-59	M600-65A5						
7,00	M700-65A	DK-66	M700-65A5						
8,00	M800-65A	DK-70	M800-65A5				(64F500)	5,00	8,60
10,00	M1000-65A		M1000-65A5				(64F550)	5,50	9,46
6,00	M600-100A		M600-100A5						
7,00	M700-100A	CK-37	M700-100A5						
8,00	M800-100A		M800-100A5						
10,00	M1000-100A		M1000-100A5						

** This grade does not appear in the standard EN 10106.*
Note: a designation within brackets, eg (35A230) indicates approximate equivalence.

Conversion factors

1 Tesla (T) = 1 Weber/m^2 (Wb/m^2) = 10000 Gauss = 64,5 kilolines/sq.in.

1 A/m = 0,01 A/cm = 0,0254 A/in = 0,01257 Oersted

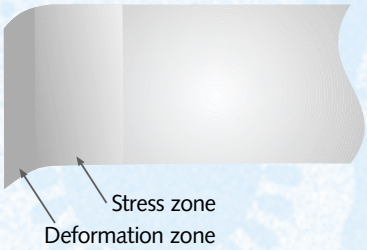
1 W/kg = 0,4536 W/lb (at the same frequency)

1 VA/kg = 0,4536 VA/lb (at the same frequency)

1 N/mm^2 (MPa) = 145,0 psi (lbs/sq.in.)

Stress relief annealing

Cogent non-oriented fully processed electrical steels are supplied finally annealed with fully developed magnetic properties and are normally used without stress relief annealing.

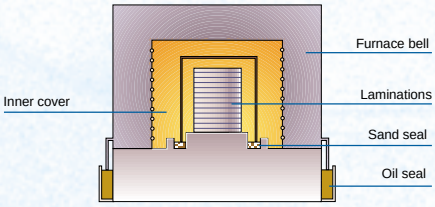


Stress zones at the cut edge (section).

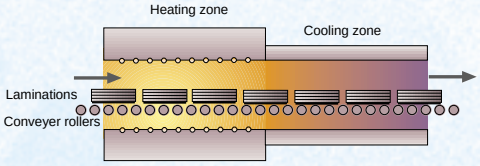
To make best use of low core loss of the steel, edge deformation zones and burrs should be minimised during the laminating process by using sharp tools, preferably those which are highly wear-resistant such as tungsten carbide. The additional cost of annealing for improvement of magnetic properties can normally only be justified for very narrow laminations.

Some aspects of stress relief annealing procedures are given in the Cogent Grain Oriented electrical steels brochure. For stress relief annealing, uncoated or SURALAC 7000 coated steel should be used.

Batch annealing



Roller hearth annealing



Applications

Cogent grades cover a wide range of properties. Since the materials are fully processed the properties are fully developed in the 'as supplied' condition. From the magnetic viewpoint, different grades are characterised, primarily, by values of power loss and permeability. An increasing alloy content (mainly silicon and aluminium) increases electrical resistivity of the steel and thus reduces power loss. On the other hand, an increased alloy content results in reduced magnetic saturation and reduced permeability at medium and high field strengths (H >1000 A/m).

Generally, higher permeability is more important for smaller machines whereas power losses are of greater importance for large machines. Grades of lower alloy content with higher losses, higher permeability and lower cost, are therefore mainly used for small machines. Grades of high alloy content with low losses, lower permeability and higher cost are used for large machines. There are, however, many exceptions to this.

The table lists examples of suitable Cogent grades for various applications.

	M235-35A – M330-35A M250-50A– M350-50A M330-65A – M350-65A	M400-50A – M700-50A M400-65A – M700-65A	M800-50A – M940-50A M800-65A – M1000-65A
Large size rotating machines	■		
Medium size rotating machines	■	■	
Small size rotating machines			■
Hermetic motors		■	■
Small power transformers	■		
Welding transformers		■	
Fluorescent lamp ballasts		■	■
Meters		■	■

Typical data tables

The following pages contain data to show typical magnetic characteristics of Cogent grades from Surahammars Bruks AB.

