

PRECISION WIRES INDIA LIMITED



PRECISION

TO ANY LENGTH . . .



PRECISION



WINDING WIRES

Precision Wires India Limited (PWIL) was set up in 1989 for the manufacture of Enamelled Copper Winding Wires. It was promoted by erstwhile Atlas Wires Limited (AWL), Mr. Mahendra Mehta, Mr. Deepak Mehta and Mr. Milan Mehta.

PWIL has been listed on the Bombay Stock Exchange (523529) and National Stock Exchange (PRECWIRE) since inception.

AWL's first manufacturing facility was set up in 1981 in the western Indian state of Gujarat. Two decades later, in 2001, AWL was amalgamated with PWIL.

Headquartered in Mumbai, India, PWIL is the largest manufacturer of Winding Wires in the country and uses a combination of Indian skill and foreign technology to ensure the best possible end-product quality.

PWIL's current production range of Winding Wires is as under:

- Enamelled Round Winding Wires between 4.5 mm and 0.08 mm (including equivalents in SWG and AWG sizes)
- Enamelled Rectangular Winding Wires between 3 mm² and 75 mm².
- Rectangular Taped Copper Conductors, between 4 mm² and 120 mm² with various insulations including kraft paper, Nomex®, MICA, Enamelled, Polyester Film etc (Single and Bunched).
- Continuously Transposed Conductors (CTC) from 5 strands to 72 strands in various varieties.

PWIL's main winding wire manufacturing facilities are located at Silvassa (Dadra & Nagar Haveli). Our effective production capacity at the end of 2017 is about 35000 MT/Annum, and is being increased to about 45000 MT/annum by 2019.

PWIL's customers include large manufacturers of electrical and electronic equipment, of international repute. Customers are catered to directly as well as through a well built network of branches/depots and stockists.

In recent years, PWIL has been increasingly targeting overseas markets. In the last financial year, exports accounted for about 15% of our sales volume.





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PRECISION HOUSE

Silvassa

Production Capacity

- State of the Art
- Largest in South Asia
- About 35000 MT/year as at Dec. 2017
- Being increased to about 45000 MT/year by 2019

PRECISION WIRES INDIA LIMITED

Across the country and abroad, Our wires are widely used in equipment such as:

- Rotating machines (Motors & Alternators)
- Power, Distribution and Instrument Transformers
- Auto Electricals
- Hermetic motors (for refrigeration and air conditioning equipment)
- House hold appliances
- Electric hand Tools
- Fans
- Switchgear, relay and magnet coils
- Ballasts
- and many others



Certifications & Recognitions

- The high Quality & Consistency of our products has won the confidence of our customers. Several of our prestigious customers have rated us as the best supplier.
- All our main plants are certified for Quality Management System ISO 9001:2008, TS 16949:2009 as well as Environmental Management System ISO 14001:2004.
- We are approved by various Government Organisations in India including POWERGRID, NTPC, NHPC, NPCIL, KPTCL, OPPTCL, GETCO, WBSEB, TNEB, AP-TRANSCO, TS-TRANSCO, UPPTCL, DMRC, PSTCL, RRVPNL, MSEB, BSPTCL & RDSO etc.
- M/s. Powergrid Corporation of India Limited has approved our CTC and PICC upto 765 KV rating

ISO 14001:2004



ISO/TS 16949:2009



ISO 9001:2008



ISO/TS 16949:2009



UL Recognition

Several of our Enamelled Wire types are tested and listed by UL (Under Writers Laboratories, USA) (UL File no. E 174288). This provides utmost confidence to our Indian and overseas customers regarding reliability and consistent quality of products supplied.

PWIL Code	Coat Type (Insulation Type)		ANSI Type	Temperature Class
	BC (Base Coat)	OC (Over Coat / Top Coat)	American/NEMA Standard MW1000	
Preci-1, Preci-3	Polyester	Polyamide	MW 24-C	155
Preci-2	Polyester	Polyamide	MW 76-C	180
Preci-4	Polyester	Polyamide-imide	MW 35-C	200
Preci-5, Preci-6	Polyesterimide	Polyamide-imide	MW 35, MW 73-C	200 & 220 (*)
Preci-7	Polyesterimide	Polyamide-imide	MW 35, MW 73-C	200 & 220 (*)
Preci-8	Polyesterimide	Polyamide	MW 24, MW 76-C	155 & 180
Preci-9	Polyurethane	—	MW 79-C	155
Preci-10	Polyurethane	Polyamide	MW 80-C	155
Preci-11	Polyesterimide	Polyamide-imide	MW 36 -C	200 & 220 (*)
(*) Non ANSI type				



Quality Assurance

At PWIL, extremely rigorous and systematic testing procedures are routinely followed to ensure excellence in the quality of wires. Our quality assurance laboratories are fully equipped to test and certify wire properties according to national and international specifications such as IS, IEC, NEMA, and JIS standards for Winding Wires as well as per specific requirements our customers may have.

Technology Transfer Agreement with M/s. ESSEX Italy S.p.A. :

PWIL entered into a long term Technology Transfer Agreement with ESSEX Italy in 2006 for manufacture of Continuously Transposed Conductors (CTC), Enamelled Copper Strips and various other types of Rectangular Insulated Winding Wires. This agreement expired in 2010. ESSEX Italy is a world leader in the manufacture of Rectangular Insulated Conductors and is one of the largest and most renowned global producers of CTC.

Exports

Export related production of PWIL is increasing and our current export volumes are about 15% of the total production.





