

Ardenmagni

Product specifications

Ardemagni offers a wide range of grades to respond to the various requirements of its customers. Our steel couples core losses with relatively higher permeability features, best geometrical and mechanical properties that will improve your products optimizing processing yields.

In case of special requirements where a new development is needed, Ardemagni will put you in contact with the engineers of CSC R&D department who will study with you the project to find a tailored solution to meet your targets.

Application of Electrical Steel grades

Grades

15CS1200HF	20CS1200FY	35CS1750HF	35CS210	50CS230-470	50CS600-1300
15CS1200FY	25CS1250FY	35CS1850HF	35CS250		
	27CS1450FY	35CS1600FY	35CS300		
	30CS1500FY		35CS440		

Rotating Machines

Big rotating machines				○	
Synchronous PM IE4/IE5 motors			○	○	
AC rotating machines IE2/IE3				○	○
Hermetical sealed motors	○	○	○	○	○
e-Drives IM and PM	○	○	○		

Static Machines

Medium Power Transformers	○	○	○	○	○
Audio Transformers			○	○	○
Welding Transformers	○	○	○	○	○
Magnetic Switch cores			○	○	

Electrical Steel NO - Standard grades fully finished according to EN 10106

Grade	Nominal thickness mm	Density kg/dm ³	Max core loss at				Min. magnetic polarization at loss at		
			1,5 T 50 Hz W/kg	1,0 T 50 Hz W/kg	1,5 T 60 Hz W/lb	1,0 T 60 Hz W/lb	2500 A/m T	5000 A/m T	10000 A/m T
M 235 - 35 A	0,35	7,60	2,35	0,95	1,35	0,55	1,49	1,60	1,70
M 250 - 35 A	0,35	7,60	2,50	1,05	1,44	0,59	1,49	1,60	1,70
M 270 - 35 A	0,35	7,65	2,70	1,10	1,55	0,63	1,49	1,60	1,70
M 300 - 35 A	0,35	7,65	3,00	1,20	1,72	0,69	1,49	1,60	1,70
M 330 - 35 A	0,35	7,65	3,30	1,30	1,90	0,75	1,49	1,60	1,70
M 250 - 50 A	0,50	7,60	2,50	1,05	1,44	0,59	1,49	1,60	1,70
M 270 - 50 A	0,50	7,60	2,70	1,10	1,55	0,63	1,49	1,60	1,70
M 290 - 50 A	0,50	7,60	2,90	1,15	1,67	0,66	1,49	1,60	1,70
M 310 - 50 A	0,50	7,65	3,10	1,25	1,78	0,72	1,49	1,60	1,70
M 330 - 50 A	0,50	7,65	3,30	1,35	1,90	0,78	1,49	1,60	1,70
M 350 - 50 A	0,50	7,65	3,50	1,50	2,01	0,86	1,50	1,60	1,70
M 400 - 50 A	0,50	7,70	4,00	1,70	2,30	0,98	1,53	1,63	1,73
M 470 - 50 A	0,50	7,70	4,70	2,00	2,70	1,15	1,54	1,64	1,74
M 530 - 50 A	0,50	7,70	5,30	2,30	3,05	1,32	1,56	1,65	1,75
M 600 - 50 A	0,50	7,75	6,00	2,60	3,45	1,49	1,57	1,66	1,76
M 700 - 50 A	0,50	7,80	7,00	3,00	4,02	1,72	1,60	1,69	1,77
M 800 - 50 A	0,50	7,80	8,00	3,60	4,60	2,07	1,60	1,70	1,78
M 400 - 65 A	0,65	7,65	4,00	1,70	2,30	0,98	1,52	1,62	1,72
M 470 - 65 A	0,65	7,65	4,70	2,00	2,70	1,15	1,53	1,63	1,73
M 530 - 65 A	0,65	7,70	5,30	2,30	3,05	1,32	1,54	1,64	1,74
M 600 - 65 A	0,65	7,75	6,00	2,60	3,45	1,49	1,56	1,66	1,76
M 700 - 65 A	0,65	7,75	7,00	3,00	4,02	1,72	1,57	1,67	1,76
M 800 - 65 A	0,65	7,80	8,00	3,60	4,60	2,07	1,60	1,70	1,78

