posco

ELECTRICAL STEEL

Electrical steels have excellent electro-magnetic properties. There are two types of electrical steel: grain-oriented and non grain-oriented electrical steel. Today, as the needs to reduce energy loss are increasing sharply, demands for high quality electrical steel are also growing. POSCO produces 1 million tons of high quality electrical steel each year.

Contents

ELECTRICAL STEEL

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Pohang & Gwangyang steelworks

Upon completion of its first-phase manufacturing facility in 1973, Pohang Steelworks, Korea's first integrated steel mill, was finally completed after 4 stages of construction at Young-il Bay in February 1981.
POSCO is capable of producing and processing a variety of carbon steels and stainless steels. The company's global competitiveness was further enhanced when we opened the world's first FINEX commercialization facility in May 2007.

Main products hot-rolled steel, plate, cold-rolled steel, wire rod, electrical steel, stainless steel, API steel, etc.
Crude steel production 16,185 million tons (as of 2013)

Gwangyang Steelworks is the world's largest integrated steel mill. It features an optimal plant layout with carbon steel processing and high-mill processing capabilities, producing automotive steel, high-strength hot rolled steel, high-quality API steel, and thick plates among other products.
With the goal of specializing in the manufacturing of the world's best automotive steels, Gwangyang Steelworks focuses on enhancing its competitive edge.

Main products hot-rolled steel, plate, cold-rolled steel, car steel, API steel, etc.
Crude steel production 20,231 million tons (as of 2013)

The POSCO Quality

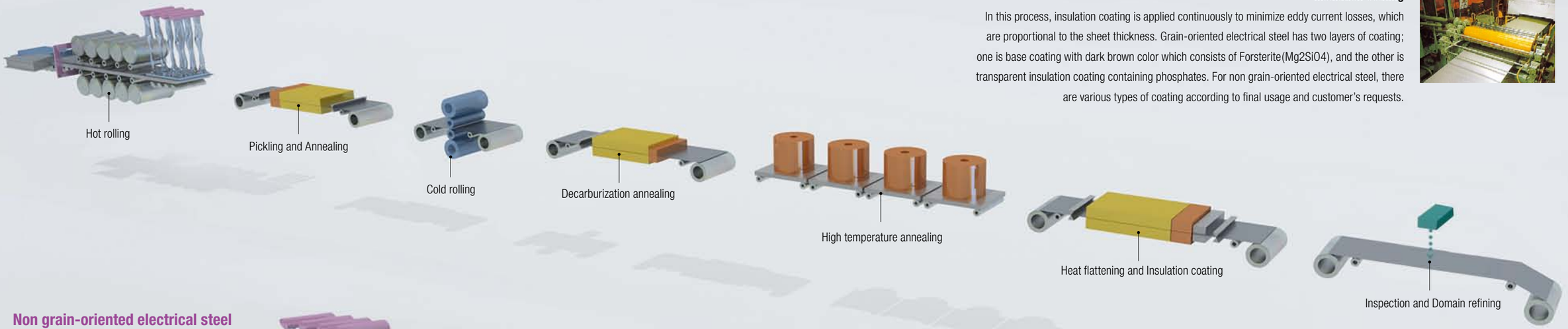
Ultra-High Quality Products Which Touch the Customer's Soul

- **Customer Inside**: We create the best value for customers by keeping their needs foremost.
- **Basic Inside**: We focus on fundamentals and principles, eliminating deviation and waste.
- **Synergy Inside**: We seek to grow alongside our supplier chain through trust and communications.

Manufacturing processes & equipment

Cutting-edge facilities and state-of-art technologies enable us to meet customer's request for high quality products. Every process is controlled automatically to keep the best quality of products.

Grain-oriented electrical steel



Annealing

Annealing is a recrystallizing process of hardened cold rolled structures by heat treatment. There are two annealing processes for grain-oriented electrical steel : decarbonization and high temperature annealing. During decarbonization annealing, excess carbon in the steel is removed and MgO coating is applied on the surface of the steel. High temperature annealing produces secondary recrystallized structures having superior magnetic properties. Non grain-oriented electrical steel is recrystallized and insulation coating is applied during annealing process.

Insulation Coating

In this process, insulation coating is applied continuously to minimize eddy current losses, which are proportional to the sheet thickness. Grain-oriented electrical steel has two layers of coating; one is base coating with dark brown color which consists of Forsterite(Mg2SiO4), and the other is transparent insulation coating containing phosphates. For non grain-oriented electrical steel, there are various types of coating according to final usage and customer's requests.

Non grain-oriented electrical steel

Preliminary Annealing

In this process, scales on the surface of hot rolled coil are removed by scale breaker and hydrochloric acid cleaning. This process improves cold rolling properties of steel as well as it's magnetic properties.

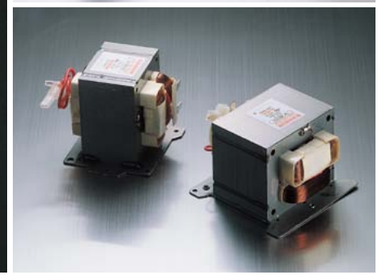
Cold Rolling

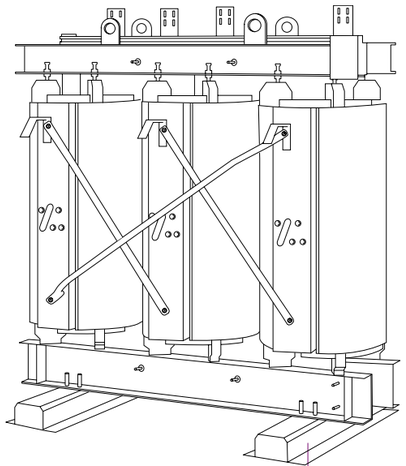
In order to obtain specific thickness and material properties, cold rolling process should be conducted. For uniform thickness and width of strip, this process is controlled automatically.

Specification

		Grain-Oriented			Non-Oriented						
					PN-Core			PNM-Core	PNA-Core	PNS-Core	PNF-Core
		PHD-Core	PH-Core	PG-Core	PN210 -400	PN440 -700	PN800 -1300	PNM500 -540	PNA300 -450	PNS250	PNF1500
Rotating Machines	Large rotating machine			●	●					●	
	Medium rotating machine				●	●			●	●	
	General use AC motor					●	●		●		●
	Compressor motor				●	●	●		●	●	
	Hybrid/Electric Vehicle motor				●					●	●
Static Machines	Large size transformer	●	●	●							
	Small & medium size transformer	●	●	●	●						
	Distribution transformer	●	●	●							
	Reactor & magnetic amplifier	●	●	●	●						
	Small power transformer	●	●	●	●	●	●		●		
	Voltage transformer	●	●	●	●						
	Ballast stabilizer				●	●	●		●		
	Welding transformer					●					
	Magnetic switch core							●			

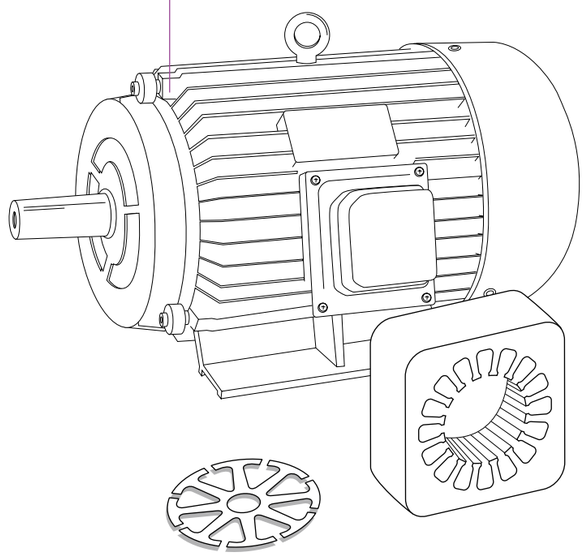
Main Application





Transformer Core

Motor core



Grain-oriented electrical steel

PG-Core

PG-core has excellent magnetic properties in the rolling direction. It is widely used for large or mid/small-size transformers.

■Standard Size

Product	Grade	Thickness in. (mm)	Width in. (mm)		Internal diameter in. (mm)
			Available	Standard	
PG-Core	27PG 120	0.0106 (0.27)	33.46~47.24 (850~1200)	39.37 (1000) 47.24 (1200)	20 (508)
	27PG 130				
	30PG 120	0.0118 (0.30)			
	30PG 130				
	35PG 145	0.0138 (0.35)			
	35PG 155				

Note) For non-standard sizes, please contact us.

■Specification

Magnetic properties and lamination factors

Grade	Equivalent ASTM Grade	Density (kg/dm³)	Max Core Loss, W/lb (W/kg)		Magnetic Flux Density.Min T(B8)	Lamination Factor, Min(%)
			1.7T/50Hz	1.7T/60Hz		
27PG 120	27H074	7.65	0.54 (1.20)	0.74 (1.63)	1.80	95.0
27PG 130	-		0.59 (1.30)	0.76 (1.67)		
30PG 120	-		0.54 (1.20)	0.74 (1.63)		95.5
30PG 130	30H083		0.59 (1.30)	0.79 (1.73)		
35PG 145	-		0.66 (1.45)	0.92 (2.03)		96.0
35PG 155	35H094		0.70 (1.55)	0.94 (2.07)		

Note) Above test is conducted in accordance with IEC60404-2 (or JIS C 2550-1). B8 indicates the magnetic flux density at 800A/m. Core loss and magnetic flux density are measured after stress relief annealing and speciemen is parallel to the rolling direction. (Annealing condition: 840°C, 1Hr, non-oxidation atmosphere)

■Dimension & Shape Tolerance

Width in. (mm)	Thickness in. (mm)	Thickness Tolerance in. (mm)	Thickness deviation in Width in. (mm)	Width Tolerance in. (mm)	Camber (Length: 2m) in. (mm)
33.46 (850) and over	0.0106 (0.27)	±0.0012 (0.03)	0.0012 (0.03) and under	+0.0236 (0.6)	0.0394 (1.0) and under
	0.0118 (0.30)				
	0.0138 (0.35)				

Note) Thickness deviation in width means the gap between the thickness of center and the one section 15mm away from the edge part.