Product Range

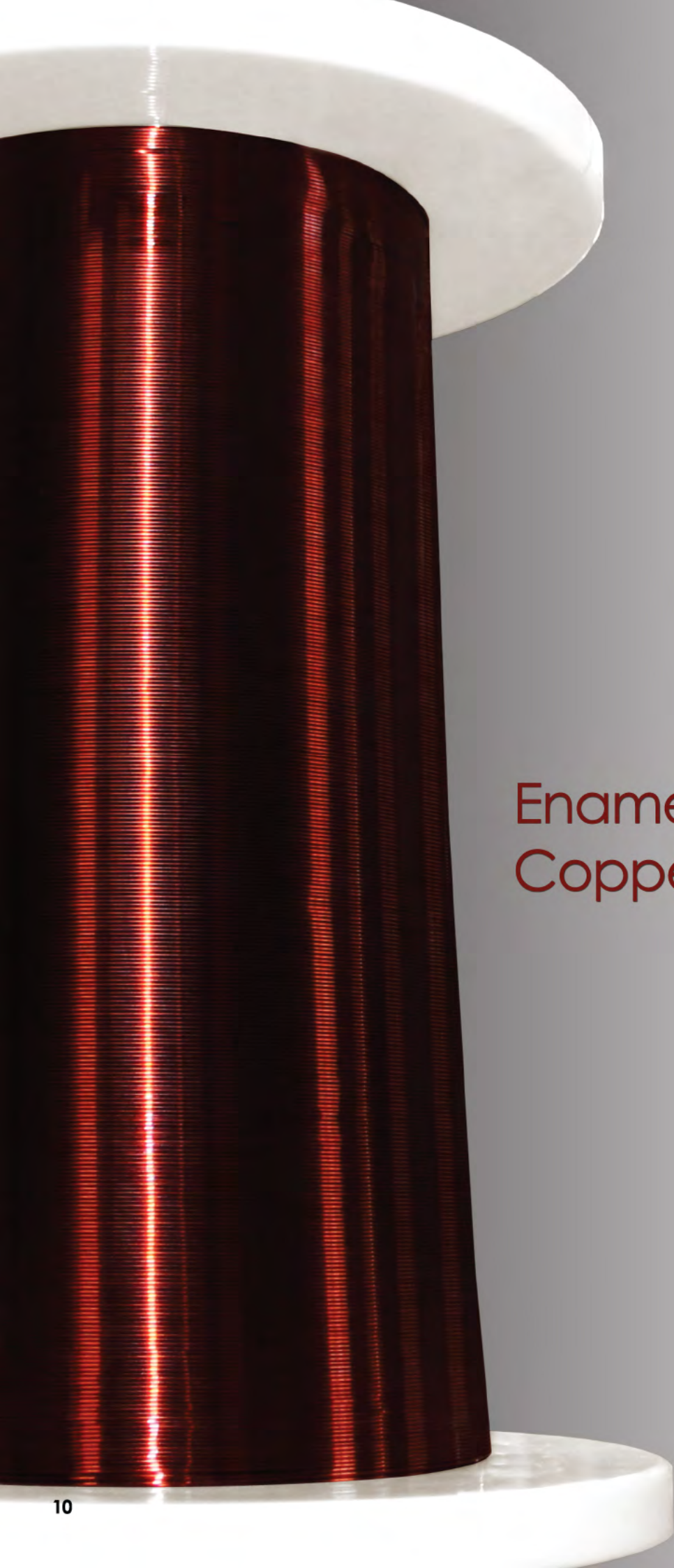
Enamelled Round Copper Wires

Enamelled Round Copper Wires

These wires are available with various insulation coatings, such as :

- Poly Vinyl Acetal, Class 105
- Polyester, Class 130 and 155
- Polyurethane, Class 130, 155 and 180
- Polyesterimide 180
- Dual Coated Polyester (imide) + Polyamide imide, Class 200.
- Polyamide imide, Class 200 and class 220
- Polyesterimide Bondable, Class 155 and 180
- Polyurethane Bondable, Class 130, 155 and 180
- Dual Coated Polyester (imide) + Polyamide, Class 155 and 180
- Polyimide, Class 240
- Triple Coated Bondable Polyesterimide + Polyamide imide + Aromatic Polyamide Bond Coat, Class 180
- And other insulation coatings according to customer specifications





Enamelled Round Copper Wires

Enamelled Round Winding Wires - Product Range

	1	2	3	4	5	6
Type of enamelled wire	High mechanical strength	Self solderable & bondable	General purpose	Self solderable	High Thermal & Mechanical strength	High temperature
SPECIFICATION STANDARD*	IS : 13730-1/ IEC-60317-1/ NEMA MW-15C/ JIS C 3202	IS : 13730-2/ IEC-60317-2	IS : 13730-3/ IEC-60317-3/ NEMA MW-5C	IS : 13730-4/ IEC-60317-4/ NEMA MW-75C/ JIS C 3202	IS : 13730-7/ IEC-60317-7	IS : 13730-8/ IEC-60317-8/ NEMA MW-30C/ JIS C 3202
THERMAL CLASS	130 (B)	130 (B)	155 (F)	130 (B)	200	180 (B)
Chemical base of base coat	Modified Polyvinyl Acetal	Polyurethanel	Modified Polyester	Polyurethane	Polyimide	Polyesterimide
Chemical base of top coat	Not applicable	Polyvinyl butyral/Polyamide	Not applicable	Not Applicable	Not Applicable	Not Applicable
Range of Wire (Diameter)	5.000-0.500 mm	2.000-0.050 mm	5.000-0.050 mm	2.000-0.050 mm	5.000-0.200 mm	5.000-0.050 mm
Insulation Range	Grade 1, 2 & 3 as per IEC (Single, Heavy & Triple as per NEMA)	Grade 1, 2 & 3 as per IEC (Single, Heavy & Triple as per NEMA)	Grade 1, 2 & 3 as per IEC (Single, Heavy & Triple as per NEMA)	Grade 1, 2 & 3 as per IEC (Single, Heavy & Triple as per NEMA)	Grade 1 & 2 as per IEC (Single, Heavy & Triple as per NEMA)	Grade 1, 2 & 3 as per IEC (Single, Heavy & Triple as per NEMA)
Standard colour	Golden Yellow to Light Orange	As per requirement	Light Brown/ Medium Brown	As per requirement	Golden Yellow to Light Orange	Light Brown/ Medium Brown
UL Listed	File No. : None	File No. : None	File No. : None	File No. : None	File No. : None	File No. : None
TECHNICAL PROPERTIES AS PER IS:13730-0-1 / IEC-60317-0-1						
Heat shock (°C)	155	155	175	155	240	200
Cut through (°C)	170	170	240	170	400	300
Solderable temperature (°C)	Not applicable	375	Not applicable	375	Not applicable	Not applicable
Resistance to Abrasion for 1.00mm dia grade 2 wire (n)	>11.3	>9.3	>10.4	>9.3	>6.6	>10.9
Resistance to refrigerants	Very good	Not applicable	Not applicable	Not applicable	Very Good	Good
Flexibility & Adherence	Very good	Good	Good	Good	Very Good	Good
Bonding Temperature (°C)	Not applicable	170/200 depending on overcoat	Not applicable	Not applicable	Not applicable	Not applicable
SPECIAL CHARACTERISTICS & APPLICATION	High mechanical properties, good transformer oil resistance, suitable for 130°C Hermetic applications, used in oil filled transformers & equipments requiring high mechanical properties such as auto electricals.	Solderable, thermoplastic bonded by heat or solvent, used for all self supported coils for television, small motors, relays, magnets, telephones & voice coils of all kinds can be bonded in forms by heating at 170 /180°C	Upgraded thermo mechanical properties compared to ordinary polyesters, used in ignition coils, oil filled transformers, relays, contactors, fhp motors. This version can also be made for upgraded abrasion.	Self solderable property with good insulation resistance, high flexibility used in all communication equipments, relays, magnetic spools, universal & non-impregnated winding of all kinds of transformers.	Designed for using of wire for product with maximum value of the thermal and mechanical characteristics	Good resistance against refrigerants, transformer oil, high burnout resistance, used in fhp motors, hermetic application and thermal class 180°C equipments.
Delivery Spools	Please refer to page 38 to 40					
Special Notes	Can be supplied with Polyamide (Nylon) topcoated for improved high-speed windability, if required.		Can be supplied with Polyamide (Nylon) topcoated for improved high-speed windability, if required.	Can be supplied with Polyamide (Nylon) topcoated for improved high-speed windability, if required.		Can be supplied with Polyamide (Nylon) topcoated for improved high-speed windability, if required.