Typical magnetic properties of CSC conventional grades

Grade	Iron Loss (W/Kg)								
	W10/50	W15/50	W10/60	W15/60	W15/100	W15/200	W10/400	W5/2000	W2/5000
35CS210	0,79	1,99	1,00	2,51	4,96	13,43	15,75	53,99	44,09
35CS230	0,88	2,08	1,11	4,96	5,14	13,87	16,72	56,60	46,02
35CS250	0,98	2,31	1,24	13,43	5,73	15,31	18,19	59,84	48,70
35CS300	1,08	2,46	1,35	2,63	5,86	15,32	18,17	58,44	47,37
35CS440	1,34	2,92	1,66	5,14	6,89	17,76	21,59	68,11	54,40
35CS550	1,63	3,69	2,02	13,87	8,63	21,94	24,99	72,41	54,80
50CS230	1,00	2,28	1,28	2,93	6,06	17,76	22,64	75,14	56,26
50CS250	1,00	2,30	1,28	2,95	6,10	17,94	22,70	75,48	57,19
50CS270	1,06	2,36	1,36	5,73	6,23	18,15	23,82	80,95	61,77
50CS290	1,18	2,60	1,50	15,31	6,91	20,26	26,31	89,51	67,51
50CS350	1,23	2,66	1,57	3,08	7,16	21,25	27,52	92,69	70,73
50CS400	1,34	2,98	1,70	5,86	7,82	22,78	28,69	96,11	74,40
50CS470	1,65	3,63	2,07	15,32	9,19	25,96	31,67	98,14	73,61
50CS470C	1,39	3,19	1,78	3,63	8,57	25,59	32,44	108,30	73,16
50CS600	1,88	4,23	2,38	6,89	11,02	32,13	38,63	123,05	86,12
50CS700	2,05	4,49	2,57	17,76	11,34	31,99	38,12	113,02	80,27
50CS800	2,17	4,71	2,70	4,59	11,72	32,52	39,06	116,52	80,51
50CS1000	2,51	5,42	3,15	8,63	14,00	40,64	48,39	139,83	93,93
50CS1300	2,87	5,88	3,60	21,94	14,74	41,21	50,78	151,71	102,70
65CS470	1,65	3,67	2,21	2,95	10,54	33,38	45,77	153,14	108,04
65CS600	2,11	4,80	2,73	6,10	13,81	44,41	54,93	173,43	108,15
65CS700	2,00	4,57	2,59	17,94	13,30	43,15	54,52	173,30	109,10
65CS800	2,33	5,18	2,99	3,02	14,47	45,22	56,44	175,54	112,56
65CS1300	2,89	6,28	3,64	8,01	16,46	48,52	58,57	172,31	109,04