Grade EN

M235-35A
M250-35A
M270-35A
M300-35A
M330-35A
M700-35A

M250-50A
M270-50A
M290-50A
M310-50A
M330-50A
M350-50A
M400-50A
M470-50A
M530-50A
M600-50A
M700-50A
M800-50A
M940-50A

M530-50HP

M310-65A
M330-65A
M350-65A
M400-65A
M470-65A
M530-65A
M600-65A
M700-65A
M800-65A
M1000-65A

M650-65HP

M600-100A
M700-100A
M800-100A
M1000-100A

Specific total loss
pages 18-19

Specific apparent power
pages 20-21

A.C. Magnetization
pages 22-23

Grade EN

M235-35A
M250-35A
M270-35A
M300-35A
M330-35A

M250-50A
M270-50A
M290-50A
M310-50A
M330-50A
M350-50A
M400-50A

High frequency specific total loss
pages 24-26

Typical specific total loss data, W/kg at 50 Hz

Grade EN 10106	Thickness mm	Specific total loss, W/kg at 50 Hz and peak magnetic polarization $\hat{J}$ (T) of									
		0,10	0,20	0,30	0,40	0,50	0,60	0,70	0,80	0,90	1,00
M235-35A	0,35	0,02	0,06	0,11	0,20	0,29	0,38	0,50	0,62	0,77	0,92
M250-35A	0,35	0,02	0,06	0,13	0,21	0,31	0,41	0,52	0,66	0,81	0,98
M270-35A	0,35	0,03	0,07	0,13	0,22	0,31	0,43	0,54	0,68	0,83	1,01
M300-35A	0,35	0,03	0,08	0,15	0,24	0,35	0,48	0,61	0,76	0,92	1,10
M330-35A	0,35	0,03	0,08	0,16	0,27	0,39	0,52	0,66	0,82	1,00	1,19
M700-35A*	0,35	0,06	0,17	0,35	0,57	0,82	1,09	1,40	1,74	2,12	2,53
M250-50A	0,50	0,02	0,07	0,13	0,22	0,31	0,43	0,55	0,70	0,86	1,02
M270-50A	0,50	0,02	0,07	0,14	0,23	0,33	0,45	0,58	0,73	0,90	1,07
M290-50A	0,50	0,03	0,07	0,15	0,25	0,37	0,49	0,63	0,79	0,96	1,14
M310-50A	0,50	0,03	0,08	0,17	0,27	0,40	0,53	0,68	0,85	1,03	1,23
M330-50A	0,50	0,03	0,09	0,18	0,28	0,41	0,55	0,71	0,89	1,08	1,29
M350-50A	0,50	0,03	0,09	0,18	0,29	0,42	0,56	0,73	0,91	1,11	1,33
M400-50A	0,50	0,03	0,09	0,20	0,32	0,46	0,62	0,80	1,00	1,22	1,46
M470-50A	0,50	0,04	0,10	0,23	0,38	0,56	0,76	0,97	1,20	1,49	1,79
M530-50A	0,50	0,04	0,13	0,28	0,46	0,66	0,88	1,12	1,39	1,68	2,01
M600-50A	0,50	0,04	0,16	0,33	0,54	0,78	1,04	1,32	1,63	1,96	2,34
M700-50A	0,50	0,05	0,16	0,37	0,59	0,84	1,12	1,43	1,77	2,15	2,57
M800-50A	0,50	0,05	0,18	0,43	0,70	1,01	1,35	1,72	2,13	2,56	3,05
M940-50A	0,50	0,05	0,23	0,51	0,85	1,22	1,62	2,06	2,53	3,03	3,57
M530-50HP*	0,50	0,03	0,14	0,28	0,46	0,67	0,90	1,15	1,42	1,72	2,05
M310-65A	0,65	0,02	0,07	0,15	0,25	0,37	0,51	0,66	0,84	1,03	1,24
M330-65A	0,65	0,02	0,08	0,16	0,27	0,39	0,53	0,70	0,88	1,08	1,30
M350-65A	0,65	0,02	0,08	0,18	0,29	0,42	0,58	0,75	0,95	1,16	1,40
M400-65A	0,65	0,03	0,10	0,20	0,33	0,48	0,65	0,84	1,06	1,30	1,57
M470-65A	0,65	0,04	0,11	0,22	0,37	0,53	0,74	0,96	1,20	1,48	1,79
M530-65A	0,65	0,05	0,11	0,23	0,39	0,58	0,79	1,01	1,28	1,57	1,90
M600-65A	0,65	0,05	0,13	0,27	0,45	0,67	0,91	1,16	1,48	1,81	2,19
M700-65A	0,65	0,05	0,17	0,35	0,58	0,84	1,12	1,44	1,78	2,18	2,62
M800-65A	0,65	0,05	0,19	0,41	0,67	0,96	1,29	1,66	2,06	2,52	3,02
M1000-65A	0,65	0,06	0,24	0,50	0,81	1,16	1,56	1,99	2,47	3,01	3,60
M600-65HP*	0,50	0,04	0,15	0,30	0,49	0,71	0,95	1,22	1,52	1,86	2,24
M600-100A	1,00	0,03	0,11	0,24	0,42	0,63	0,86	1,16	1,52	1,90	2,32
M700-100A	1,00	0,04	0,14	0,29	0,51	0,77	1,05	1,42	1,85	2,32	2,83
M800-100A	1,00	0,05	0,17	0,37	0,62	0,92	1,27	1,70	2,18	2,74	3,33
M1000-100A	1,00	0,06	0,21	0,45	0,75	1,12	1,54	2,07	2,65	3,33	4,05

** This grade does not appear in EN 10106.*

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Typical specific total loss data, W/kg at 50 Hz