* IS 13730 and IEC 60317 are completely harmonized standards and identical.

Enamelled Round Winding Wires - Product Range (Contd...)

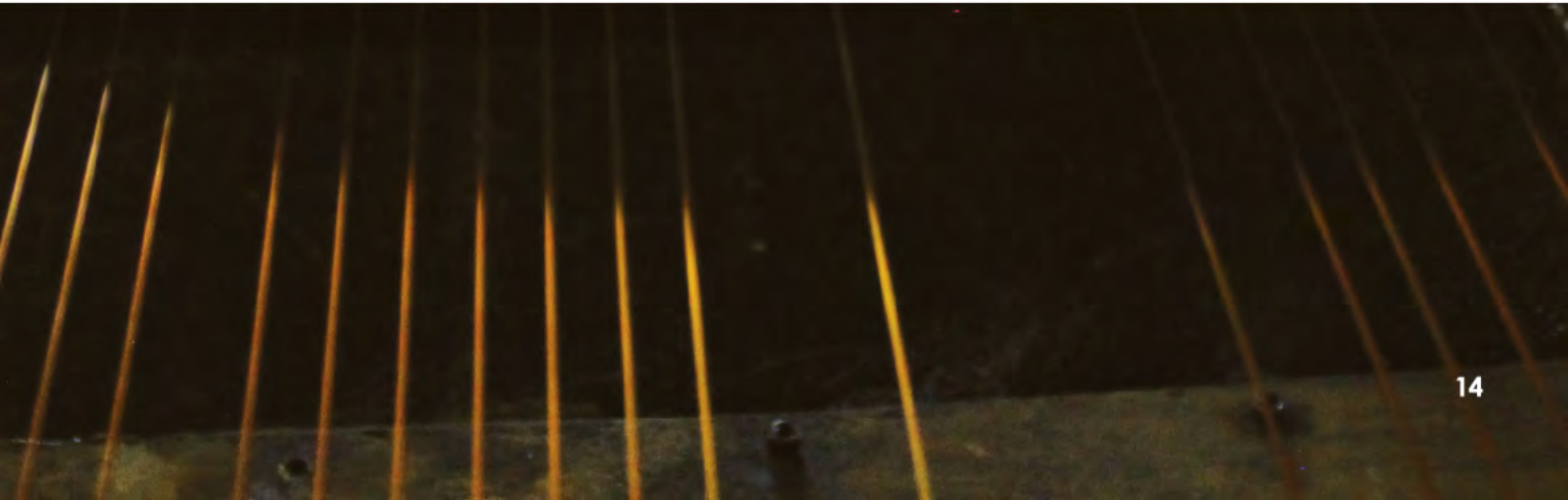
7	8	9	10	11	12	13	14	15
High temperature	Self solderable	Self solderable	Self solderable	High temperature	Self solderable		High temperature	General purpose
IS : 13730-13/ IEC- 60317-13/ NEMA MW-35C/ 73C(Hermetic)	IS : 13730-19/ IEC-60317-19 NEMA MW-28C	IS : 13730-20/ IEC-60317-20/ NEMA MW-79C	IS : 13730-21/ IEC-60317-21 NEMA MW-80C	IS : 13730-22/ IEC-60317-22/ NEMA MW-76C	IS : 13730-23/ IEC-60317-23	NEMA MW-24C	IS : 13730-26/ IEC-60317-26/ NEMA MW-81C	IS : 13730-34/ IEC-60317-34/ JIS C 3202-PEW
200 (C)	130 (B)	155 (F)	155 (F)	180 (H)	180 (H)	155 (F)	200 (C)	130 (B)
Theicpolyester / Polyesterimide	Polyurethane	Polyurethane	Polyurethane	Polyester/ Polyesterimide	Polyesterimide	Polyester	Polyamideimide	Polyester
Polyamideimide	Nylon	Not applicable	Nylon	Nylon	Not applicable	Polyamide	Not applicable	Not applicable
5.000-0.050 mm	2.000-0.050 mm	0.800-0.050 mm	1.600-0.050 mm	5.000-0.050 mm	1.600-0.050 mm	1.600-0.254 mm	1.600-0.071 mm	5.000-0.050 mm
Grade 1, 2 & 3 as per IEC (Single, Heavy & Triple as per NEMA)	Grade 1, 2 & 3 as per IEC (Single, Heavy & Triple as per NEMA)	Grade 1, 2 & 3 as per IEC (Single, Heavy & Triple as per NEMA)	Grade 1, 2 & 3 as per IEC (Single, Heavy & Triple as per NEMA)	Grade 1, 2 & 3 as per IEC (Single, Heavy & Triple as per NEMA)	Grade 1, 2 & 3 as per IEC (Single, Heavy & Triple as per NEMA)	Grade 1, 2 & 3 as per IEC (Single, Heavy & Triple as per NEMA)	Grade 1, 2 & 3 as per IEC (Single, Heavy & Triple as per NEMA)	Grade 1, 2 & 3 as per IEC (Single, Heavy & Triple as per NEMA)
Light Brown Medium Brown	As per requirements	As per requirements	As per requirements	Medium Brown to Dark Brown	Light Brown	As per requirement	Light Brown	Medium Brown
File No. : E174288 Thermal Class 200 and 220	File No. : None	File No. : E174288 Thermal Class 155	File No. : None	File No. : E174288 Thermal Class 180	File No. : None	File No. : E174288 Thermal Class 155	File No. : None	File No. : None
200	155	175	175	200	200	175	220	155
320	170	200	200	265	265	240	350	240
Not applicable	375	390	390	Not applicable	470	Not applicable	Not applicable	Not applicable
>11.3	>9.3	>8.1 (0.8 mm)	>9.3	>10.9	>10.9	>10.0	>7.05 (for gr.1)	>10.4
Very good	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Very good	Not applicable
Very good	Good	Good	Good	Good	Good	Good	Good	Good
Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
Very good resistance for refrigerants & chemicals, high burnout resistance, excellent windability, low coefficient of friction, high slotfill factor, used in special motors including Hermetic motors, Armatures, Alternators, Power Tools and high HP motors, suitable for high speed coil winding.	Low coefficient of friction, besides properties of general purpose polyurethane. It is suitable for winding in small size motors, coils of electrical instruments, especially of high speed winding.	Self solderable property with its low dielectric dissipation factor under high frequency. It can be widely used in electrical instruments of machine tools, motors which have special requirements of this type of enamel.	Low coefficient of friction, besides properties of polyurethane, suitable for winding in small and medium electrical instruments, for high speed winding.	Used in all 180°C class equipment requiring high speed machine winding, low coefficient of friction.	Self solderable with high potential both under the dry and humid conditions, good properties in heat shock and cut through, it is suitable for the coils of various motor appliances, instruments and telephone equipments.	Good mechanical, electrical & chemical resistance properties. Improved for high speed winding. FHP motors, coils & relays, audio & instrument coils.	High burnout resistance, excellent windability, low coefficient of friction, high slot fill factor, used in special types of motors & electromotive tools.	Good thermal & electrical properties, used in general purpose rotating & static electrical equipments, oil transformers, control coils.
Please refer to page 38 to 40								
Top coat Polyamide imide can be supplied of the type Self Lubricated, if required		Can be supplied with Polyamide (Nylon) topcoated for improved high-speed windability, if required.		Can be supplied with Polyamide (Nylon) topcoated for improved high-speed windability, if required.				Can be supplied with Polyamide (Nylon) topcoated for improved high-speed windability, if required.