■Typical Electrical and Magnetic Properties

Grade	Resistivity Ω·m (×10⁻⁸)	Core Loss, W/lb (W/kg)				Magnetic Flux Density. T(B8)
		1.5T/50Hz	1.7T/50Hz	1.5T/60Hz	1.7T/60Hz	
27PG 120	48	0.35 (0.78)	0.52 (1.15)	0.46 (1.02)	0.67 (1.48)	1.85
27PG 130		0.37 (0.82)	0.55 (1.22)	0.49 (1.07)	0.70 (1.55)	1.84
30PG 120		0.38 (0.83)	0.53 (1.17)	0.49 (1.09)	0.69 (1.53)	1.85
30PG 130		0.40 (0.87)	0.57 (1.25)	0.51 (1.12)	0.73 (1.61)	1.84
35PG 145		0.44 (0.98)	0.62 (1.37)	0.59 (1.29)	0.82 (1.80)	1.84
35PG 155		0.46 (1.01)	0.66 (1.45)	0.61 (1.33)	0.86 (1.89)	1.83

Note) Above values are not guaranteed. Tests are conducted in accordance with IEC 60404-2 (or JIS C 2550-1) method. Specimen is parallel to the rolling direction and annealed for magnetic properties.

■Typical Mechanical Property and Lamination Factor

Thickness in. (mm)	Tensile Strength(N/mm²)		Yield Point(N/mm²)		Elongation(%)		Hardness Hv1	Lamination Factor(%)
	L	C	L	C	L	C		
0.0106 (0.27)	344	385	322	340	11	44	182	97.5
0.0118 (0.30)	345	412	330	350	12	49	180	98.0
0.0138 (0.35)	364	423	345	357	10	40	181	98.4

Note) 1. Tests are conducted in accordance with JIS Z 2241 and 2244.
2. L: Specimen is parallel to the rolling direction / C: Specimen is transverse to the rolling direction.
3. Specimens with 0A coating are used for lamination factor test.

Grain-oriented electrical steel

PH-Core

Through highly advanced texture control technologies, PH-core has superior magentic properties. This is widely used for energy efficient transformer.

■Standard Size

Product	Grade	Thickness in. (mm)	Width in. (mm)		Inside diameter mm (in.)
			Available	Standard	
PH-Core	23PH 085	0.0091 (0.23)	33.46~47.24 (850~1200)	39.37 (1000) 47.24 (1200)	20 (508)
	23PH 090				
	23PH 095				
	27PH 090	0.0106 (0.27)			
	27PH 095				
	27PH 100				
	30PH 100	0.0118 (0.30)			
	30PH 105				

Note) For non-standard sizes, please contact us

■Specification

Magnetic properties and lamination factors

Grade	Equivalent ASTM Grade	Density (kg/dm³)	Max Core Loss, W/lb (W/kg)		Magnetic Flux Density.Min T(B8)	Lamination Factor, Min(%)
			1.7T/50Hz	1.7T/60Hz		
23PH 085	-	7.65	0.39 (0.85)	0.53 (1.17)	1.88	94.5
23PH 090	-		0.41 (0.90)	0.57 (1.26)		
23PH 095	23P060		0.43 (0.95)	0.59 (1.28)		
27PH 090	-		0.41 (0.90)	0.56 (1.23)		95.0
27PH 095	-		0.43 (0.95)	0.59 (1.30)		
27PH 100	27P066		0.45 (1.00)	0.61 (1.35)		
30PH 100	-		0.45 (1.00)	0.64 (1.40)		95.5
30PH 105	-		0.48 (1.05)	0.66 (1.45)		

Note) Above test is conducted in accordance with IEC60404-2 (or JIS C 2550-1). B8 indicates the magnetic flux density at 800A/m. Core loss and magnetic flux density are measured after stress relief annealing and speciemen is parallel to the rolling direction. (Annealing condition: 840°C, 1Hr, non-oxidation atmosphere)

■Dimension & Shape Tolerance

Width in. (mm)	Thickness in. (mm)	Thickness Tolerance in. (mm)	Thickness deviation in Width in. (mm)	Width Tolerance in. (mm)	Camber (Length: 2m) in. (mm)
33.46 (850) and over	0.0091 (0.23)	±0.0008 (0.02)	0.0008 (0.02) & under	+0.0236 (0.6)	0.0394 (1.0) & under
	0.0106 (0.27)	±0.0012 (0.03)	0.0012 (0.03) & under		
	0.0118 (0.30)				

Note) Thickness deviation in width means the gap between the thickness of center and the one section 15mm away from the edge part.

■Typical Electrical and Magnetic Properties

Grade	Resistivity Ω·m (×10⁻⁸)	Core Loss, W/lb (W/kg)				Magnetic Flux Density. T(B8)
		1.5T/50Hz	1.7T/50Hz	1.5T/60Hz	1.7T/60Hz	
23PH 085	48	0.28 (0.62)	0.38 (0.83)	0.37 (0.81)	0.49 (1.09)	1.91
23PH 090		0.29 (0.64)	0.40 (0.88)	0.38 (0.84)	0.52 (1.14)	1.91
23PH 095		0.30 (0.65)	0.41 (0.90)	0.39 (0.86)	0.53 (1.17)	1.91
27PH 090		0.30 (0.67)	0.40 (0.88)	0.40 (0.88)	0.52 (1.16)	1.91
27PH 095		0.32 (0.70)	0.42 (0.93)	0.42 (0.92)	0.55 (1.22)	1.91
27PH 100		0.32 (0.71)	0.44 (0.96)	0.42 (0.93)	0.57 (1.26)	1.90
30PH 100		0.34 (0.74)	0.45 (0.99)	0.44 (0.98)	0.59 (1.29)	1.91
30PH 105		0.35 (0.76)	0.46 (1.01)	0.45 (1.00)	0.60 (1.33)	1.90

Note) Above values are not guaranteed. Tests are conducted in accordance with IEC 60404-2 (or JIS C 2550-1) method. Specimen is parallel to the rolling direction and annealed for magnetic properties.

■Typical Mechanical Property and Lamination Factor

Thickness in. (mm)	Tensile Strength(N/mm²)		Yield Point(N/mm²)		Elongation(%)		Hardness Hv1	Lamination Factor(%)
	L	C	L	C	L	C		
0.0091 (0.23)	381	424	356	383	14	42	183	97.0
0.0106 (0.27)	361	415	337	367	14	42	182	97.5
0.0118 (0.30)	345	412	330	358	16	45	184	98.0

Note) 1. Tests are conducted in accordance with JIS Z 2241 and 2244.
2. L: Specimen is parallel to the rolling direction / C: Specimen is transverse to the rolling direction.
3. Specimens with 0A coating are used for lamination factor test.

Grain-oriented electrical steel

PHD-Core

PHD-core has excellent magnetic properties by domain refining technologies which can achieve significant loss reduction.

■Standard Size

Product	Grade	Thickness in. (mm)	Width in. (mm)		Inner diameter in. (mm)
			Available	Standard	
PHD-Core	23PHD080	0.0091 (0.23)	33.46~47.24 (850~1200)	39.37 (1000) 47.24 (1200)	20 (508)
	23PHD085				
	23PHD090				
	27PHD085	0.0106 (0.27)			
	27PHD090				
	27PHD095				
	30PHD095	0.0118 (0.30)			
	30PHD100				

Note) For non-standard sizes, please contact us

■Specification

Magnetic properties and lamination factors

Grade	Equivalent ASTM Grade	Density (kg/dm³)	Max Core Loss, W/lb (W/kg)		Magnetic Flux Density.Min T(B8)	Lamination Factor, Min(%)
			1.7T/50Hz	1.7T/60Hz		
23PHD080	-	7.65	0.36 (0.80)	0.52 (1.14)	1.88	94.5
23PHD085	-		0.39 (0.85)	0.53 (1.17)		
23PHD090	23Q054		0.41 (0.90)	0.54 (1.19)		
27PHD085	-		0.39 (0.85)	0.53 (1.17)		95.0
27PHD090	-		0.41 (0.90)	0.55 (1.22)		
27PHD095	27Q057		0.43 (0.95)	0.57 (1.26)		
30PHD095	-		0.43 (0.95)	0.59 (1.30)		95.5
30PHD100	-		0.45 (1.00)	0.62 (1.36)		

Note) 1. Above test is conducted in accordance with IEC60404-3 (or JIS C 2556-1996), using single sheet tester, without stress relief annealing.
2. Domain refining effect of PHD core will be nullified by annealing.
3. B8 indicates the magnetic flux density at 800A/m

■Dimension & Shape Tolerance

Width in. (mm)	Thickness in. (mm)	Thickness Tolerance in. (mm)	Thickness deviation in Width in. (mm)	Width Tolerance in. (mm)	Camber (Length: 2m) in. (mm)
33.46 (850) and over	0.0091 (0.23)	±0.0008 (0.02)	0.0008 (0.02) and under	+0.0236 (0.6)	0.0394 (1.0) and under
	0.0106 (0.27)	±0.0012 (0.03)	0.0012 (0.03) and under		
	0.0118 (0.30)				

Note) Thickness deviation in width means the gap between the thickness of center and the one section 15mm away from the edge part.