Grade	Magnetic Flux Density (T)								
	B1	B3	B5	3,33	B25	B50	B100	B200	B300
35CS210	1,108	1,339	1,394	1,459	1,559	1,662	1,793	1,925	1,974
35CS230	1,043	1,339	1,398	1,470	1,568	1,668	1,794	1,926	1,973
35CS250	1,013	1,338	1,380	1,471	1,568	1,666	1,793	1,932	1,988
35CS300	0,989	1,366	1,370	1,497	1,588	1,679	1,801	1,941	2,005
35CS440	0,908	1,411	1,482	1,550	1,638	1,721	1,830	-	-
35CS550	0,763	1,379	1,449	1,516	1,604	1,690	1,809	1,963	2,048
50CS230	1,041	1,349	1,407	1,472	1,569	1,665	1,787	1,912	1,959
50CS250	0,918	1,338	1,404	1,473	1,570	1,667	1,789	1,916	1,963
50CS270	1,073	1,366	1,421	1,484	1,580	1,675	1,794	1,920	1,966
50CS290	0,840	1,335	1,420	1,498	1,596	1,688	1,804	-	-
50CS350	0,907	1,395	1,464	1,533	1,625	1,714	1,825	-	-
50CS400	0,901	1,395	1,469	1,539	1,630	1,715	1,823	-	-
50CS470	0,779	1,404	1,481	1,554	1,645	1,727	1,834	-	-
50CS470C	0,909	1,339	1,419	1,497	1,596	1,685	1,803	-	-
50CS600	0,744	1,371	1,450	1,531	1,629	1,714	1,824	-	-
50CS700	0,488	1,403	1,490	1,566	1,656	1,738	1,848	-	-
50CS800	0,336	1,361	1,472	1,561	1,655	1,737	1,847	-	-
50CS1000	0,288	1,410	1,505	1,584	1,674	1,757	1,866	-	-
50CS1300	0,215	1,211	1,433	1,567	1,672	1,757	1,867	-	-
65CS470	0,788	1,322	1,434	1,529	1,634	1,722	1,828	-	-
65CS600	0,668	1,372	1,461	1,543	1,645	1,731	1,839	-	-
65CS700	0,688	1,355	1,444	1,529	1,624	1,707	1,819	-	-
65CS800	0,454	1,368	1,474	1,565	1,662	1,744	1,851	-	-
65CS1300	0,164	1,308	1,459	1,563	1,665	1,750	1,859	-	-

Typical mechanical properties of CSC Conventional grades

Grade	Yield strength (N/mm ²)	Tensile strength (N/mm ²)	Elongation (%)
	Average	Average	Average
35CS210	413	533	17
35CS230	419	541	19
35CS250	377	514	23
35CS300	330	473	26
35CS440	285	439	32
35CS550	270	424	35
50CS230	450	564	15
50CS250	427	554	22
50CS270	421	546	21
50CS290	378	516	26
50CS350	332	478	29
50CS400	309	463	29
50CS470	281	438	35
50CS470C	283	443	33
50CS600	260	419	36
50CS700	270	404	38
50CS800	277	412	37
50CS1000	315	420	38
50CS1300	299	409	37
65CS400	334	480	31
65CS470	310	464	33
65CS600	239	409	37
65CS800	265	424	37
65CS1300	314	444	36

Typical magnetic properties of CSC High Permeability grades

Grade	Iron Loss (W/Kg)								
	W10/50	W15/50	W10/60	W15/60	W15/100	W15/200	W10/400	W5/2000	W2/5000
35CS250H	0,99	2,20	1,24	2,77	5,49	14,90	18,78	63,52	51,83
35CS300H	1,06	2,34	1,34	2,96	5,90	16,25	21,15	70,64	57,33
50CS290H	1,17	2,59	1,50	3,34	7,05	21,06	26,93	94,96	71,63
50CS350H	1,24	2,72	1,59	3,50	7,41	22,25	28,50	95,48	72,27
50CS470H	1,62	3,47	2,03	4,40	8,88	25,38	31,63	100,08	72,56
50CS600H	1,79	3,96	2,28	5,08	10,59	31,62	38,45	119,06	82,60
65CS470H	1,59	3,41	2,06	4,45	9,76	30,95	40,55	134,30	92,57

Grade	Magnetic Flux Density (T)								
	B1	B3	B5	B10	B25	B50	B100	B200	B300
35CS250H	1,049	1,396	1,458	1,524	1,616	1,707	1,821	-	-
35CS300H	1,030	1,405	1,473	1,540	1,633	1,724	1,839	-	-
50CS290H	1,008	1,397	1,459	1,525	1,616	1,707	1,821	-	-
50CS350H	1,041	1,415	1,476	1,541	1,631	1,719	1,830	-	-
50CS470H	0,606	1,384	1,482	1,564	1,657	1,740	1,846	-	-
50CS600H	0,845	1,399	1,482	1,565	1,674	1,760	1,863	-	-
65CS470H	0,720	1,373	1,463	1,542	1,640	1,727	1,835	-	-