* IS 13730 and IEC 60317 are completely harmonized standards and identical.

Enamelled Round Winding Wires - Product Range (Contd...)

	16	17	18	19	20	21
Type of enamelled wire	Self solderable/ Self bonding	Self solderable/ Self bonding	Self bonding	General purpose	General purpose	Self solderable High Temperature
SPECIFICATION STANDARD*	IS : 13730-35/ IEC-60317-35 JIS C 3202- SBUEW	IS : 13730-36/ IEC-60317-36 JIS C 3202- SBUEW	IS : 13730-37/ IEC-60317-37	IS : 13730-45/ IEC-60317-45	IS : 13730-54/ IEC-60317-54	IS : 13730-51/ IEC-60317-51/ NEMA MW-82C
THERMAL CLASS	155 (F)	180 (H)	180 (H)	130 (B)	155 (F)	180 (H)
Chemical base of base coat	Polyurethane	Polyesterimide	Polyesterimide	Polyester	Polyester	Polyurethane
Chemical base of top coat	Polyvinyl butyral/Polyamide	Polyvinyl butyral/Polyamide	Polyvinyl butyral/Polyamide	Not applicable	Not applicable	Not applicable
Range of Wire (Diameter)	0.800-0.050 mm	1.600-0.050 mm	1.600-0.050 mm	5.000-0.050 mm	5.000-0.050 mm	1.000-0.050 mm
Insulation Range	Grade 1b, 2b & 3b as per IEC (Single, Heavy & Triple as per NEMA)	Grade 1b, 2b & 3b as per IEC (Single, Heavy & Triple as per NEMA)	Grade 1b, 2b & 3b as per IEC (Single, Heavy & Triple as per NEMA)	Grade 1, 2 & 3 as per IEC (Single, Heavy & Triple as per NEMA)	Grade 1, 2 & 3 as per IEC (Single, Heavy & Triple as per NEMA)	Grade 1, 2 & 3 as per IEC (Single, Heavy & Triple as per NEMA)
Standard colour	As per requirements	Light Brown / Medium Brown	Light Brown/ Medium Brown	Light Brown/ Medium Brown	Light Brown/ Medium Brown	As per requirements
UL Listed	File No. : None	File No. : None	File No. : None	File No. : None	File No. : None	File No. : None
TECHNICAL PROPERTIES AS PER IS:13730-0-1 / IEC-60317-0-1						
Heat shock (°C)	175	200	200	155	175	200
Cut through (°C)	200	265	300	240	240	240
Solderable temperature (°C)	390	470	Not applicable	Not applicable	Not applicable	Not applicable
Resistance to Abrasion for 1.00mm dia grade 2 wire (n)	>8.1	>10.9	>10.9	>10.4	>10.4	>7.8
Resistance to refrigerants	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
Flexibility & Adherence	Good	Good	Good	Good	Good	Good
Bonding Temperature (°C)	170/200 depending on overcoat	170/200 depending on overcoat	170/200 depending on overcoat	Not applicable	Not applicable	Not applicable
SPECIAL CHARACTERISTICS & APPLICATION	Solderable, thermoplastic bonded by heat or solvent, used for all self supported coils for television, electronics, small motors, relays, magnets, telephones & volve coils of all kinds can be bonded in forms by heating at 170/180°C	Solderable, thermoplastic bonded by heat or solvent, used for all self supported coils for television, electronics, small motors, relays, magnets, telephones & volve coils of all kinds can be bonded in forms by heating at 170/180°C	Class 180°C with self bonding property and all other properties of Polyesterimide.	General purpose 130°C polyester. Good thermal & electrical properties, used in general purpose rotating & static electrical equipments, oil transformers, control coils.	General purpose 155°C polyester with heat shock at higher mandrel diameter. Good thermal & electrical properties, used in general purpose rotating & static electrical equipments, oil transformers, control coils.	Good mechanical, electrical & chemical resistant properties. Improved thermal resistance. Fast solderability. Fractional & integral horsepower motors Class 155. Coils & relays. Instrument & audio coils.
Delivery Spools	Please refer to page 38 to 40					
Special Notes			Can be supplied with Polyamide (Nylon) topcoated for improved high- speed windability, if required.			Can be supplied with Polyamide (Nylon) topcoated for improved high-speed windability, if required.

* IS 13730 and IEC 60317 are completely harmonized standards and identical.