■Typical Electrical and Magnetic Properties

Grade	Resistivity Ω·m (×10⁻⁸)	Core Loss, W/lb (W/kg)				Magnetic Flux Density. T(B8)
		1.5T/50Hz	1.7T/50Hz	1.5T/60Hz	1.7T/60Hz	
23PHD080	48	0.26 (0.57)	0.35 (0.77)	0.34 (0.75)	0.46 (1.01)	1.91
23PHD085		0.27 (0.59)	0.36 (0.80)	0.35 (0.78)	0.48 (1.05)	1.91
23PHD090		0.28 (0.62)	0.38 (0.83)	0.36 (0.80)	0.49 (1.09)	1.91
27PHD085		0.28 (0.62)	0.37 (0.81)	0.38 (0.83)	0.48 (1.06)	1.91
27PHD090		0.29 (0.64)	0.38 (0.84)	0.39 (0.86)	0.50 (1.10)	1.91
27PHD095		0.30 (0.66)	0.41 (0.88)	0.39 (0.86)	0.54 (1.18)	1.91
30PHD095		0.31 (0.68)	0.42 (0.93)	0.41 (0.91)	0.56 (1.23)	1.91
30PHD100		0.32 (0.70)	0.43 (0.95)	0.42 (0.93)	0.57 (1.26)	1.91

Note) Above values are not guaranteed. Tests are conducted in accordance with IEC60404-3 (or JIS C 2556-1996) method, using as-sheared specimen which is parallel to the rolling direction, without stress relief annealing.

■Typical Mechanical Property and Lamination Factor

Thickness in. (mm)	Tensile Strength (N/mm²)		Yield Point(N/mm²)		Elongation(%)		Hardness Hv1	Lamination Factor(%)
	L	C	L	C	L	C		
0.0091 (0.23)	381	424	356	383	14	42	183	97.0
0.0106 (0.27)	361	415	337	367	14	42	182	97.5
0.0118 (0.30)	345	412	330	358	16	45	184	98.0

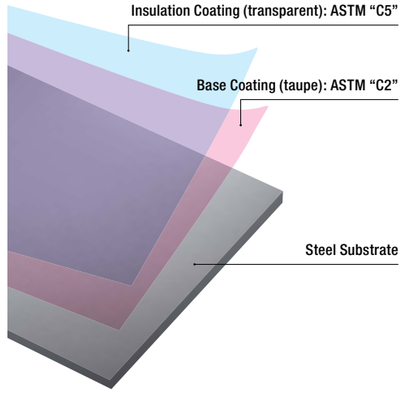
Note) 1. Tests are conducted in accordance with JIS Z 2241 and 2244.
2. L: Specimen is parallel to the rolling direction / C: Specimen is transverse to the rolling direction.
3. Specimens with 0A coating are used for lamination factor test.

■Insulation Coating

Coating Name		0A
ASTM Type		C-2+C-5
Composition		Inorganic(Phosphate Base)
Film thickness (Before SRA, μm)		2~5
*Resistivity (Ωcm²/sheet)	Before SRA	15
	After SRA	15
Annealing(in N_2 or DX rich gas)		Excellent
Heat resistance (flaking after SRA)	Continuous(155℃×24hr in Air.)	Not recogniozed
	Short(750℃×2hrs. in DX rich gas)	Not recogniozed
Adhesion (Before SRA)	Pipe bending	30 mmø
	*Cross cut	5B(Top level)
Anti-Corrosion / Weathering		Good
Weldability(TIG)		Excellent
Punchability		Excellent

* Tests are conducted in accordance with ASTM A 717. (SRA condition: 750℃ × 2hrs, in DX rich gas.)

POSCO insulation coating.



Non-oriented electrical steel

PN-Core

Non grain-oriented electrical steel has homogeneous magnetic properties in all directions. They are used as core materials in rotating machines, from tiny precision electric motors to large power generators.

■Standard Size

Product	Grade	Thickness in. (mm)	Width in. (mm)		Inner diameter in. (mm)
			Available	Standard	
PN-Core	35PN 210, 35PN 230, 35PN 250, 35PN 270, 35PN 300	0.0138 (0.35)	37.40~47.24 (950~1200)	39.37 (1000) 43.31 (1100) 47.24 (1200)	20 (508)
	50PN 250, 50PN 270, 50PN 290, 50PN 310, 50PN 350	0.0197 (0.50)			
	65PN 310, 65PN 350	0.0256 (0.65)			
	35PN 360, 35PN 440	0.0138 (0.35)	37.40~49.21 (950~1250)		
	50PN 400, 50PN 470, 50PN 600, 50PN 700, 50PN 800, 50PN 1000, 50PN 1300	0.0197 (0.50)			
	65PN 400, 65PN 470, 65PN 600, 65PN 700, 65PN 800, 65PN 1000, 65PN 1300	0.0256 (0.65)			

Note) For non-standard sizes, please contact us

■Dimension & Shape Tolerance

Width in. (mm)	Thickness in. (mm)	Thickness Tolerance in. (mm)	Thickness deviation in Width in. (mm)	Width Tolerance in. (mm)	Camber (Length: 2m) in. (mm)
39.37 (1000) and over	0.0138 (0.35)	±0.00138(0.035)	0.0008 (0.02) and under	+0.0591 (1.5)	0.0394 (1.0) and under
	0.0197 (0.50)	±0.00158(0.040)	0.0012 (0.03) and under		
	0.0256 (0.65)	±0.00205(0.052)	0.0016 (0.04) and under		

Note) Thickness deviation in width means the gap between the thickness of center and the one section 15mm away from the edge part.

■Specification

Magnetic properties and lamination factors

Grade	Equivalent ASTM Grade	Density (kg/dm³)	Max Core Loss, W/lb (W/kg)		Magnetic Flux Density.Min T(B50)	Lamination Factor, Min(%)
			1.5T/50Hz	1.5T/60Hz		
35PN 210	-	7.60	0.95 (2.10)	1.20 (2.63)	1.61	95.0
35PN 230	-	7.60	1.04 (2.30)	1.30 (2.86)	1.61	
35PN 250	36F145	7.60	1.13 (2.50)	1.42 (3.12)	1.62	
35PN 270	36F155	7.65	1.23 (2.70)	1.53 (3.37)	1.62	
35PN 300	36F175	7.65	1.36 (3.00)	1.69 (3.72)	1.62	
35PN 330	36F185	7.65	1.50 (3.30)	1.85 (4.08)	1.62	
35PN 360	36F205	7.65	1.63 (3.60)	2.01 (4.42)	1.63	
35PN 440	-	7.70	2.00 (4.40)	2.44 (5.37)	1.65	
50PN 250	-	7.60	1.13 (2.50)	1.46 (3.22)	1.62	96.0
50PN 270	-	7.60	1.23 (2.70)	1.57 (3.46)	1.62	
50PN 290	47F165	7.60	1.32 (2.90)	1.67 (3.69)	1.62	
50PN 310	47F180	7.65	1.41 (3.10)	1.79 (3.95)	1.62	
50PN 330	47F190	7.65	1.50 (3.30)	1.87 (4.12)	1.62	
50PN 350	47F200	7.65	1.59 (3.50)	1.97 (4.34)	1.62	
50PN 400	47F240	7.65	1.81 (4.00)	2.30 (5.07)	1.63	
50PN 470	47F280	7.70	2.13 (4.70)	2.70 (5.94)	1.64	
50PN 600	-	7.75	2.72 (6.00)	3.39 (7.47)	1.66	
50PN 700	47F400	7.80	3.18 (7.00)	3.95 (8.72)	1.70	
50PN 800	47F450	7.85	3.63 (8.00)	4.53 (9.99)	1.70	
50PN 1000	-	7.85	4.54 (10.0)	5.90 (13.0)	1.70	
50PN 1300	-	7.85	5.90 (13.0)	7.33 (16.2)	1.70	
65PN 310	-	7.60	1.41 (3.10)	1.82 (4.01)	1.62	97.0
65PN 350	64F200	7.60	1.59 (3.50)	2.03 (4.48)	1.62	
65PN 400	64F235	7.65	1.81 (4.00)	2.35 (5.18)	1.65	
65PN 470	64F275	7.70	2.13 (4.70)	2.72 (6.00)	1.65	
65PN 600	64F320	7.75	2.72 (6.00)	3.47 (7.66)	1.66	
65PN 700	-	7.80	3.18 (7.00)	4.11 (9.06)	1.70	
65PN 800	64F500	7.85	3.63 (8.00)	4.65 (10.2)	1.70	
65PN 1000	64F550	7.85	4.54 (10.0)	5.96 (13.2)	1.70	
65PN 1300	-	7.85	5.90 (13.0)	7.38 (16.3)	1.70	

Note) 1. Above test is conducted in accordance with IEC 60404-2 (or JIS C 2550-1), using as-sheared specimens taken one half parallel and one half transverse to the rolling direction.
2. W15/50 indicates the core loss at the frequency of 50 Hz and the magnetic flux density of 1.5T.
3. B50 indicates the magnetic flux density at 5000A/m