Typical mechanical properties of CSC High Permeability grades

Grade	Yield strength (N/mm ²)	Tensile strength (N/mm ²)	Elongation (%)
	Average	Average	Average
35CS250H	330	470	25
35CS300H	342	465	22
50CS290H	341	465	25,1
50CS350H	311	444	29,3
50CS470H	284	438	35
50CS600H	242	388	37
65CS470H	261	416	38

CSC's EV Grades count for the excellence

Since 2014 CSC developed thin gage Electrical Steel grades and became the pioneer supplier for e-mobility car makers collecting a unique experience.

Today, CSC counts for the excellence in this field, it has developed various grades to respond to the specific requirements of each motor type, specifically higher strength with low iron losses for Permanent Magnet Motors and ultra-high magnetic flux field 5000 A for the application in Induction Motors.

One of the latest development is 25CS1100AFY designed for PM, which offers ultra-high strength as 534 MPa for rotors and very low iron loss 10.7 W/Kg at T1.0/400Hz for stators after SRA.

Customized grades can be developed on demand.

Electrical Steel for e-mobility and high frequencies according to EN 10303

Grade	Thickness mm	Iron loss (W/Kg)		Flux density	Mechanical Strength	
		T 1,0/400 Hz		B50 (T)	YS (MPa)	TS (MPa)
NO 20-13	0,20	13		1,58	390	470
NO 20-15	0,20	15		1,59	320	430
NO 25-14	0,25	14		1,59	390	470
NO 25-17	0,25	17		1,60	320	430
NO 27-15	0,27	15		1,59	370	450
NO 27-18	0,27	18		1,60	320	430
NO 30-16	0,30	16		1,59	370	450
NO 30-19	0,30	19		1,60	320	430
NO 35-19	0,35	19		1,60	370	450
NO 35-22	0,35	22		1,60	320	430

Top CSC Electrical Steel grades for EV

Grade	Thickness mm	Iron loss (W/Kg)		Flux density	Mechanical Strength	
		W 15/50	W 10/400	B50 (T)	YS (MPa)	TS (MPa)
20CS1150FY	0,20	1,9	10,3	1,64	477	579
20CS1200FY	0,20	2,1	11,3	1,65	439	544
20CS1200HF	0,20	2,1	11,5	1,64	400	495
25CS1200FY	0,25	1,9	11,6	1,64	475	589
25CS1250FY	0,25	2,0	12,2	1,66	430	533
25CS1250HF	0,25	2,0	12,2	1,66	408	517
25CS2000P	0,25	2,6	16,4	1,75	256	388
27CS1300FY	0,27	1,9	11,9	1,65	447	548
27CS1450FY	0,27	1,9	12,3	1,64	454	556
27CS1450HF	0,27	2,0	12,9	1,66	427	532
27CS2000P	0,27	2,5	17,0	1,75	264	385
30CS1500FY	0,30	2,0	13,8	1,66	423	545
30CS1800HF	0,30	2,2	15,3	1,68	360	470
30CS2000P	0,30	2,8	19,3	1,75	265	400
35CS210	0,35	2,0	15,8	1,66	425	535
35CS250	0,35	2,1	16,7	1,68	389	515

FY = frequency and yield - HF = high frequency - P = high permeability

1. High strength & low iron loss

Grade	Thickness mm	Iron loss (W/Kg)		Flux density	Mechanical Strength		
		W 15/50	W 10/400	B50 (T)	YS (MPa)	TS (MPa)	
25CS1200FY	0,25	1,9	11,6	1,64	475	589	extremely lower iron loss and excellent strength
25CS1250FY	0,25	2,0	12,2	1,66	430	533	higher strength compared with 25CS1250HS
25CS1250HF	0,25	2,0	12,2	1,66	408	517	the iron loss keep the same level with 12.2 and yield strength increase from 408 to 430 Mpa