Product Range

Enamelled Rectangular Copper Wires



Enameled Rectangular Copper Wires are available with various insulation coatings such as:

- Poly Vinyl Acetal, Class 105, 120
- Polyester, Class 155
- Polyesterimide 180
- Dual Coated Polyester (imide) + Polyamide imide, Class 200
- Polyimide Class 240
- Polyamide imide, Class 220
- Poly Vinyl Acetal + Epoxy Bondable Class 120
- Polyesterimide Bondable, Class 155 and 180
- And other insulation coatings according to customer specifications

Enamelled Rectangular Copper Wires

Enamelled Rectangular Copper Conductors Product Range

	1	2	3	4	5
SPECIFICATION STANDARD	IEC-60317-17 NEMA MW-18C	IEC-60317-18	IEC-60317-16	IEC-13730-28	IEC-60317-29/ NEMA MW-36C
THERMAL CLASS	105	120	155	180	200
Chemical base of base coat	Polyvinyl Acetal	Polyvinyl Acetal	Polyester	Polyesterimide	Polyesterimide
Chemical base of top coat					Polyamide-imide
Range of Wire	Cross section area up to 75 sq.mm, Thickness : from 1.00-5.50 mm, Width : from 2.0-14 mm				
Insulation Range	IEC Grade 1:0.060-0.110, IEC Grade 2:0.120-0.179; NEMA Grade Heavy : Increase in width / thickness : 0.076-0.127, Grade Quadruple : increase in width / thickness : 0.127-0.178mm				
Standard colour	Golden Yellow	Golden Yellow	Brown	Brown	Brown
TECHNICAL PROPERTIES AS PER IEC-60317-0-2					
Flexibility & Adherence					
Mandrel Bending on Thickness & on Width (upto 10 mm) (Over Width)	2 x W & T 3 x W	2 x W & T 3 x W	4 x W & T 5 x W	4 x W & T 5 x W	4 x W & T 5 x W
Adherence (the distance of loss of adhesion =< 1 x Width)	20	20	15	15	15
Heat Shock No cracks after bending on thickness / Temperature °C	6 x T / 155	6 x T / 155	6 x T / 175	6 x T / 200	6 x T / 220
Break down voltage at Room temp. (minimum) Volts	Grade 1 : ≥ 1000, Grade 2: ≥ 2000				
Resistance to hot transformer oil	Excellent	Excellent	Not applicable	Excellent	Excellent
Heat Bonding Temperature/Time	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
SPECIAL CHARACTERISTICS & APPLICATION	High mechanical strength, strong adhesion of enamel to copper conductor, Excellent hydrolysis & oil resistance		Good thermal, and overall good mechanical, electrical and chemical properties	High thermal, and overall good mechanical, electrical and chemical resistance	High thermal, electrical and mechanical, properties, excellent heat shock and burnout
Delivery Spools	Please refer to page 41				
Special Notes	Oil filled power & distribution transformers, Inductance coils, etc.	Oil filled large transformers chokes & Inductance coils, etc.	Large rotating Machines such as: motors, DC motors, High Voltage motors, etc.	Large and special electrical machines such as: generators, alternators, Motors, HV motors, Dry type transformers, Loco Transformer Inductor coils, etc.	

Enamelled Rectangular Copper Conductors Product Range (Contd...)

	6	7	8	9
SPECIFICATION STANDARD	IEC-60317-30/ IEC-60317-47/ NEMA MW-20C	IEC-60317-58 draft	IEC-60317-18	IEC-60317-16
THERMAL CLASS	220/240	220	120	180
Chemical base of base coat	Polyimide	Polyamide-imide	Polyvinyl Acetal	Polyesterimide
Chemical base of top coat			Epoxy-Bond coat	Epoxy-Bond coat
Range of Wire	Cross section area up to 75 sq.mm, Thickness : from 1.00-5.50 mm, Width : from 2.0-14 mm			
Insulation Range	IEC Grade 1:0.060-0.110, IEC Grade 2:0.120-0.179; NEMA Grade Heavy : Increase in width / thickness : 0.076-0.127, Grade Quadruple : increase in width / thickness : 0.127-0.178mm			In addition to base coat increase in dimensions, additional bond coat increase in thickness of 0.02 - 0.08 mm
Standard colour	Light Brown	Light Brown	Golden Yellow	Brown
TECHNICAL PROPERTIES AS PER IS:13730-1/IEC-60317-0-1				
Flexibility & Adherence				
Mandrel Bending on Thickness & on Width (upto 10 mm) (Over Width)	4 x W & T 5 x W	4 x W & T 5 x W	2 x W & T 3 x W	4 x W & T 5 x W
Adherence (the distance of loss of adhesion $\leq 1 \times$ Width)	15	15	20	15
Heat Shock No cracks after bending on thickness / Temperature °C	6 x T / 240	6 x T / 240	6 x T / 155	6 x T / 200
Break down voltage at Room temp. (minimum) Volts	Grade 1 : ≥ 1000 , Grade 2: ≥ 2000			
Resistance to hot transformer oil	Not applicable	Not applicable	Excellent	Excellent
Heat Bonding temperature/Time	Not applicable	Not applicable	110 C/48 h or 120 C/24 h / As per customer specification	
SPECIAL CHARACTERISTICS & APPLICATION	Very high thermal properties	Very high thermal properties	Bondable coating with excellent mechanical properties	Bondable coating with excellent thermal properties
Delivery Spools	Please refer to page 41			
Special Notes	Special electrical machine and magnet coils for aerospace industries	Large and special electrical machines such as: Generators, Motors, HV motors, Dry type transformers, Inductor coils, etc.	Oil filled large transformers, LOCO transformers, chokes & Inductance coils, particularly with improved mechanical strength (hoop stress) to resist high short circuit	