Non-oriented electrical steel

■Typical Electrical and Magnetic Property

Grade	Resistivity Ω·m (×10^{-8})	Core Loss, W/lb (W/kg)				Magnetic Flux Density, (T)	
		1.0T/50Hz	1.5T/50Hz	1.0T/60Hz	1.5T/60Hz	B25	B50
35PN 210	59	0.38 (0.84)	0.93 (2.04)	0.47 (1.03)	1.15 (2.53)	1.56	1.65
35PN 230	59	0.40 (0.89)	0.95 (2.10)	0.49 (1.07)	1.18 (2.60)	1.57	1.66
35PN 250	55	0.43 (0.96)	1.02 (2.25)	0.53 (1.17)	1.29 (2.85)	1.57	1.66
35PN 270	52	0.46 (1.02)	1.09 (2.40)	0.58 (1.28)	1.36 (3.00)	1.58	1.67
35PN 300	45	0.49 (1.08)	1.15 (2.53)	0.63 (1.38)	1.44 (3.18)	1.59	1.69
35PN 330	45	0.52 (1.14)	1.18 (2.60)	0.64 (1.42)	1.47 (3.24)	1.59	1.69
35PN 360	45	0.57 (1.25)	1.27 (2.80)	0.70 (1.55)	1.57 (3.45)	1.59	1.69
35PN 440	42	0.63 (1.39)	1.40 (3.08)	0.79 (1.73)	1.73 (3.82)	1.62	1.71
50PN 250	59	0.45 (1.00)	1.08 (2.37)	0.59 (1.31)	1.40 (3.08)	1.57	1.67
50PN 270	59	0.48 (1.05)	1.14 (2.50)	0.61 (1.35)	1.46 (3.22)	1.57	1.67
50PN 290	56	0.50 (1.09)	1.18 (2.60)	0.65 (1.45)	1.52 (3.35)	1.58	1.67
50PN 310	53	0.55 (1.21)	1.23 (2.70)	0.70 (1.55)	1.57 (3.46)	1.59	1.68
50PN 330	50	0.57 (1.26)	1.28 (2.82)	0.72 (1.59)	1.63 (3.60)	1.60	1.69
50PN 350	50	0.59 (1.30)	1.33 (2.93)	0.74 (1.63)	1.70 (3.74)	1.60	1.69
50PN 400	45	0.64 (1.41)	1.44 (3.18)	0.83 (1.82)	1.82 (4.01)	1.61	1.70
50PN 470	42	0.74 (1.64)	1.61 (3.55)	0.94 (2.06)	2.07 (4.56)	1.61	1.70
50PN 600	34	0.90 (1.98)	2.00 (4.40)	1.13 (2.49)	2.56 (5.63)	1.62	1.71
50PN 700	30	1.19 (2.62)	2.52 (5.55)	1.50 (3.30)	3.19 (7.03)	1.64	1.72
50PN 800	17	1.33 (2.93)	2.84 (6.26)	1.65 (3.63)	3.60 (7.94)	1.66	1.74
50PN 1000	17	1.45 (3.20)	3.09 (6.80)	1.86 (4.10)	3.91 (8.62)	1.67	1.75
50PN 1300	17	1.70 (3.75)	3.43 (7.56)	2.16 (4.75)	4.33 (9.54)	1.67	1.75
65PN 310	59	0.58 (1.27)	1.34 (2.95)	0.75 (1.65)	1.74 (3.83)	1.57	1.65
65PN 350	59	0.64 (1.40)	1.45 (3.20)	0.82 (1.80)	1.87 (4.12)	1.58	1.66
65PN 400	45	0.74 (1.63)	1.68 (3.70)	1.01 (2.23)	2.20 (4.85)	1.62	1.70
65PN 470	42	0.87 (1.91)	1.89 (4.16)	1.18 (2.59)	2.47 (5.45)	1.62	1.70
65PN 600	34	1.03 (2.27)	2.33 (5.14)	1.40 (3.09)	3.03 (6.68)	1.63	1.72
65PN 700	30	1.37 (3.02)	2.94 (6.47)	1.84 (4.06)	3.78 (8.33)	1.65	1.73
65PN 800	17	1.53 (3.38)	3.30 (7.28)	2.07 (4.56)	4.26 (9.39)	1.67	1.75
65PN 1000	17	1.65 (3.64)	3.57 (7.86)	2.27 (5.00)	4.60 (10.1)	1.68	1.75
65PN 1300	17	1.96 (4.32)	4.00 (8.79)	2.65 (5.83)	5.13 (11.3)	1.68	1.75

Note) Above values are not guaranteed. Tests are conducted in accordance with IEC 60404-2 (or JIS C 2550-1) method, using as-sheared specimens taken one half parallel and one half transverse to the rolling direction.

■Typical Mechanical Property and Lamination Factor

Grade	Tensile Strength(N/mm²)		Yield Point(N/mm²)		Elongation(%)		Hardness Hv1	Lamination Factor(%)
	L	C	L	C	L	C		
35PN 210	538	547	415	427	18	19	220	
35PN 230	535	545	393	403	19	20	216	
35PN 250	522	539	370	385	19	21	214	
35PN 270	467	485	347	361	21	23	190	97.5
35PN 300	456	469	336	351	21	23	188	
35PN 330	453	469	340	355	22	24	175	
35PN 360	450	470	350	366	23	25	170	
35PN 440	405	415	273	285	27	29	161	
50PN 250	550	570	413	426	20	22	223	
50PN 270	535	550	406	460	22	23	205	
50PN 290	510	530	370	386	23	25	195	
50PN 310	483	505	355	361	25	28	189	
50PN 330	475	492	348	358	25	28	190	
50PN 350	470	489	344	354	25	28	189	
50PN 400	465	482	352	365	27	30	183	98.0
50PN 470	415	420	275	285	34	36	160	
50PN 600	395	405	268	278	37	39	130	
50PN 700	385	395	270	280	38	39	120	
50PN 800	375	385	270	280	39	40	115	
50PN 1000	370	380	265	275	40	41	113	
50PN 1300	350	360	250	260	40	41	105	
65PN 310	540	543	411	415	21	20	225	
65PN 350	522	531	410	413	15	14	222	
65PN 400	479	510	370	380	31	30	180	
65PN 470	425	440	300	315	35	36	146	
65PN 600	395	430	278	288	37	38	130	98.0
65PN 700	386	405	273	285	39	41	121	
65PN 800	375	385	270	280	40	41	113	
65PN 1000	370	380	265	275	41	42	110	
65PN 1300	350	360	250	260	41	42	110	

Note) 1. Tests are conducted in accordance with JIS Z 2241 and 2244.
2. L: Specimen is parallel to the rolling direction / C: Specimen is transverse to the rolling direction.
3. Specimens with C-6A coating are used for lamination factor test.

PNM-Core

PNM-Core has a improved wear resistance and low residual magnetism. This product is suitable for magnetic switches.

■Standard Size

Product	Grade	Thickness in. (mm)	Width in. (mm)		Inner diameter in. (mm)
			Available	Standard	
PNM-Core	65PNM540	0.0256 (0.65)	37.40~47.24 (950~1200)	39.37 (1000) 43.31 (1100) 47.24 (1200)	20 (508)
	70PNM500	0.0276 (0.70)			

Note) For non-standard sizes, please contact us

■Specification

Magnetic properties and lamination factors

Grade	Equivalent ASTM Grade	Density (kg/dm³)	Max Core Loss, W/lb (W/kg)		Magnetic Flux Density.Min T(B50)	Lamination Factor, Min(%)
			1.5T/50Hz	1.5T/60Hz		
65PNM540	-	7.70	2.45 (5.40)	3.10 (6.82)	1.66	97.0
70PNM500	-	7.65	2.27 (5.00)	2.89 (6.37)	1.65	97.0

Note) 1. Above test is conducted in accordance with IEC60404-2 (or JIS C 2550-1), using as-sheared specimens taken one half parallel and one half transverse to the rolling direction.
2. W15/50 indicates the core loss at the frequency of 50 Hz and the magnetic flux density of 1.5T.
3. B50 indicates the magnetic flux density at 5000A/m

■Dimension & Shape Tolerance

Width in. (mm)	Thickness in. (mm)	Thickness tolerance in. (mm)	Thickness deviation in Width in. (mm)	Width tolerance in. (mm)	Camber (Length: 2m) in. (mm)
39.37 (1000) and over	0.0256 (0.65)	±0.00205 (0.052)	0.0016 (0.04) and under	+0.0591 (1.5)	0.0394 (1.0) and under
	0.0276 (0.70)	±0.00221 (0.056)			

Note) Thickness deviation in width means the gap between the thickness of center and the one section 15mm away from the edge part.

■Typical Electrical and Magnetic Properties

Grade	Resistivity Ω·m (×10⁻⁸)	Core Loss, W/lb (W/kg)				Magnetic Flux Density, (T)	
		1.0T/50Hz	1.5T/50Hz	1.0T/60Hz	1.5T/60Hz	B25	B50
65PNM540	42	0.82 (1.80)	1.69 (3.72)	1.03 (2.27)	2.18 (4.81)	1.65	1.72
70PNM500	44	0.78 (1.72)	1.65 (3.63)	0.99 (2.18)	2.17 (4.78)	1.61	1.70

Note) Above values are not guaranteed. Tests are conducted in accordance with IEC 60404-2 (or JIS C 2550-1) method, using as-sheared specimens taken one half parallel and one half transverse to the rolling direction.