For the application of permanent magnetic motor, we develop ES with higher strength and keep the low iron loss. At the same thickness (2.5 mm) we can provide various options in mass production

2. High flux density

Grade	Thickness mm	Iron loss (W/Kg)		Flux density	Mechanical Strength		
		W 15/50	W 10/400	B50 (T)	YS (MPa)	TS (MPa)	
25CS2000P	0,25	2,6	16,4	1,75	256	388	the products with ultra high magnetic flux density (B50) have already been developed for mass production. The magnetic induction of these products is at significantly high level (1.7 T) and iron loss could be improved by thickness reduction
27CS2000P	0,27	2,5	17,0	1,75	264	385	
30CS2000P	0,30	2,8	19,3	1,75	265	400	
25CS1250HF	0,25	2,0	12,2	1,66	408	517	

For the application of induction motor, we develop ES with ultra-high magnetic flux density to 1.75 T under magnetic field 5000 A

3. Advanced design for next generation

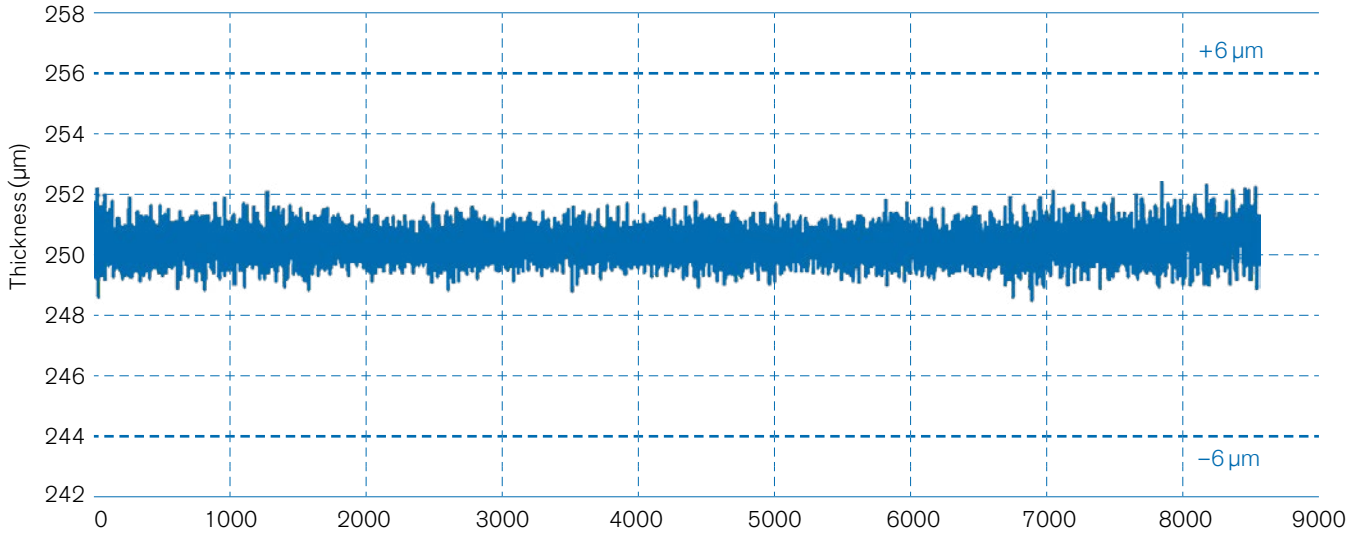
Grade	Thickness mm	Iron loss (W/Kg)		Flux density	Mechanical Strength		
		W 15/50	W 10/400	B50 (T)	YS (MPa)	TS (MPa)	
20CS1150FY	0,20	1,9	10,3	1,64	477	579	The core loss at high frequency would be strongly enhanced by thickness reduction, and the strength(YS & TS) can also fit the demands of EV motors
25CS1100AFY	0,25	3,1	15,3	1,66	534	639	Before SRA, ultra-high strength for rotor
		1,9	10,7	1,64	–	–	After SRA, extremely low loss for stator
25CS1250HF	0,25	2,0	12,2	1,66	408	517	