PRECISION



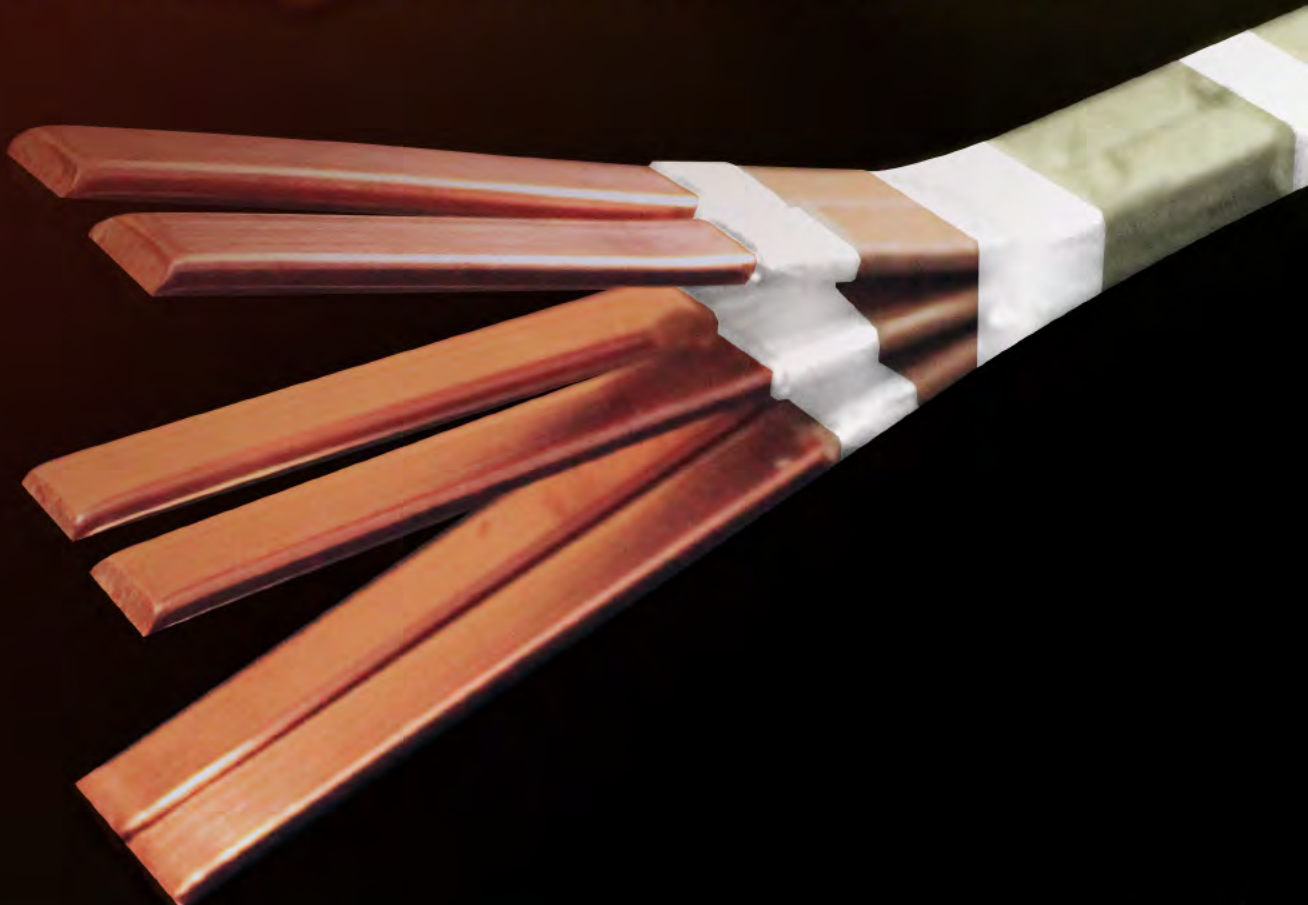


Product Range
Rectangular Taped Conductors

PWIL produces various types of Rectangular Taped Conductors as below

Rectangular/ Single/ Bunched Proof Stressed Taped Copper Conductors with -	
a) Bare Width	:- 3mm to 25 mm.
b) Bare Thickness	:- 1.2 mm to 10 mm
c) Cross Section Area	:- 5 sq.mm to 120sq.mm
d) Periphery of Rectangular Conductor	:- 50 mm Max.
e) Width / Thickness Ratio	:- 1:9
f) Insulation Thickness	:- 0.3 mm to 6 mm
g) Number of Layers	:- 1 to 40 nos.

Note : Specific requirement as per customer specification



Rectangular Taped Conductors



Sr. No.	DESCRIPTION
1.	<p>Kraft paper insulated Rectengular Copper Conductors single to six bunched (Radial / Axial Bunched) as per IEC 60317-27 or as per customer specifications.</p> <p>a. Regular Kraft Paper Insulation - It is a cellulosic Paper, as per IEC 554-3-5, and available in thickness from 50 Micron to 100 Micron, used widely for conductor insulation in Oil filled Transformers.</p> <p>b. Thermally Upgraded Paper - with Thermal Class E (120 Deg.C) as per IEC 554-3-5, available in thickness from 50 Micron to 100 Micron.</p> <p>c. Diamond Dotted Epoxy Paper in various thickness, which improves thermal properties.</p> <p>d. High Dencity Thermally upgraded electrical grade creped kraft paper.</p>
2.	<p>Nomex™ Paper Insulated Rectangular Copper Conductors single to 6 bunched (Radial / Axial Bunched) as per IEC 60317-27 or as per customer specifications.</p> <p>a. Type 410/ 926 :This is a 220 Aramid based Calendered paper which offers high dielectric strength, mechanical toughness, flexibility and resilience.</p> <p>Rectangular Conductors with this type of Nomex paper Insulation is used in Electrical Motors, Generators Traction Equipments and Transformer Windings, due to high temperature index, excellent chemical resistance and outstanding overall insulating properties.</p> <p>b. Type E 188 : This type of Paper is used in low, medium and high voltage Motors and Generators, Power, Distribution, Dry Type and Welding Transformers and also for all Transformers, that requires high Thermal Class.</p> <p>Non Flammability of Nomex™ Paper allows its use , where there are high Fire Risks.</p>
3.	<p>Enameled+Kraft / Nomex Paper Insulated Rectangular Copper Conductors single to 6 bunched (Radial / Axial Bunched) as per IEC 60317-27 or as per customer specifications.</p> <p>a. Rectangular Conductors with this type of (Kraft / Nomex paper) Insulation is used in High Voltage Electrical Motors, Generators and Transformer Windings so as to provide outstanding overall insulating properties.</p>
4.	<p>MICA Tape Insulated / Enameled+MICA Tape Insulated Rectangular Copper Conductors (Single Conductor) as per IEC 60317-27 or as per customer specifications.</p> <p>a. Insulation used in such type is MICA / Polyester Insulation.</p> <p>MICA Paper is a type of Paper composed only of small strips of MICA with no admixture or bonding material (100% MICA).</p> <p>MICA - POLYESTER compounds generally comprise MICA Paper on which a Polyester film Coat (PETP) is spread using an Epoxy resin.</p> <p>The above materials are of Thermal Class 150 Deg.C and are used as insulation for High Voltage Motors / Generators Windings.</p>