Specific total loss, W/kg at 50 Hz and peak magnetic polarization $\hat{J}$ (T) of								Grade EN 10106
1,10	1,20	1,30	1,40	1,50	1,60	1,70	1,80	
1,10	1,31	1,56	1,92	2,25	2,53	2,75	2,94	M235-35A
1,15	1,37	1,65	2,00	2,35	2,65	2,87	3,06	M250-35A
1,20	1,42	1,70	2,12	2,47	2,80	3,05	3,25	M270-35A
1,30	1,54	1,82	2,20	2,62	2,98	3,25	3,41	M300-35A
1,42	1,67	1,99	2,42	2,93	3,47	3,90	4,23	M330-35A
2,93	3,38	3,93	4,66	5,50	6,51	7,31	7,94	M700-35A*
1,21	1,42	1,67	2,02	2,38	2,71	2,96	3,18	M250-50A
1,27	1,50	1,76	2,13	2,52	2,87	3,13	3,37	M270-50A
1,35	1,58	1,83	2,25	2,62	2,95	3,21	3,46	M290-50A
1,45	1,71	2,00	2,40	2,83	3,25	3,57	3,86	M310-50A
1,53	1,81	2,12	2,56	3,03	3,49	3,84	4,15	M330-50A
1,58	1,86	2,19	2,63	3,14	3,66	4,07	4,40	M350-50A
1,73	2,04	2,41	2,88	3,42	3,96	4,38	4,74	M400-50A
2,10	2,49	2,94	3,46	4,05	4,67	5,19	5,58	M470-50A
2,37	2,77	3,23	3,78	4,42	5,11	5,75	6,20	M530-50A
2,76	3,23	3,78	4,43	5,17	5,94	6,60	7,06	M600-50A
3,03	3,55	4,13	4,83	5,68	6,54	7,29	7,81	M700-50A
3,59	4,20	4,91	5,70	6,60	7,54	8,30	8,83	M800-50A
4,17	4,87	5,65	6,54	7,55	8,61	9,46	10,05	M940-50A
2,42	2,82	3,28	3,83	4,45	5,16	5,83	6,33	M530-50HP*
1,48	1,74	2,05	2,46	2,90	3,32	3,67	4,01	M310-65A
1,55	1,83	2,15	2,58	3,04	3,48	3,86	4,21	M330-65A
1,66	1,96	2,30	2,75	3,23	3,69	4,07	4,43	M350-65A
1,87	2,20	2,58	3,07	3,63	4,21	4,70	5,13	M400-65A
2,12	2,50	2,92	3,45	4,06	4,69	5,22	5,69	M470-65A
2,26	2,67	3,13	3,71	4,35	5,00	5,56	6,02	M530-65A
2,60	3,06	3,58	4,23	4,95	5,69	6,33	6,85	M600-65A
3,11	3,67	4,32	5,06	5,88	6,77	7,59	8,25	M700-65A
3,59	4,22	4,96	5,81	6,74	7,72	8,58	9,25	M800-65A
4,26	4,99	5,87	6,82	7,90	9,05	10,03	10,79	M1000-65A
2,66	3,14	3,67	4,29	5,00	5,79	6,52	7,08	M650-65HP*
2,76	3,26	3,82	4,41	5,11	5,85	6,57	7,24	M600-100A
3,37	3,98	4,66	5,39	6,24	7,13	8,02	8,83	M700-100A
4,00	4,73	5,47	6,28	7,20	8,22	9,12	10,06	M800-100A
4,88	5,79	6,71	7,73	8,89	10,15	11,26	12,42	M1000-100A

** This grade does not appear in EN 10106.*

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Typical specific apparent power, VA/kg at 50 Hz

Grade EN 10106	Thickness mm	Specific apparent power, VA/kg at 50 Hz and peak magnetic polarization $\hat{J}$ (T) of									
		0,10	0,20	0,30	0,40	0,50	0,60	0,70	0,80	0,90	1,00
M235-35A	0,35	0,05	0,14	0,24	0,37	0,51	0,67	0,87	1,09	1,36	1,71
M250-35A	0,35	0,06	0,15	0,27	0,40	0,56	0,74	0,95	1,21	1,52	1,92
M270-35A	0,35	0,06	0,17	0,29	0,44	0,61	0,81	1,04	1,31	1,63	2,04
M300-35A	0,35	0,07	0,17	0,30	0,45	0,62	0,82	1,05	1,31	1,63	2,03
M330-35A	0,35	0,08	0,19	0,32	0,47	0,64	0,85	1,08	1,35	1,68	2,08
M700-35A*	0,35	0,14	0,37	0,62	0,90	1,20	1,53	1,88	2,26	2,67	3,13
M250-50A	0,50	0,06	0,17	0,31	0,46	0,65	0,86	1,12	1,41	1,77	2,21
M270-50A	0,50	0,07	0,18	0,32	0,48	0,67	0,89	1,14	1,45	1,80	2,25
M290-50A	0,50	0,07	0,18	0,32	0,48	0,67	0,89	1,15	1,44	1,80	2,24
M310-50A	0,50	0,07	0,19	0,33	0,50	0,69	0,91	1,16	1,45	1,79	2,21
M330-50A	0,50	0,07	0,19	0,34	0,51	0,70	0,93	1,20	1,50	1,86	2,30
M350-50A	0,50	0,07	0,19	0,34	0,52	0,72	0,95	1,21	1,52	1,88	2,31
M400-50A	0,50	0,08	0,22	0,39	0,58	0,80	1,05	1,33	1,65	2,02	2,46
M470-50A	0,50	0,10	0,27	0,47	0,70	0,96	1,25	1,58	1,94	2,36	2,87
M530-50A	0,50	0,11	0,29	0,49	0,73	1,00	1,29	1,62	1,99	2,41	2,92
M600-50A	0,50	0,13	0,35	0,59	0,87	1,18	1,51	1,88	2,28	2,73	3,25
M700-50A	0,50	0,14	0,36	0,63	0,92	1,23	1,58	1,96	2,38	2,84	3,36
M800-50A	0,50	0,17	0,44	0,76	1,12	1,52	1,97	2,46	3,00	3,60	4,27
M940-50A	0,50	0,21	0,54	0,92	1,36	1,80	2,28	2,81	3,38	4,02	4,65
M530-50HP*	0,50	0,12	0,31	0,54	0,80	1,09	1,40	1,75	2,13	2,56	3,04
M310-65A	0,65	0,05	0,15	0,28	0,43	0,61	0,82	1,07	1,36	1,70	2,13
M330-65A	0,65	0,06	0,16	0,28	0,44	0,62	0,83	1,08	1,37	1,73	2,16
M350-65A	0,65	0,06	0,16	0,29	0,45	0,64	0,85	1,11	1,42	1,71	2,08
M400-65A	0,65	0,06	0,17	0,32	0,49	0,70	0,95	1,25	1,60	2,02	2,53
M470-65A	0,65	0,07	0,18	0,33	0,50	0,71	0,95	1,23	1,56	1,94	2,41
M530-65A	0,65	0,09	0,25	0,45	0,68	0,94	1,23	1,56	1,93	2,36	2,87
M600-65A	0,65	0,10	0,28	0,49	0,73	1,01	1,32	1,67	2,06	2,52	3,05
M700-65A	0,65	0,12	0,32	0,56	0,84	1,16	1,51	1,91	2,36	2,87	3,46
M800-65A	0,65	0,15	0,41	0,71	1,04	1,41	1,82	2,27	2,78	3,35	4,01
M1000-65A	0,65	0,17	0,45	0,77	1,13	1,53	1,96	2,44	2,98	3,58	4,26
M600-65HP*	0,65	0,13	0,35	0,60	0,89	1,22	1,58	1,98	2,42	2,92	3,49
M600-100A	1,00	0,06	0,19	0,37	0,60	0,90	1,27	1,73	2,28	2,95	3,78
M700-100A	1,00	0,06	0,19	0,38	0,62	0,93	1,31	1,79	2,37	3,07	3,94
M800-100A	1,00	0,10	0,30	0,55	0,87	1,26	1,73	2,30	2,97	3,77	4,75
M1000-100A	1,00	0,11	0,34	0,64	1,02	1,48	2,04	2,71	3,49	4,42	5,52