CSC persistently work-on to optimize the magnetic properties of ES and try to provide the material for next generation. So far, we can make material with thickness 0.2mm, iron loss < 11.5, YS higher than 450 MPa. We also develop the grade 25CS1100AFY especially for PM, which is ultra-high YS as 534 MPa for rotor and iron loss reach 10.7 for stator once after SRA (Stress Relief Annealing, at 750/850°C for 1~2 hr)

1. Thickness deviation in length

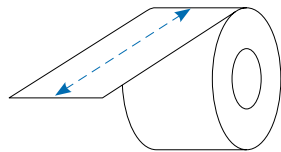
The thickness deviation parallel to rolling direction is normally within $\pm 3.0 \mu\text{m}$ (in central line).
Beyond the central line, the edge drop takes effect, which enlarges the deviation

Center thickness of coil 3520796



Guaranteed variation (μm)

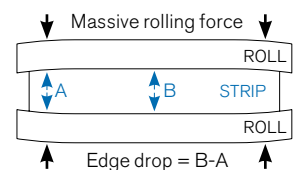
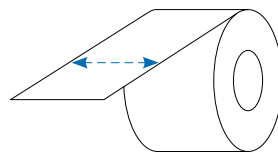
35CS250	350 ± 8
30CS1500FY	300 ± 7
27CS1450FY	270 ± 7
25CS1250FY	250 ± 6
20CS1200FY	200 ± 5



2. Thickness deviation in width (μm)

Edge drop statistic data of 25CS1250HF

Position	Direction	Average	Std. EV	Max
DC15	L	2,10	0,87	4,84
	R	2,90	1,17	5,84
DC25	L	2,06	0,76	4,36
	R	2,89	1,05	5,49



DC15: Difference between Center & 15mm from the side. The variance of thickness perpendicular to rolling direction is mainly caused by edge drop, because of deformation of rolls during rolling. The distribution value of 25CS1250HF edge drop (DC15) is $0 \sim 6 \mu\text{m}$

Coating type and properties

Besides the Electrical Steel, CSC also develops the surface coating material by its own.

	Coating			
	C628	C6N8	G1MN	C3S1 Self-Bonding coating
Coating type	ASTM A976: C5	ASTM A976: C5	ASTM A976: C5	ASTM A976: C3
	IEC 60404-1-1: EC5	IEC 60404-1-1: EC5	IEC 60404-1-1: EC5	IEC 60404-1-1: EC3
	EN 10342: EC5	EN 10342: EC5	EN 10342: EC5	EN 10342: EC3
Composition	Chromate + resin	Phosphate + resin	Rembrandtin EB5350s	Resin
Coating thickness	Normal: 0.6 μm	Normal: 0.6 μm	1.0 μm	Normal: 1.5 μm
	Heavy: 1.0 μm	Heavy: 1.0 μm		Heavy: 2.0-3.5 μm
Surface resistance (JIS C2550)	Normal: $\geq 5 \Omega \text{ cm}^2/\text{s}$	Normal: $\geq 5 \Omega \text{ cm}^2/\text{s}$	$\geq 15 \Omega \text{ cm}^2/\text{s}$	Normal: $\geq 8 \Omega \text{ cm}^2/\text{s}$
	Heavy: $\geq 10 \Omega \text{ cm}^2/\text{s}$	Heavy: $\geq 10 \Omega \text{ cm}^2/\text{s}$		Heavy: $\geq 30 \Omega \text{ cm}^2/\text{s}$
Stacking factor (ASTM A719)	Normal: > 97.5%	Normal: > 97.5%	> 97%	Normal: > 97%
	Heavy: > 97%	Heavy: > 97%		Heavy: > 96%
Bonding strength (ASTM D1002)	Not available	Not available	Not available	Normal: > 2 MPa
				Heavy: > 5 MPa