■Typical Mechanical Property and Lamination Factor

Grade	Tensile Strength(N/mm²)		Yield Point(N/mm²)		Elongation(%)		Hardness Hv1	Lamination Factor(%)
	L	C	L	C	L	C		
65PNM540	437	452	300	315	32	33	155	98.0
70PNM500	485	496	356	371	31	32	177	

Note) 1. Tests are conducted in accordance with JIS Z 2241 and 2244.
2. L : Specimen is parallel to the rolling direction / C : Specimen is transverse to the rolling direction
3. Specimens with C-6A coating are used for lamination factor test.

PNX Core

PNX-Core is optimized core for traction motor in electrical vehicle(EV), hybrid electrical vehicle(HEV). It has low core loss at high frequencies, high magnetic flux density and has high mechanical strength for excellent endurance.

■Standard Size

Product	Grade	Thickness in. (mm)	Width in. (mm)		Inner diameter in. (mm)
			Available	Standard	
PNX-Core	27PNX1350F	0.0106(0.27)	37.40~41.34(950~1050)	37.40(950) / 39.37(1000)	20(508)

Note) For non-standard sizes, please contact us

■Specification

Magnetic properties and lamination factors

Grade	Equivalent ASTM Grade	Density (kg/dm³)	Max Core Loss, W/lb (W/kg)	Min. Yield Point (N/mm²)	Magnetic Flux Density.Min T(B50)	Lamination Factor, Min(%)
			1.0T/400Hz			
27PNX1350F	-	7.60	6.12 (13.5)	400	1.65	94.0

Note) 1. Above test is conducted in accordance with IEC60404-2 (or JIS C 2550-1), using as-sheared specimens taken one half parallel and one half transverse to the rolling direction.
2. W10/400 indicates the core loss at the frequency of 400 Hz and magnetic flux density of 1.0T.
3. B50 indicates the magnetic flux density at 5000A/m

■Dimension & Shape Tolerance

Width in. (mm)	Thickness in. (mm)	Thickness tolerance in. (mm)	Thickness deviation in Width in. (mm)	Width tolerance in. (mm)	Camber (Length: 2m) in. (mm)
39.37(1000) and under	0.0106(0.27)	±0.00106(0.027)	0.0008(0.02) and under	+0.0591(1.5)	0.0394(1.0)and under

Note) Thickness deviation in width means the gap between the thickness of center and the one section 15mm away from the edge part.

■Typical Electrical and Magnetic Properties

Grade	Resistivity Ω·m (×10⁻⁸)	Core Loss, W/lb (W/kg)					Magnetic Flux Density, (T)	
		1.0T/50Hz	1.5T/50Hz	1.0T/60Hz	1.5T/60Hz	1.0T/400Hz	B25	B50
27PNX1350F	59	0.38 (0.84)	0.90 (1.99)	0.47 (1.03)	1.11 (2.44)	5.81 (12.8)	1.57	1.66

Note) Above values are not guaranteed. Tests are conducted in accordance with IEC 60404-2 (or JIS C 2550-1) method, using as-sheared specimens taken one half parallel and one half transverse to the rolling direction.

■Typical Mechanical Property and Lamination Factor

Grade	Tensile Strength(N/mm²)		Yield Point(N/mm²)		Elongation(%)		Hardness Hv1	Lamination Factor(%)
	L	C	L	C	L	C		
27PNX1350F	545	556	420	432	16	16	220	97.0

Note) 1. Tests are conducted in accordance with JIS Z 2241 and 2244.
2. L : Specimen is parallel to the rolling direction / C : Specimen is transverse to the rolling direction
3. Specimens with C-6A coating are used for lamination factor test.

Non-oriented electrical steel

PNF-Core

PNF-Core has excellent magnetic properties at high frequencies. It is suitable for motors which needs low core loss at high frequencies.

■Standard Size

Product	Grade	Thickness in. (mm)	Width in. (mm)		Inner diameter in. (mm)
			Available	Standard	
PNF-Core	20PNF1500	0.0080 (0.20)	37.40~47.24 (950~1200)	39.37 (1000) 43.31 (1100)	20 (508)
	30PNF1600	0.0118 (0.30)			
	35PNF1800	0.0138 (0.35)			

Note) For non-standard sizes, please contact us

■Specification

Magnetic properties and lamination factors

Grade	Equivalent ASTM Grade	Density (kg/dm^3)	Max Core Loss, W/lb (W/kg)	Magnetic Flux Density.Min T(B50)	Lamination Factor, Min(%)
			1.0T/400Hz		
20PNF1500	-	7.65	6.80 (15.0)	1.62	93.0
30PNF1600	-	7.60	7.26 (16.0)	1.62	94.5
35PNF1800	-	7.60	8.17 (18.0)	1.62	95.0

Note) 1. Above test is conducted in accordance with IEC60404-2 (or JIS C 2550-1), using as-sheared specimens taken one half parallel and one half transverse to the rolling direction.
2. W10/400 indicates the core loss at the frequency of 400 Hz and magnetic flux density of 1.0T.
3. B50 indicates the magnetic flux density at 5000A/m

■Dimension & Shape Tolerance

Width in. (mm)	Thickness in. (mm)	Thickness Tolerance in. (mm)	Thickness deviation in Width in. (mm)	Width Tolerance in. (mm)	Camber (Length: 2m) in. (mm)
39.37 (1000) and under	0.0080 (0.20)	±0.0008 (0.020)	0.0008 (0.02) and under	+0.0591 (1.5)	0.0394 (1.0) and under
	0.0118 (0.30)	±0.0012 (0.030)			
	0.0138 (0.35)	±0.0014 (0.035)			
39.37 (1000) and over	0.0080 (0.20)	±0.0008 (0.020)	0.0012 (0.03) and under		
	0.0118 (0.30)	±0.0012 (0.030)			
	0.0138 (0.35)	±0.0014 (0.035)			

Note) Thickness deviation in width means the gap between the thickness of center and the one section 15mm away from the edge part.

■Typical Electrical and Magnetic Properties

Grade	Resistivity Ω·m (×10⁻⁸)	Core Loss, W/lb (W/kg)					Magnetic Flux Density. (T)	
		1.0T/50Hz	1.5T/50Hz	1.0T/60Hz	1.5T/60Hz	1.0T/400Hz	B25	B50
20PNF1500	50	0.56 (1.24)	1.23 (2.71)	0.69 (1.53)	1.49 (3.28)	5.76 (12.8)	1.57	1.66
30PNF1600	59	0.42 (0.93)	0.98 (2.16)	0.53 (1.17)	1.23 (2.72)	6.71 (14.8)	1.56	1.66
35PNF1800	59	0.44 (0.97)	0.99 (2.19)	0.54 (1.20)	1.24 (2.73)	7.67 (16.9)	1.56	1.66

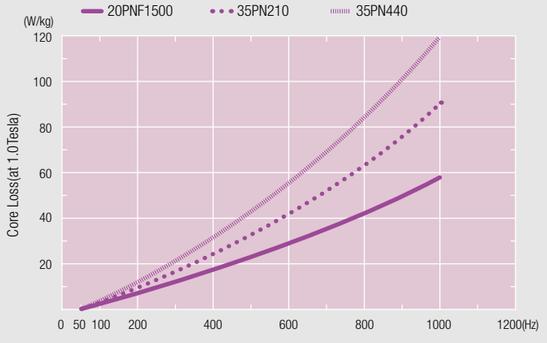
Note) Above values are not guaranteed. Tests are conducted in accordance with IEC 60404-2 (or JIS C 2550-1) method, using as-sheared specimens taken one half parallel and one half transverse to the rolling direction.

■Typical Mechanical Property and Lamination Factor

Grade	Tensile Strength(N/mm^2)		Yield Point(N/mm^2)		Elongation(%)		Hardness Hv1	Lamination Factor(%)
	L	C	L	C	L	C		
20PNF1500	471	490	363	381	16	19	195	97.0
30PNF1600	535	545	416	426	18	19	223	97.5
35PNF1800	536	546	418	428	19	20	224	97.5

Note) 1. Tests are conducted in accordance with JIS Z 2241 and 2244.
2. L : Specimen is parallel to the rolling direction / C : Specimen is transverse to the rolling direction
3. Specimens with C-6A coating are used for lamination factor test.

■Comparison of Core Loss with Frequency



PNF-Core of 0.20mm has lower iron loss than 0.35mm product due to less eddy current loss in high frequency. 20PNF1500 has 30% improved magnetic properties(W10/400) compared to 35PN 210.

Non-oriented electrical steel

PNA-Core

PNA-Core has low core loss, high induction and good punchability after SRA(Stress Relief Anealing).