** This grade does not appear in EN 10106.*

cogent

Typical specific apparent power, VA/kg at 50 Hz

Specific apparent power, VA/kg at 50 Hz and peak magnetic polarization $\hat{J}$ (T) of								Grade EN 10106
1,10	**1,20**	**1,30**	**1,40**	**1,50**	**1,60**	**1,70**	**1,80**	
2,17	2,89	4,45	10,3	32,4	84,6	162	274	M235-35A
2,46	3,30	4,97	10,3	30,0	75,7	153	267	M250-35A
2,58	3,38	4,90	9,64	28,0	72,3	149	264	M270-35A
2,55	3,32	4,71	8,61	23,7	64,1	138	255	M300-35A
2,62	3,41	4,85	8,69	22,7	61,8	135	252	M330-35A
3,66	4,32	5,25	6,93	11,8	31,8	86,0	182	M700-35A*
2,79	3,63	5,16	9,69	26,7	68,6	143	263	M250-50A
2,82	3,64	5,12	9,35	25,3	66,0	139	257	M270-50A
2,80	3,62	5,09	9,23	25,0	65,3	138	257	M290-50A
2,75	3,50	4,80	8,14	20,4	55,7	125	239	M310-50A
2,86	3,65	5,00	8,27	19,9	54,7	124	239	M330-50A
2,86	3,63	4,90	8,01	19,5	54,3	124	238	M350-50A
3,01	3,77	5,00	7,92	18,5	51,8	121	236	M400-50A
3,49	4,34	5,69	8,68	18,6	50,6	119	232	M470-50A
3,54	4,37	5,71	8,63	18,3	49,5	117	229	M530-50A
3,86	4,62	5,68	7,55	12,8	31,7	82,6	176	M600-50A
3,96	4,71	5,76	7,57	12,4	30,3	79,7	172	M700-50A
5,04	5,96	6,95	8,49	11,9	25,2	67,4	151	M800-50A
5,39	6,25	7,12	8,45	11,7	24,5	65,2	147	M940-50A
3,61	4,31	5,27	6,87	10,9	25,3	67,4	152	M530-50HP*
2,68	3,48	4,92	9,16	24,9	65,4	140	261	M310-65A
2,73	3,54	5,01	9,05	23,6	61,7	133	251	M330-65A
2,51	3,20	4,50	7,73	20,0	54,9	123	235	M350-65A
3,19	4,10	5,58	8,89	19,5	51,1	117	228	M400-65A
3,00	3,79	5,02	7,86	17,9	48,6	113	223	M470-65A
3,51	4,37	5,69	8,54	17,7	46,7	111	220	M530-65A
3,72	4,58	5,87	8,53	17,0	45,2	109	218	M600-65A
4,15	5,02	6,22	8,18	13,0	28,8	73,8	162	M700-65A
4,76	5,64	6,81	8,64	12,7	26,5	68,4	154	M800-65A
5,04	5,93	7,13	8,90	12,5	24,5	62,7	144	M1000-65A
4,14	4,93	5,99	7,65	11,5	24,2	62,6	144	M650-65HP*
4,85	6,32	8,61	13,0	23,5	51,6	113	221	M600-100A
5,06	6,59	8,91	13,2	23,3	49,9	109	214	M700-100A
5,98	7,59	9,97	14,1	23,1	48,0	107	214	M800-100A
6,84	8,53	10,8	13,6	18,1	30,0	71,6	157	M1000-100A