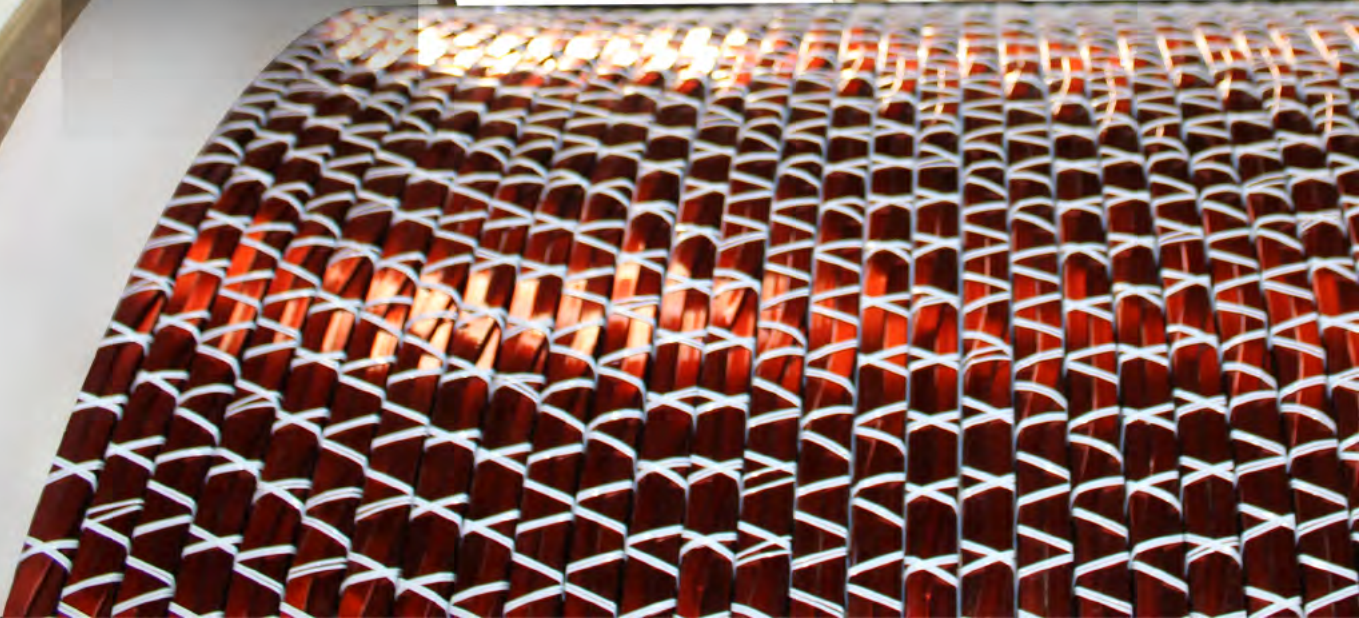
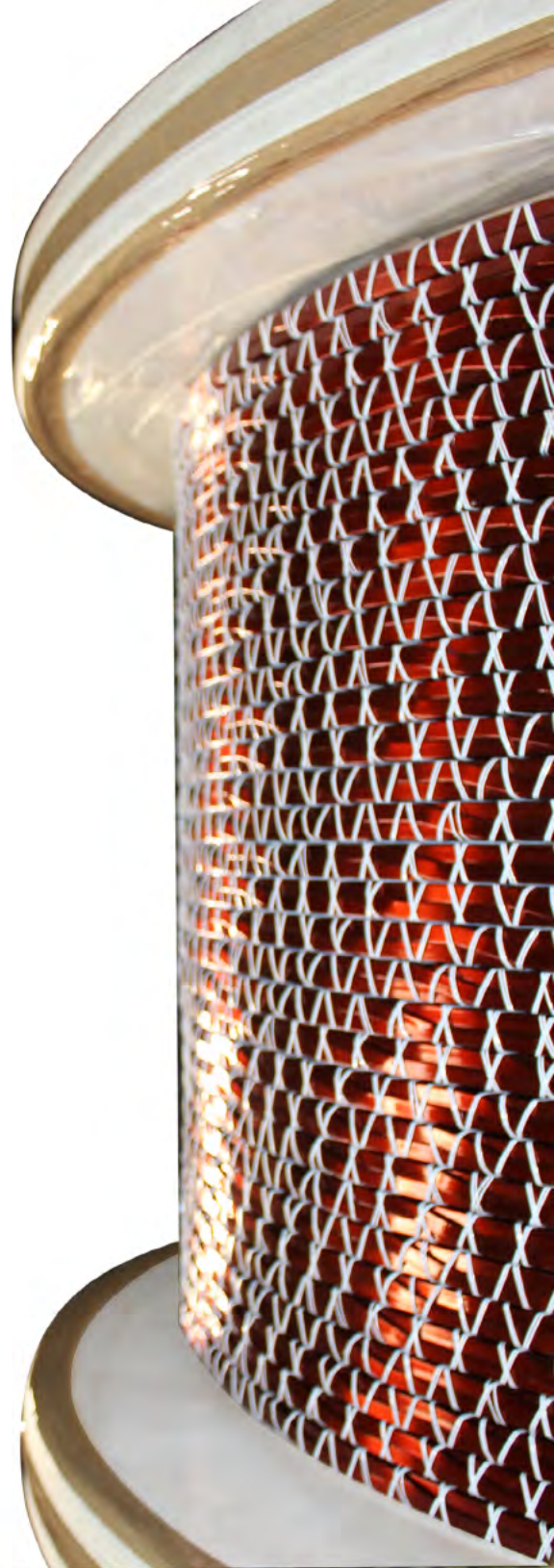


PRECISION



MILAN

WINDING WIRES



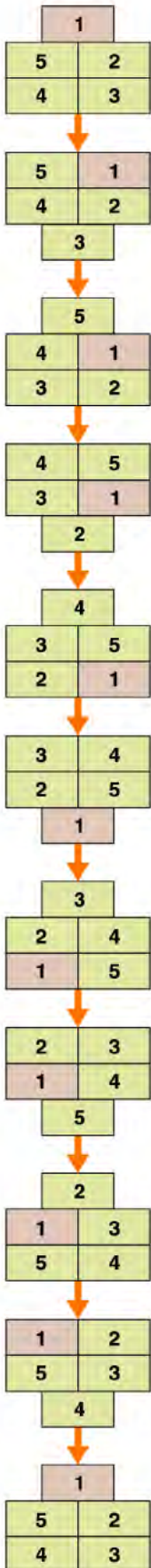


Product Range

Continuously Transposed Conductors (CTC)

Rectangular Taped Conductors

WHAT IS TRANSPOSING ?



The enamelled wire conductors within CTC are arranged in two parallel stacks. One stack having one more conductor than the other. The conductors are continuously transposed by machine action moving them from position to position in discrete steps :

Step 1 : Conductor 1 is moved from the top of the left hand stack to the top of right hand stack.

Step 2 : The right hand stack is moved down one conductor thickness in relation to the left hand stack.

Step 3 : Conductor 3 is moved from bottom of right hand stack to the bottom of left hand stack.