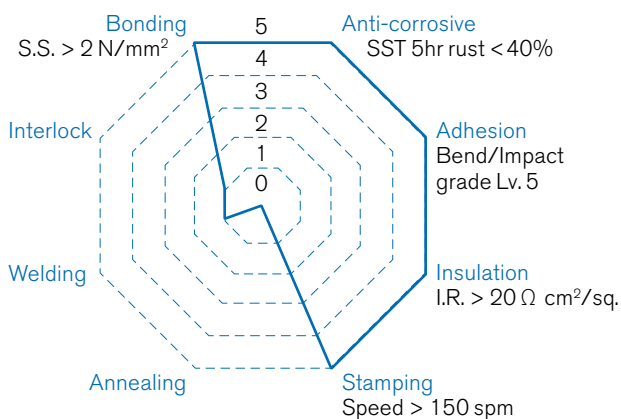
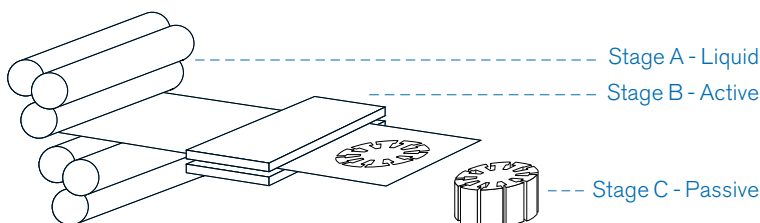
We provide the coating C628 or C6N8 for most of our Electrical Steels. C6N8 is combination of phosphate and resin which is Cr-free, but both C628 and C6N8 match the REACH and RoHS regulation of EU. We also provide G1MN which is Rembrandtin EB5350S for European market. To improve efficiency for thin gauge Electrical Steel we developed the Self-Bonding coating C3S1. The coating thickness could be ultra-thin as 1.5 μm and reach bonding strength higher than 2 MPa.

Self-Bonding coating technology

Magnetic flux is crucial to motors and generators efficiency. Our thin self-bonding coating technology allows to bond electrical steel laminations with a very high stacking factor > 97% without damaging the magnetic flux as it happens when traditional bonding technics such as interlocking, welding or riveting are used. In addition, this technology minimizes noise and vibrations. With our "Rapid" C3S1 you have quick stamping, low production cost (it bonds in 60 sec), high dimensional precision of motor cores, and high bonding force.

Self-Bonding coating C3S1

Category	ASTM A976 C - organic based coating
Content	Waterborne epoxy resin
Highlights	Stage A Application of coating by ACL coater
	Stage B Drying of coating in continuous furnace
	Stage C Thermal curing of coating for laminations



Self-Bonding coating	General type	Rapid C3S1
Applications	Wind turbine, Maglev...	EV motor, compressor...
Coat thickness	5,0 \pm 1,0 μm	1,5 \pm 0,3 μm
Recommended curing process	Oven baking	In-die induction heating Out-die induction heating
Thermal curing conditions	Temperature: 200 $^{\circ}\text{C}$ Pressure: 1~3 N/mm ² Time: 90 min	Temperature: 150~250 $^{\circ}\text{C}$ Pressure: 1~3 N/mm ² Time: < 1 min
Bonding str. (shear stress)	> 5 N/mm ² (typical 15)	> 2 N/mm ² (typical 10~15)



Ardemagni



Ardemagni S.p.A.
via Monfalcone, 25
20092 Cinisello Balsamo
Milano, Italy

phone +39 02 618 1227
info@ardemagnispa.com
c.f./p.i. vat IT05974550963
www.ardemagnispa.com
www.linkedin.com/company/
ardemagni-spa/