** This grade does not appear in EN 10106.*

Typical peak magnetic field strength, A/m at 50 Hz

Grade EN 10106	Thickness mm	Peak magnetic field strength, A/m at 50 Hz and peak magnetic polarization $\hat{J}$ (T) of									
		0,10	0,20	0,30	0,40	0,50	0,60	0,70	0,80	0,90	1,00
M235-35A	0,35	24,7	32,6	38,1	43,1	48,2	53,9	60,7	68,8	79,3	93,7
M250-35A	0,35	26,8	35,7	41,8	47,5	53,4	60,0	67,9	77,5	90,0	107
M270-35A	0,35	30,0	39,6	46,0	52,0	58,2	65,2	73,3	83,1	95,5	112
M300-35A	0,35	30,9	40,2	46,4	52,1	57,9	64,4	72,0	81,1	92,6	108
M330-35A	0,35	31,4	41,4	48,2	54,3	60,4	67,1	74,9	84,2	96,3	113
M700-35A*	0,35	70,2	89,1	98,8	106	113	120	127	135	144	155
M250-50A	0,50	30,6	40,7	47,9	54,5	61,3	69,0	77,8	88,6	102	120
M270-50A	0,50	31,5	42,0	49,4	56,1	63,1	70,7	79,5	90,1	103	121
M290-50A	0,50	32,2	42,9	50,3	57,1	63,9	71,4	79,9	89,9	103	119
M310-50A	0,50	33,3	43,9	51,2	57,7	64,2	71,2	79,1	88,4	100	116
M330-50A	0,50	33,2	44,3	52,0	58,9	65,9	73,4	82,0	92,2	105	122
M350-50A	0,50	34,8	46,0	53,7	60,6	67,4	74,6	82,6	91,8	103	119
M400-50A	0,50	40,1	52,5	60,8	68,1	75,2	82,5	90,4	99,3	110	125
M470-50A	0,50	48,8	64,8	74,3	82,4	90,2	98,2	107	117	129	146
M530-50A	0,50	51,5	68,1	77,6	85,6	93,3	101	110	120	132	147
M600-50A	0,50	65,6	83,8	94,1	103	110	118	127	136	147	159
M700-50A	0,50	67,8	88,3	99,2	108	116	124	132	142	152	164
M800-50A	0,50	84,5	107	121	133	145	156	168	180	194	209
M940-50A	0,50	102	129	146	161	171	181	192	203	217	228
M530-50HP*	0,50	57,7	74,9	85,2	93,7	102	109	118	127	137	148
M310-65A	0,65	25,8	35,5	42,9	49,7	56,7	63,8	71,7	80,6	91,5	107
M330-65A	0,65	26,5	36,2	43,7	50,6	57,6	64,8	72,7	81,8	93,3	109
M350-65A	0,65	27,3	37,7	45,9	53,1	59,9	66,8	74,2	82,5	90,1	101
M400-65A	0,65	29,5	40,1	48,4	56,2	64,2	72,6	81,9	93,0	108	127
M470-65A	0,65	31,2	42,0	50,2	57,8	65,5	73,5	82,1	91,6	103	118
M530-65A	0,65	44,0	59,5	69,6	78,2	86,6	95,0	104	113	125	138
M600-65A	0,65	48,8	65,1	75,6	84,9	93,8	103	112	122	133	147
M700-65A	0,65	57,4	75,8	87,6	98,0	108	118	129	140	153	167
M800-65A	0,65	74,7	97,5	110	120	130	140	150	162	175	190
M1000-65A	0,65	83,3	107	119	130	140	150	160	172	185	200
M600-65HP*	0,65	63,6	82,6	93,9	103	113	122	131	142	153	167
M600-100A	1,00	29,0	44,1	57,1	70,2	84,1	99,2	116	134	153	176
M700-100A	1,00	29,3	44,8	58,4	72,2	87,0	103	121	140	161	185
M800-100A	1,00	49,3	69,2	85,1	101	117	135	154	174	196	221
M1000-100A	1,00	56,0	80,8	100	119	139	161	183	208	233	257

** This grade does not appear in EN 10106.*

Typical peak magnetic field strength, A/m at 50 Hz

Peak magnetic field strength, A/m at 50 Hz and peak magnetic polarization $\hat{J}$ (T) of								Grade EN 10106
1,10	1,20	1,30	1,40	1,50	1,60	1,70	1,80	
115	156	260	690	1950	4410	7630	12000	M235-35A
133	179	284	642	1810	4030	7290	11700	M250-35A
136	178	272	596	1700	3880	7160	11600	M270-35A
130	168	250	510	1440	3490	6700	11300	M300-35A
137	179	266	521	1380	3400	6610	11100	M330-35A
169	192	237	342	681	1890	4570	8580	M700-35A*
145	186	278	584	1600	3680	6890	11600	M250-50A
145	185	273	557	1520	3560	6730	11400	M270-50A
144	184	271	549	1500	3520	6700	11400	M290-50A
139	175	251	470	1230	3070	6150	10700	M310-50A
145	183	259	470	1190	3030	6120	10700	M330-50A
141	178	250	455	1180	3020	6100	10700	M350-50A
146	181	251	443	1110	2900	6020	10600	M400-50A
170	209	284	475	1100	2850	5980	10500	M470-50A
170	208	282	470	1080	2790	5890	10400	M530-50A
177	205	255	370	718	1840	4370	8330	M600-50A
180	206	254	363	690	1760	4230	8130	M700-50A
228	254	304	402	660	1480	3710	7300	M800-50A
243	267	311	400	645	1440	3590	7090	M940-50A
164	189	232	326	594	1460	3620	7320	M530-50HP*
130	169	257	545	1490	3540	6800	11600	M310-65A
133	174	261	530	1410	3350	6500	11200	M330-65A
121	155	230	441	1210	3020	6040	10600	M350-65A
155	197	278	484	1140	2820	5830	10300	M400-65A
140	175	242	426	1060	2700	5670	10100	M470-65A
159	196	270	454	1040	2630	5620	10100	M530-65A
169	205	273	444	991	2550	5540	9980	M600-65A
185	211	265	379	688	1630	3920	7760	M700-65A
208	227	265	366	633	1490	3670	7420	M800-65A
218	237	275	368	604	1360	3370	7010	M1000-65A
182	202	244	337	587	1360	3370	7010	M650-65HP*
212	281	401	646	1250	2740	5560	9980	M600-100A
225	294	412	649	1220	2630	5370	9710	M700-100A
261	332	450	675	1190	2550	5360	9770	M800-100A
291	348	444	576	847	1610	3760	7520	M1000-100A

** This grade does not appear in EN 10106.*

cogent

Typical specific total loss data, W/kg at 100 Hz - 2500 Hz

Measurements are carried out in the 25 cm Epstein frame according to IEC 60404-2 at 100 Hz and 200 Hz, according to IEC 60404-10 at 400 Hz to 2500 Hz. Half of the sample strips are taken in the rolling direction and half in the transverse direction. Samples are tested as sheared and are not aged or stress relief annealed.