■Standard Size

Product	Grade	Thickness in. (mm)	Width in. (mm)		Inside diameter in. (mm)
			Available	Standard	
PNA-Core	50PNA300	0.0197 (0.50)	37.40~47.24 (950~1200)	39.37 (1000) 43.31 (1100) 47.24 (1200)	20 (508)
	50PNA350				
	50PNA450				
	50PNA500				

Note) For non-standard sizes, please contact us

■Specification

Magnetic properties and lamination factors

Grade	Equivalent ASTM Grade	Density (kg/dm³)	Max Core Loss, W/lb (W/kg)		Magnetic Flux Density.Min T(B50)	Lamination Factor, Min(%)
			1.5T/50Hz	1.5T/60Hz		
50PNA300	-	7.75	1.36 (3.00)	1.75 (3.86)	1.70	96.0
50PNA350	-	7.75	1.59 (3.50)	2.03 (4.48)	1.70	
50PNA450	-	7.80	2.04 (4.50)	2.62 (5.79)	1.70	
50PNA500	-	7.85	2.27 (5.00)	2.95 (6.49)	1.70	

Note) 1. Above test is conducted in accordance with IEC60404-2 (or JIS C 2550-1), using specimens one half parallel and one half transverse to the rolling direction. Core loss and magnetic flux density are measured after stress relief annealing. (Annealing condition : 750°C×2hrs, under non-oxidation atmosphere)
2. W15/50 indicates the core loss at the frequency of 50 Hz and magnetic flux density of 1.5T. B50 indicates the magnetic flux density at 5000A/m.

■Dimension & Shape Tolerance

Width in. (mm)	Thickness in. (mm)	Thickness tolerance in. (mm)	Thickness deviation in Width in. (mm)	Width tolerance in. (mm)	Camber(Length : 2m) in. (mm)
39.37 (1000) and under	0.0197 (0.50)	±0.00158 (0.040)	0.0012 (0.03) and under	+0.0591 (1.5)	0.0394 (1.0) and under
39.37 (1000) and over	0.0197 (0.50)	±0.00158 (0.040)	0.0016 (0.04) and under		

Note) Thickness deviation in width means the gap between the thickness of center and the one section 15mm away from the edge part.

■Typical Electrical and Magnetic Properties

Grade	Resistivity Ω·m (×10⁻⁸)	Core Loss, W/lb (W/kg)				Magnetic Flux Density. (T)	
		1.0T/50Hz	1.5T/50Hz	1.0T/60Hz	1.5T/60Hz	B25	B50
50PNA300	37	0.59 (1.29)	1.35 (2.70)	0.78 (1.72)	1.68 (3.71)	1.65	1.73
50PNA350	33	0.62 (1.36)	1.38 (3.05)	0.83 (1.83)	1.77 (3.91)	1.67	1.74
50PNA450	20	0.79 (1.73)	1.77 (3.89)	1.01 (2.22)	2.32 (5.11)	1.63	1.72
50PNA500	17	0.85 (1.88)	2.02 (4.46)	1.09 (2.41)	2.66 (5.86)	1.64	1.72

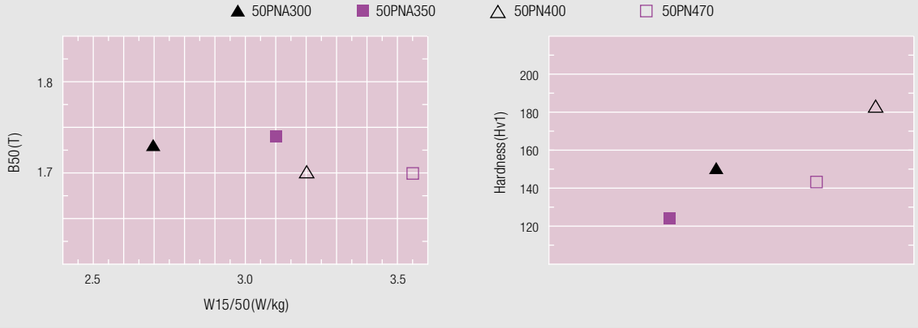
Note) Above values are not guaranteed. Tests are conducted in accordance with IEC 60404-2 (or JIS C 2550-1) method, after stress relief annealing.
(Annealing conditions: 750°C (1380°F) × 2hrs, under neutral atmosphere)

■Typical Mechanical Property and Lamination Factor

Grade	Tensile Strength(N/mm²)		Yield Point(N/mm²)		Elongation(%)		Hardness Hv1	Lamination Factor(%)
	L	C	L	C	L	C		
50PNA300	402	415	260	269	37	39	141	98.0
50PNA350	382	401	268	278	36	38	124	
50PNA450	372	381	269	270	37	38	117	
50PNA500	376	382	270	272	37	38	113	

Note) 1. Tests are conducted in accordance with JIS Z 2241 and 2244.
2. L : Specimen is parallel to the rolling direction / C : Specimen is transverse to the rolling direction
3. Specimens with C-6A coating are used for lamination factor test.

■Comparison of magnetic properties and puchability (PNA VS PN-Core)



Through higher induction and punchability, PNA-core features higher efficiency of products and longer life of dies.

Non-oriented electrical steel

PNH-Core

PNH-Core has superior induction property than other non grain-oriented cores. It is widely used for industrial motors.

■Standard Size

Product	Grade	Thickness in. (mm)	Width in. (mm)		Inside diameter in. (mm)
			Available	Standard	
PNH-Core	23PNH270	0.0091 (0.23)	37.40~47.24 (950~1200)	39.37 (1000) 43.31 (1100) 47.24 (1200)	20 (508)
	35PNH230	0.0138 (0.35)			
	35PNH250				
	50PNH300	0.0197 (0.50)			
	50PNH470				
	65PNH470	0.0256 (0.65)			

Note) For non-standard sizes, please contact us

■Specification

Magnetic properties and lamination factors

Grade	Equivalent ASTM Grade	Density (kg/dm^3)	Max Core Loss, W/lb (W/kg)		Magnetic Flux Density.Min T(B50)	Lamination Factor, Min(%)
			1.5T/50Hz	1.5T/60Hz		
23PNH270	-	7.75	1.23 (2.70)	1.51 (3.32)	1.70	93.0
35PNH230	-	7.65	1.04 (2.30)	1.30 (2.87)	1.65	95.0
35PNH250	-	7.65	1.13 (2.50)	1.41 (3.11)	1.67	
50PNH300	-	7.70	1.36 (3.00)	1.75 (3.85)	1.67	96.0
50PNH470	-	7.75	2.13 (4.70)	2.67 (5.89)	1.72	
65PNH470	-	7.75	2.13 (4.70)	2.76 (6.08)	1.72	97.0

Note) 1. Above test is conducted in accordance with IEC60404-2 (or JIS C 2550-1), using as-sheared specimens taken one half longitudinal and one half transverse to the rolling direction.
2. W15/50 indicates the core loss at the frequency of 50 Hz and the magnetic flux density of 1.5T.
3. B50 indicates the magnetic flux density at 5000A/m

■Dimension & Shape Tolerance

Width in. (mm)	Thickness in. (mm)	Thickness tolerance in. (mm)	Thickness deviation in Width in. (mm)	Width tolerance in. (mm)	Camber(Length : 2m) in. (mm)
39.37 (1000) and over	0.0091 (0.23)	±0.00091 (0.023)	0.0008 (0.02) and under	+0.0591 (1.5)	0.0394 (1.0) and under
	0.0138 (0.35)	±0.00138 (0.035)	0.0016 (0.04) and under		
	0.0197 (0.50)	±0.00158 (0.040)			
	0.0256 (0.65)	±0.00205 (0.052)			

Note) Thickness deviation in width means the gap between the thickness of center and the one section 15mm away from the edge part.

■Typical Electrical and Magnetic Properties

Grade	Resistivity Ω·m ($\times10^{-8}$)	Core Loss, W/lb (W/kg)				Magnetic Flux Density. (T)	
		1.0T/50Hz	1.5T/50Hz	1.0T/60Hz	1.5T/60Hz	B25	B50
23PNH270	34	0.57 (1.26)	1.21 (2.68)	0.70 (1.54)	1.49 (3.28)	1.65	1.74
35PNH230	49	0.41 (0.90)	0.93 (2.06)	0.52 (1.14)	1.17 (2.58)	1.57	1.68
35PNH250	46	0.49 (1.08)	1.07 (2.36)	0.61 (1.35)	1.35 (2.97)	1.57	1.68
50PNH300	42	0.52 (1.16)	1.17 (2.58)	0.67 (1.48)	1.55 (3.41)	1.63	1.71
50PNH470	34	0.66 (1.46)	1.45 (3.19)	0.85 (1.87)	1.86 (4.10)	1.65	1.74
65PNH470	34	0.85 (1.88)	1.84 (4.05)	1.09 (2.41)	2.40 (5.30)	1.65	1.74

Note) Above values are not guaranteed. Tests are conducted in accordance with IEC 60404-2 (or JIS C 2550-1) method, using as-sheared specimens taken one half parallel and one half transverse to the rolling direction.

■Typical Mechanical Property and Lamination Factor

Grade	Tensile Strength(N/mm^2)		Yield Point(N/mm^2)		Elongation(%)		Hardness Hv1	Lamination Factor(%)
	L	C	L	C	L	C		
23PNH270	400	411	264	277	24	26	156	97.0
35PNH230	485	488	363	369	13	13	205	97.5
35PNH250	477	487	359	372	18	19	194	
50PNH300	456	467	330	346	27	29	191	98.0
50PNH470	386	398	245	256	34	36	140	
65PNH470	392	395	252	258	35	36	141	

Note) 1. Tests are conducted in accordance with JIS Z 2241 and 2244.
2. L : Specimen is parallel to the rolling direction / C : Specimen is transverse to the rolling direction
3. Specimens with C-6A coating are used for lamination factor test.

PNS-Core

PNS-Core has less strength than normal hyper grade PN-Core(≤2.5W/kg). It has excellent punchability so that customers can increase life cycle of mold.