100 Hz

Grade EN 10106	Specific total loss, W/kg at 100 Hz and peak magnetic polarization $\hat{J}$ (T) of														
	0,10	0,20	0,30	0,40	0,50	0,60	0,70	0,80	0,90	1,00	1,10	1,20	1,30	1,40	1,50
M235-35A	0,04	0,14	0,30	0,49	0,71	0,97	1,25	1,57	1,92	2,31	2,75	3,26	3,88	4,67	5,54
M250-35A	0,04	0,14	0,31	0,51	0,75	1,01	1,31	1,64	2,00	2,41	2,87	3,40	4,03	4,83	5,72
M270-35A	0,04	0,16	0,34	0,55	0,80	1,08	1,38	1,73	2,10	2,51	2,98	3,51	4,15	4,97	5,92
M300-35A	0,04	0,17	0,35	0,58	0,84	1,14	1,46	1,83	2,23	2,66	3,16	3,72	4,39	5,23	6,22
M330-35A	0,04	0,18	0,38	0,63	0,92	1,24	1,61	2,01	2,46	2,96	3,52	4,17	4,95	5,93	7,13
M250-50A	0,04	0,16	0,34	0,57	0,83	1,13	1,47	1,85	2,28	2,75	3,28	3,89	4,61	5,51	6,51
M270-50A	0,04	0,17	0,35	0,58	0,85	1,16	1,51	1,90	2,33	2,81	3,36	3,98	4,71	5,62	6,69
M290-50A	0,04	0,17	0,36	0,60	0,88	1,21	1,57	1,98	2,43	2,93	3,49	4,12	4,86	5,78	6,83
M310-50A	0,05	0,20	0,40	0,66	0,97	1,32	1,72	2,16	2,65	3,19	3,78	4,44	5,22	6,17	7,31
M330-50A	0,05	0,20	0,43	0,71	1,04	1,42	1,84	2,32	2,85	3,43	4,08	4,81	5,63	6,60	7,71
M350-50A	0,06	0,21	0,44	0,72	1,06	1,45	1,89	2,39	2,95	3,58	4,29	5,08	5,99	7,11	8,43
M400-50A	0,06	0,23	0,47	0,76	1,11	1,52	1,97	2,49	3,07	3,73	4,48	5,32	6,28	7,44	8,80

200 Hz

Grade EN 10106	Specific total loss, W/kg at 200 Hz and a peak magnetic polarization $\hat{J}$ (T) of														
	0,10	0,20	0,30	0,40	0,50	0,60	0,70	0,80	0,90	1,00	1,10	1,20	1,30	1,40	1,50
M235-35A	0,08	0,32	0,73	1,21	1,78	2,44	3,19	4,03	4,97	6,01	7,19	8,54	10,1	12,2	14,4
M250-35A	0,08	0,33	0,73	1,23	1,82	2,49	3,26	4,12	5,07	6,14	7,33	8,69	10,3	12,4	14,7
M270-35A	0,09	0,37	0,79	1,31	1,91	2,61	3,39	4,26	5,23	6,30	7,51	8,88	10,5	12,5	14,9
M300-35A	0,09	0,40	0,85	1,41	2,06	2,81	3,66	4,61	5,65	6,80	8,09	9,54	11,2	13,4	15,7
M330-35A	0,10	0,43	0,92	1,55	2,30	3,16	4,13	5,23	6,45	7,83	9,37	11,1	13,2	15,7	18,6
M250-50A	0,10	0,42	0,88	1,47	2,17	3,00	3,95	5,05	6,30	7,73	9,36	11,2	13,4	15,9	18,9
M270-50A	0,10	0,43	0,91	1,51	2,24	3,09	4,07	5,19	6,47	7,94	9,61	11,5	13,6	16,3	19,2
M290-50A	0,10	0,44	0,93	1,55	2,31	3,21	4,24	5,41	6,75	8,25	9,94	11,8	14,0	16,6	19,5
M310-50A	0,12	0,50	1,04	1,73	2,56	3,54	4,67	5,96	7,42	9,07	10,9	13,0	15,3	18,0	21,1
M330-50A	0,13	0,49	1,06	1,78	2,65	3,66	4,83	6,17	7,69	9,42	11,4	13,6	16,0	18,7	21,8
M350-50A	0,14	0,53	1,13	1,88	2,80	3,88	5,14	6,61	8,29	10,2	12,5	15,0	17,8	21,1	24,7
M400-50A	0,15	0,56	1,16	1,93	2,86	3,95	5,23	6,71	8,41	10,4	12,7	15,3	18,2	21,6	25,4

Typical specific total loss data, W/kg at 100 Hz - 2500 Hz

400 Hz

Grade EN 10106	Specific total loss, W/kg at 400 Hz and peak magnetic polarization $\hat{J}$ (T) of														
	0,10	0,20	0,30	0,40	0,50	0,60	0,70	0,80	0,90	1,00	1,10	1,20	1,30	1,40	1,50
M235-35A	0,19	0,87	1,88	3,17	4,73	6,56	8,67	11,0	13,8	16,9	20,3	24,3	28,9	34,8	41,2
M250-35A	0,21	0,90	1,93	3,24	4,81	6,69	8,82	11,2	14,0	17,1	20,6	24,6	29,2	35,1	41,6
M270-35A	0,21	0,92	1,99	3,33	4,94	6,84	9,00	11,4	14,2	17,3	20,9	24,9	29,5	35,4	41,8
M300-35A	0,23	1,00	2,15	3,61	5,36	7,42	9,75	12,4	15,4	18,8	22,5	26,8	31,6	37,7	44,3
M330-35A	0,27	1,15	2,45	4,13	6,16	8,58	11,4	14,5	18,2	22,3	27,0	32,4	38,7	46,2	54,7
M250-50A	0,28	1,15	2,41	4,03	6,03	8,47	11,3	14,7	18,7	23,4	28,8	35,2	42,4	50,9	60,7
M270-50A	0,29	1,15	2,48	4,17	6,24	8,75	11,7	15,2	19,3	24,1	29,7	36,0	43,3	51,9	61,9
M290-50A	0,30	1,18	2,51	4,25	6,40	9,01	12,1	15,7	20,0	24,9	30,6	37,1	44,5	53,0	62,5
M310-50A	0,34	1,36	2,83	4,75	7,14	10,0	13,5	17,5	22,1	27,4	33,6	40,7	48,6	58,0	68,5
M330-50A	0,34	1,36	2,84	4,77	7,18	10,1	13,6	17,7	22,5	28,1	34,6	42,0	50,2	59,3	69,6
M350-50A	0,39	1,49	3,11	5,23	7,85	11,1	14,9	19,4	25,0	31,3	38,8	47,5	57,7	69,5	83,1
M400-50A	0,40	1,54	3,20	5,38	8,08	11,4	15,3	20,0	25,7	32,2	39,8	48,7	59,0	70,9	84,6

1000 Hz

Grade EN 10106	Specific total loss, W/kg at 1000 Hz and peak magnetic polarization $\hat{J}$ (T) of										
	0,10	0,20	0,30	0,40	0,50	0,60	0,70	0,80	0,90	1,00	1,10
M235-35A	0,93	3,55	7,45	12,3	18,5	25,8	34,6	45,0	57,2	71,5	88,3
M250-35A	0,98	3,65	7,58	12,7	18,8	26,3	35,2	45,7	58,1	72,6	89,6
M270-35A	0,99	3,67	7,63	12,7	18,9	26,4	35,4	46,0	58,4	73,0	90,1
M300-35A	1,07	4,08	8,48	14,0	20,9	29,2	39,0	50,6	64,1	79,8	98,0
M330-35A	1,30	4,84	10,0	16,7	24,9	34,9	46,9	61,3	78,3	98,4	122
M250-50A	1,38	4,91	10,0	16,8	25,6	36,6	50,3	67,2	87,8	113	143
M270-50A	1,40	5,01	10,2	17,2	26,1	37,4	51,4	68,7	89,6	115	145
M290-50A	1,41	5,10	10,4	17,7	26,5	37,9	52,1	69,5	90,8	116	147
M310-50A	1,62	5,63	11,5	19,5	29,7	42,6	58,4	77,8	101	130	163
M330-50A	1,64	5,71	11,7	19,7	30,1	43,1	59,2	78,2	103	132	166
M350-50A	1,77	6,19	12,6	21,2	32,4	46,8	65,1	88,0	116	151	192
M400-50A	1,83	6,34	12,9	21,6	33,0	47,6	66,0	89,0	117	152	194

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Typical specific total loss data, W/kg at 100 Hz - 2500 Hz

2500 Hz

Grade EN10106	Specific total loss, W/kg at 2500 Hz and peak magnetic polarization $\hat{J}$ (T) of									
	0,10	0,20	0,30	0,40	0,50	0,60	0,70	0,80	0,90	1,00
M235-35A	3,89	14,3	29,6	50,2	76,7	110	153	205	270	349
M250-35A	4,09	14,8	30,6	51,7	78,8	113	155	208	273	352
M270-35A	4,10	14,9	30,7	52,0	79,1	113	156	209	274	353
M300-35A	4,45	16,1	33,6	56,9	86,6	124	170	227	297	382
M330-35A	5,44	19,5	40,9	69,5	107	154	213	287	373	476
M250-50A	5,71	19,8	41,4	71,8	113	169	243	338	461	617
M270-50A	5,75	20,1	42,4	73,7	116	173	248	344	468	627
M290-50A	5,79	20,3	42,6	74,1	117	174	249	346	470	629
M310-50A	6,31	21,8	45,9	80,2	128	193	279	390	526	695
M330-50A	6,55	22,7	47,8	82,9	130	194	281	392	529	697
M350-50A	7,37	25,4	53,3	93,0	148	224	324	454	608	796
M400-50A	7,48	25,7	54,0	94,1	150	226	327	457	612	800

Thin non-oriented electrical steels for medium to high frequencies

For applications at frequencies higher than that of the normal power frequency (50 or 60 Hz), it may be necessary to select a thinner steel to maintain low losses. A range of thin non-oriented fully processed electrical steels for application at medium to high frequencies (200 -3000 Hz) has been developed.

Thin gauge grades are available with an insulating coating, SURALAC 7000 (see page 11), or as uncoated strip. For more detailed descriptions please refer to separate brochures.