■Standard Size

Product	Grade	Thickness in. (mm)	Width in. (mm)		Inside diameter in. (mm)
			Available	Standard	
PNS-Core	35PNS250	0.0138 (0.35)	37.40~47.24 (950~1200)	39.37 (1000) 41.34 (1050) 43.31 (1100)	20 (508)

Note) For non-standard sizes, please contact us

■Specification

Magnetic properties and lamination factors

Grade	Equivalent ASTM Grade	Density (kg/dm³)	Max Core Loss, W/lb (W/kg)		Magnetic Flux Density.Min T(B50)	Lamination Factor, Min(%)
			1.5T/50Hz	1.5T/60Hz		
35PNS250	-	7.60	1.13 (2.50)	1.42 (3.13)	1.63	95.0

Note) 1. Above test is conducted in accordance with IEC60404-2 (or JIS C 2550-1), using as-sheared specimens taken one half longitudinal and one half transverse to the rolling direction.
2. W15/50 indicates the core loss at the frequency of 50 Hz and the magnetic flux density of 1.5T.
3. B50 indicates the magnetic flux density at 5000A/m

■Dimension & Shape Tolerance

Width in. (mm)	Thickness in. (mm)	Thickness Tolerance in. (mm)	Thickness deviation in Width in. (mm)	Width tolerance in. (mm)	Camber(Length : 2m) in. (mm)
39.37 (1000) and under	0.0138 (0.35)	±0.00138 (0.035)	0.0008 (0.02) and under	+0.0591 (1.5)	0.0394 (1.0) and under
39.37 (1000) and over	0.0138 (0.35)	±0.00138 (0.035)	0.0012 (0.03) and under		

Note) Thickness deviation in transverse direction is the difference between the thickness of center and 15mm from the edge.

■Typical Electrical and Magnetic Properties

Grade	Resistivity Ω·m (×10⁻⁸)	Core Loss, W/lb (W/kg)				Magnetic Flux Density. (T)	
		1.0T/50Hz	1.5T/50Hz	1.0T/60Hz	1.5T/60Hz	B25	B50
35PNS250	56	0.45 (0.98)	1.02 (2.25)	0.55 (1.22)	1.29 (2.83)	1.57	1.66

Note) Above values are not guaranteed. Tests are conducted in accordance with IEC 60404-2 (or JIS C 2550-1) method, using as-sheared specimens taken one half parallel and one half transverse to the rolling direction.

■Typical Mechanical Property and Lamination Factor

Grade	Tensile Strength(N/mm²)		Yield Point(N/mm²)		Elongation(%)		Hardness Hv1	Lamination Factor(%)
	L	C	L	C	L	C		
35PNS250	442	445	330	332	23	25	186	97.5

Note) 1. Tests are conducted in accordance with JIS Z 2241 and 2244.
2. L : Specimens taken parallel to the rolling direction / C : Specimens taken transverse to the rolling direction
3. Specimens with C-6A coating are used for lamination factor test.

■POSCO insulation coating

POSCO Coating Type		General (Chromate base)		Eco-friendly (Phosphate base)			Remark
		C6-A	C9-A	NS	NM	NT	
ASTM Code		C-5	C-5	C-5	C-5	C-6	-
Composition		Organic + Inorganic	Organic + Inorganic	Organic + Inorganic	Organic + Inorganic	Organic + Inorganic filler	
Thickness(μm)		0.5~1.0	1.2~1.8	0.5~1.0	1.2~1.8	5.0~7.0	
Resistivity (Ωcm²/lam.)	Before SRA	0.5	5.0	3.0	5.0	50	ASTM A 717 SRA condition : 750℃×2hr in DX rich gas
	After SRA	0.1	0.5	1.5	2.5	SRA Not Accepted	
Lamination Factor(%)		98.0	98.0	98.0	98.0	97.0	JIS C 2550 1.0Mpa±0.05 in Pressure
Heat resistance	Continuous	Not recogniozed	Not recogniozed	Not recogniozed	Not recogniozed	SRA Not Accepted	155℃×24hr in Air.
	Short	Not recogniozed	Not recogniozed	Not recogniozed	Not recogniozed	SRA Not Accepted	750℃×2hr in DX rich gas
Weathering (powdering)		Not recogniozed	Not recogniozed	Not recogniozed	Not recogniozed	Not recogniozed	65℃, 95% humidity, 72hr
Adhesion	Before SRA	10 mmø	10 mmø	10 mmø	10 mmø	20 mmø	ISO 1519 Mandrel Pipe bending
	After SRA	5B	5B	5B	5B	5B	
Resistance to refrigerants	Change of surface	Not recogniozed	Not recogniozed	Not recogniozed	Not recogniozed	-	R-134a/Freol @15C= 65g/100g (130℃, 21days, 0.45μm filter paper)
	Change of weight	Not recogniozed	Not recogniozed	Not recogniozed	Not recogniozed	-	
Weldability		Excellent	Nomal	Good	Nomal	Not allowed	Current : 100~150A Ar 99% flow : 10~20L/min Speed : 0.25~0.50mpm

Note) Please designate surface insulation according to usage. Regarding coating properties, please contact us. The coating thickness and the resistivity is typical value, not guaranteed.

Stress relief annealing is a process to obtain desired magnetic properties of electrical steel sheets by relieving stress generated in the process of shearing and punching. It is conducted at a proper temperature for a certain period of time.

Annealing Temperature

If the annealing temperature is too low, it is difficult to achieve adequate magnetic properties. If the temperature is too high, it may erode surface insulation, cause fusion between layers, and degrade core properties. The optimum annealing temperature to produce desirable magnetic properties is 780°C to 840°C for grain-oriented electrical steel and 750°C to 800°C for non-oriented electrical steel.

Annealing Time

Annealing time means the in-furnace time of materials at the highest temperature during the annealing process. During this time, the materials in the furnace should be heated evenly. The annealing time varies depending upon amount of materials or type of furnace. Generally, the annealing time is between 1.5 to 2.5 hours.

Heating and Cooling Speed

Abrupt heating and cooling must be avoided to prevent any deformation of the iron core. Slow cooling must be applied until it reaches 300~350°C.

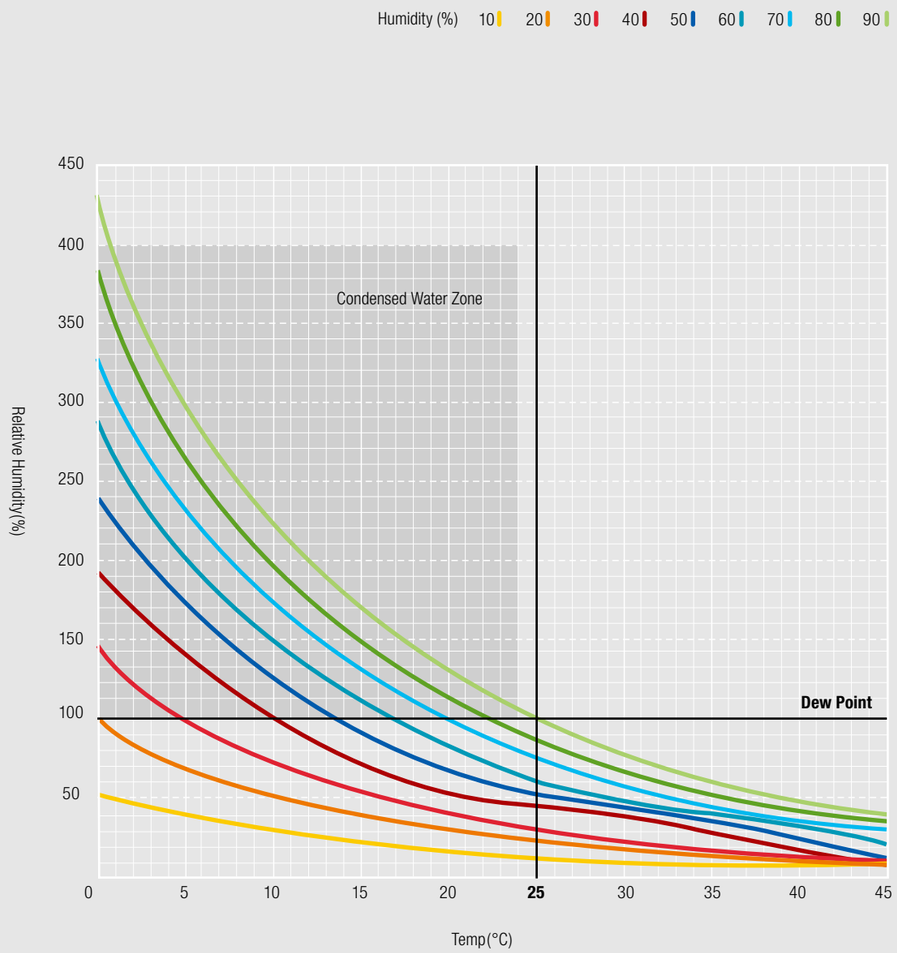
Furnace Atmosphere

Furnace atmosphere should be controlled to minimize carburization or oxidization which can diminish magnetic properties. Therefore, a pure nitrogen atmosphere is ideal and the dew point of gas should be maintained as low as possible(below 0°C is adequate). The oil used in shearing and punching should be removed completely. Otherwise both sides of piled-up core will be damaged during the annealing process, deteriorating the work capacity.