Grade	Thickness		Typical specific total loss W/kg at peak magnetic polarization $\hat{J}$ = 1,0 T			
	mm	inch	50 Hz	60 Hz	400 Hz	2500 Hz
NO 20	0,20	0.008	0,95	-	12,2	205
NO 007	0,18	0.007	-	1,32	12,3	161
NO 005	0,127	0.005	-	1,34	11,8	132

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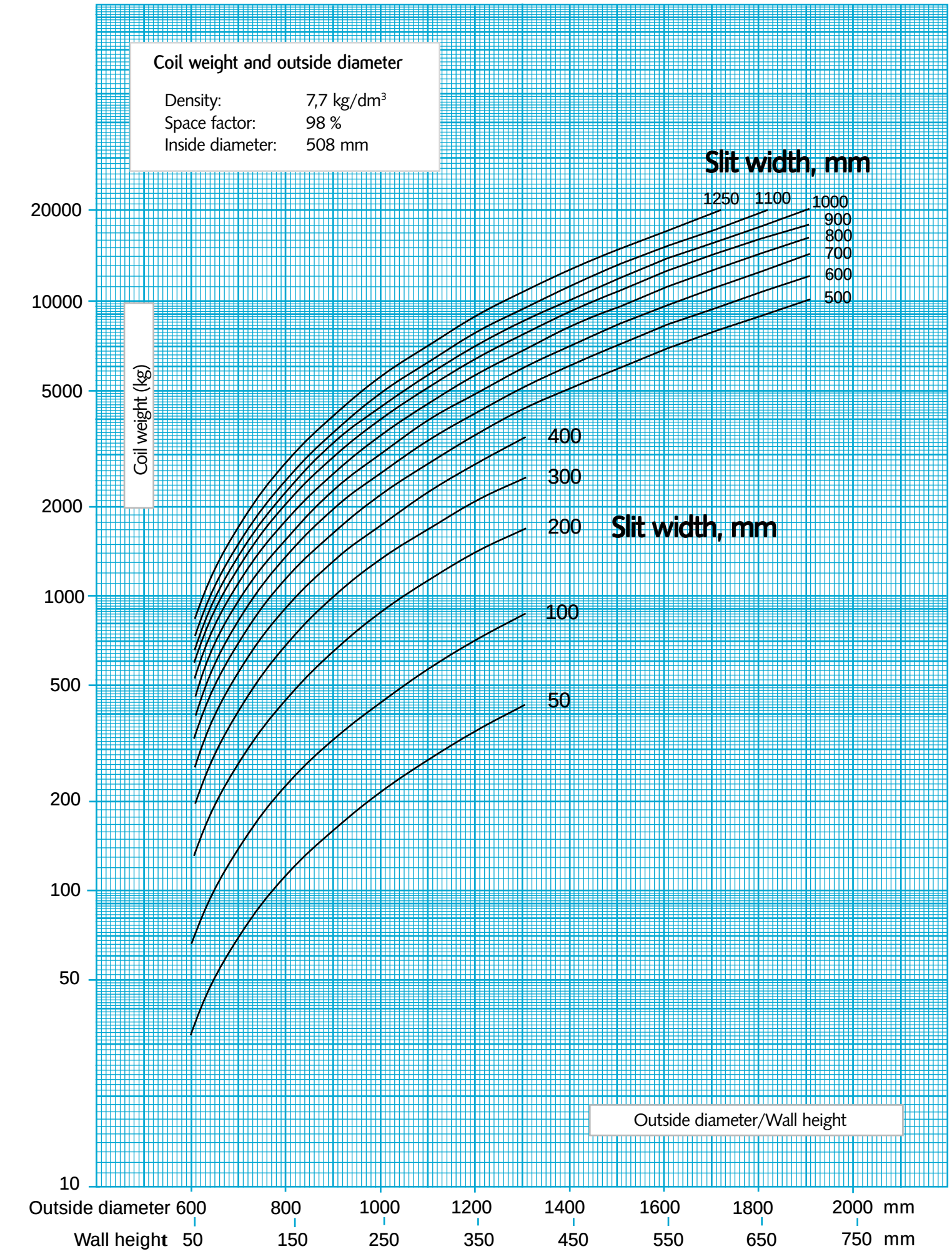
Coil weight and outside diameter
Density: 7,7 kg/dm³
Space factor: 98 %
Inside diameter: 508 mm
Slit width, mm
1250
1100
1000
900
800
700
600
500
400
300
200
100
50
Slit width, mm
Coil weight (kg)
20000
10000
5000
2000
1000
500
200
100
50
10
Outside diameter/Wall height
Outside diameter 600 800 1000 1200 1400 1600 1800 2000 mm
Wall height 50 150 250 350 450 550 650 750 mm

Cogent Power Ltd

Cogent Power Ltd is a multinational group comprising electrical steels, laminations, transformer products, precision engineering and electric motor design businesses which form a unique company that offers the customer complete solutions, from steel through to components, design to delivery.

Comprehensive Steel Product Range

The specialist product range of Cogent electrical steels extends from the high permeability grain oriented electrical steel for large transformers to fully processed silicon steels for large rotating machines and special non-alloyed semi-processed grades for smaller motors. Cogent is backed by internationally renowned steelmakers.

Product Information

This publication is part of a range of brochures that cover the following products from Cogent, on electrical steel:

- Grain Oriented electrical steels
- Non-Oriented fully processed electrical steels
- Non-Oriented semi-processed electrical steels
- Thin Non-Oriented fully processed electrical steels
- Magnetic Shielding

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