Surface condensation in relation to humidity and temperature

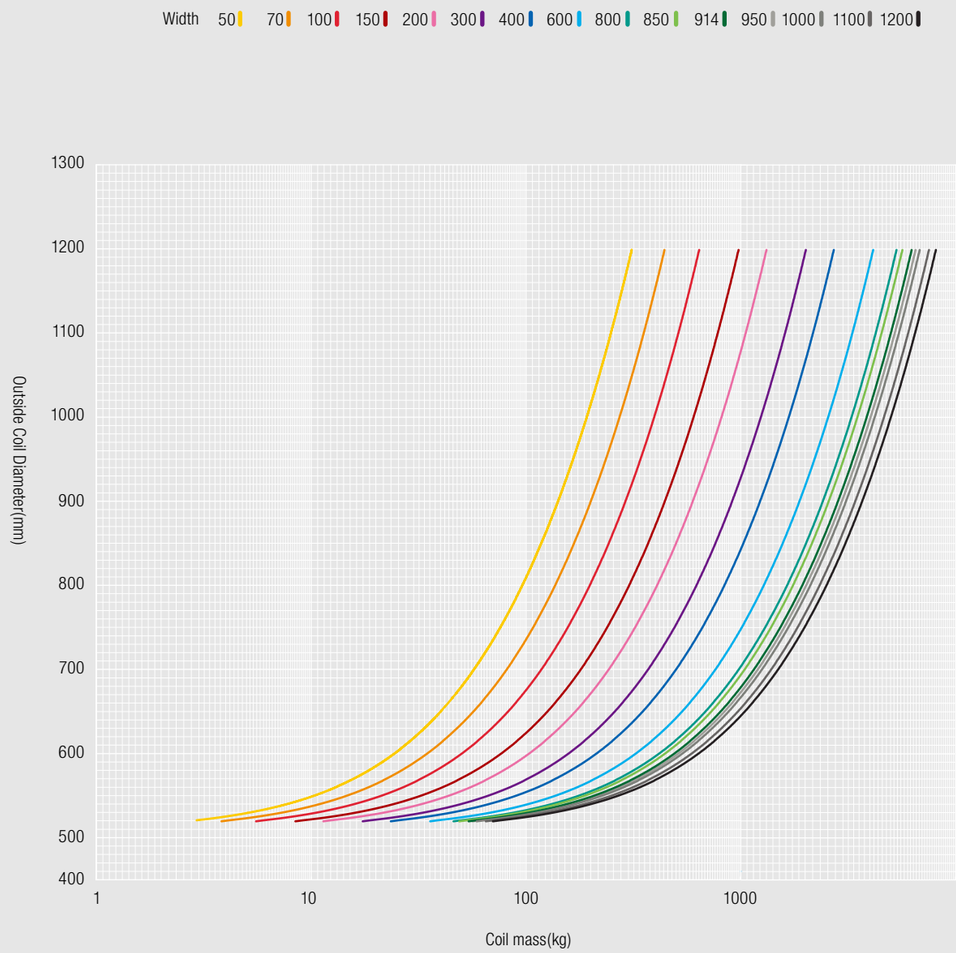
■ **Reference for rust**

Condensed Water on steel surface Graph according to Humidity and Temperature



Water is condensed on the steel surface in certain temperature and humidity in store place and steel is likely to get rusty.
Ex) In a place of 25°C, humidity 80%, water is condensed when temp decrease to 22°C.

Relation among weight, outside diameter and width of coil



Note) Inner diameter is 20inch (508mm)

Major international standards

When ordering, please be sure to consult our latest and check the specifications or standards of products may change.

■ **Grain-Oriented Electrical Steel**

Thickness in. (mm)	POSCO (2015) W/kg 17/50	JIS C 2553 (2012) W/kg 17/50	ASTM (2012) W/kg 17/50	EN10107 (2005) W/kg 17/50
0.0091 (0.23)	23PHD080 0.80	23R080 0.80	-	-
	23PHD085 0.85	23R085 0.85	-	M85-23P 0.85
	23PHD090 0.90	23R090 0.90	23Q054 0.90	M90-23P 0.90
	23PH 085 0.85	-	-	-
	23PH 090 0.90	23P090 0.90	-	-
	23PH 095 0.95	23P095 0.95	-	M95-23P 0.95
0.0106 (0.27)	27PHD085 0.85	-	-	-
	27PHD090 0.90	27R090 0.90	-	M90-27P 0.90
	27PHD095 0.95	27R095 0.95	27Q057 0.96	M95-27P 0.95
	27PH 090 0.90	-	-	-
	27PH 095 0.95	27P095 0.95	-	-
	27PH110 1.00	27P100 1.00	27P066 1.11	M103-27P 1.03
	27PG120 1.20	27G120 1.20	27H074 1.24	M120-27S 1.20
	27PG130 1.30	27G130 1.30	-	M130-27S 1.30
0.0118 (0.30)	30PHD095 0.95	-	-	-
	30PHD100 1.00	-	-	-
	30PH 100 1.00	30P100 1.00	-	M100-30P 1.00
	30PH 105 1.05	30P105 1.05	-	M105-30P 1.05
	30PG 120 1.20	30G120 1.20	-	-
	30PG 130 1.30	30G130 1.30	30H083 1.39	M130-30S 1.30
0.0138 (0.35)	35PG145 1.45	35G145 1.45	-	M150-35S 1.50
	35PG155 1.55	35G155 1.55	35H094 1.57	-

Note) The core loss of POSCO products is the maximum guarantee value at 1.7T and 50Hz

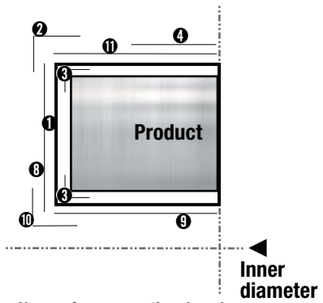
■ **Non-Oriented Electrical Steel**

Thickness in. (mm)	POSCO (2015) W/kg 17/50	JIS C 2552 (2012) W/kg 17/50	ASTM (2012) W/kg 17/50	EN10106 (2007) W/kg 17/50
0.0138 (0.35)	35PN 210 2.10	35A210 2.10	-	-
	35PN 230 2.30	35A230 2.30	-	M235-35A 2.35
	35PN 250 2.50	35A250 2.50	36F145	M250-35A 2.50
	35PN 270 2.70	35A270 2.70	36F155	M270-35A 2.70
	35PN 300 3.00	35A300 3.00	36F175	M300-35A 3.00
	35PN 330 3.30	35A330 3.30	36F185	M330-35A 3.30
	35PN 360 3.60	35A360 3.60	36F205	-
	35PN 440 4.40	35A440 4.40	-	-
0.0197 (0.50)	50PN 250 2.50	50A250 2.50	-	M250-50A 2.50
	50PN 270 2.70	50A270 2.70	-	M270-50A 2.70
	50PN 290 2.90	50A290 2.90	47F165	M290-50A 2.90
	50PN 310 3.10	50A310 3.10	47F180	M310-50A 3.10
	50PN 330 3.30	50A330 3.30	47F190	M330-50A 3.30
	50PN 350 3.50	50A350 3.50	47F200	M350-50A 3.50
	50PN 400 4.00	50A400 4.00	47F240	M400-50A 4.00
	50PN 470 4.70	50A470 4.70	47F280	M470-50A 4.70
	50PN 600 6.00	50A600 6.00	-	M600-50A 6.00
	50PN 700 7.00	50A700 7.00	47F400	M700-50A 7.00
	50PN 800 8.00	50A800 8.00	47F450	M800-50A 8.00
	50PN 1000 10.00	50A1000 10.00	-	M940-50A 9.40
	50PN 1300 13.00	50A1300 13.00	-	-

Note) The core loss of POSCO products is the maximum guarantee value at 1.5T and 50Hz

Packaging & marking

Name of outer pack

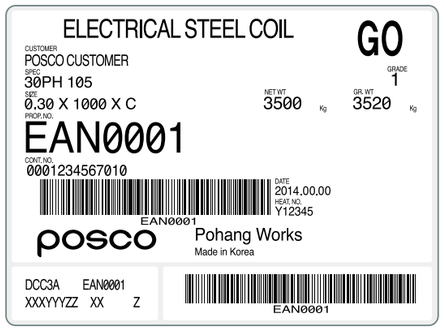


Name of cross-sectional pack

NO	Name	Meterial
❶	PP VCI WRAP	VINYL
❷	OUTER RING	STEEL
❸	CORNER WRAP	ANTI-RUST BOARD
❹	OUTER PROTECT BOARD	STEEL
❺	HORIZONTAL BAND	STEEL
❻	CENTER BAND	PET
❼	VERTICAL BAND	STEEL
❽	SIDE BOARD	PLASTIC
❾	INNER PROTECT BOARD	PLASTIC
❿	INNER RING	STEEL
⓫	OUTER PROTECT BOARD	ANTI-RUST BOARD

* Packing Type and materials are changeable.

Domestic



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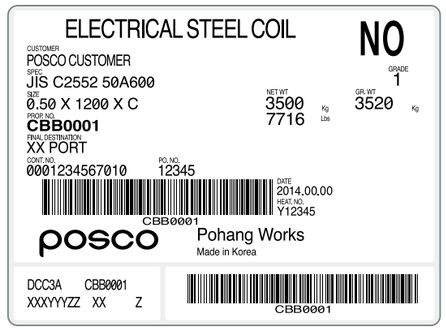

ELECTRICAL STEEL

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