Step 4 : The left hand stack is moved up one conductor thickness in relation to the right hand stack.



At the end of four transposing steps, as shown in the figure, the CTC conductors have returned to the original geometry, but each conductor advanced one position clock-wise.



Continuously Transposed Conductors (CTC)



INTRODUCTION OF CTC :

Sr. No.	Description	Type of Enamel Insulation and Thermal Class °C	Type of Insulating Paper
1.	PRECITRANS	PVA, Class 120 0.06 to 0.20 mm insulation build up	Kraft, Thermally Upgraded, Crepe, Nomex™ or others as per Customer request.
	Remarks	Suitable for large Oil Filled Power and Distribution Transformers	
	Advantages	<ul style="list-style-type: none"> Improved transformer performance by reducing eddy current losses. Considerable increase in space factor due to very small thickness of single conductor insulation. Uniform temperature distribution throughout winding. 	
2.	PRECIBOND	PVA + Epoxy, Class 120 (The epoxy coating is cured to B-stage and is tack free)	Kraft, Thermally Upgraded, Crepe, Nomex™ or others as per Customer request.
	Remarks	Suitable for large Oil Filled Power and Distribution Transformers	
	Advantages	<ul style="list-style-type: none"> Improved transformer performance against unstable electrical network and short circuit risks. Exceptional bond between Enamelled rectangular wires offers increased strength. Increased short circuit forces resistance due to conductor bonded like a solid beam. Excellent B-Stage storage stability. Strands bonding during drying process, hence no special treatment necessary at users end. Epoxy resin coating cure in the same process as paper drying at 100-120°C. Best hot transformer oil resistance. Each insulated conductor has improved insulation due to Epoxy. Tack free and dust-free surface of insulated conductor for easy handling of Strips without powder residue. No pollution since B-stage Epoxy is free from harmful solvents. Small thickness of Epoxy bond coat needed (0.020-0.080 mm) Better sliding amongst the strands, improving CTC windability. A bond coat with low insulation thickness as per customer's request can also be provided. 	
3.	PRECITRANS-200	Polyesterimide + Polyamideimide Class 200	Thermally Upgraded, Nomex™ or others as per Customer request.
	Remarks	For dry type Transformers requiring high temperature resistance	
	Advantages	<ul style="list-style-type: none"> High Temperature Resistance. Improved transformer performance by reducing eddy current losses. Considerable increase in space factor due to very small thickness of single conductor insulation. Uniform temperature distribution throughout winding. Increased short circuit force resistance, particularly with epoxy bond coat insulation. 	
4.	PRECICORD	PVA, Class-120 or PVA+Epoxy, Class 120 (The Epoxy Coating is cured to B-stage and is tack free)	Paperless width monofilament cord
	Remarks	The CTC design is generally considered for Helical winding especially for Low Voltage Winding.	
	Advantages	<ul style="list-style-type: none"> No Bulging of paper CTC Free from oil pocket among the windings. Better Space factor of the winding allowed by reduction of all ducts. Better cooling efficiencies. 	

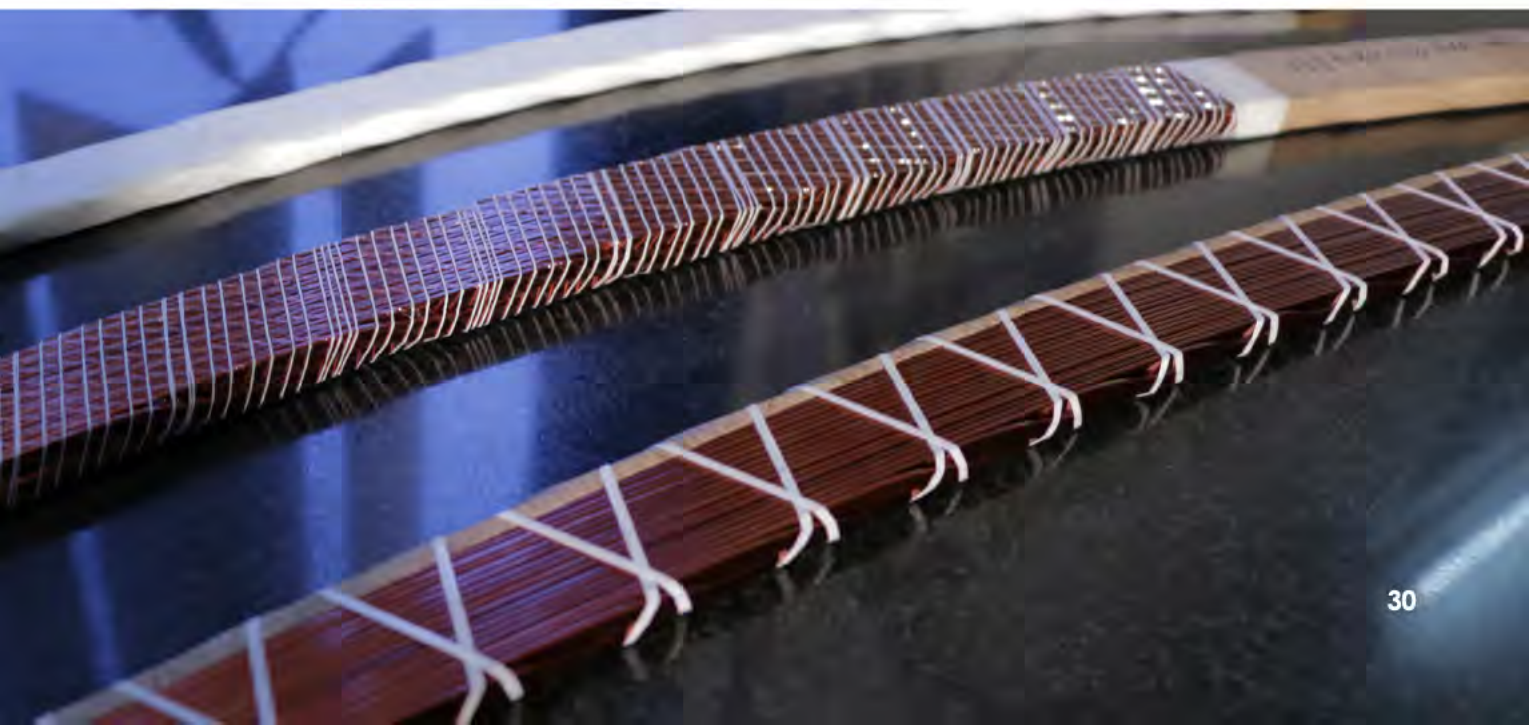
INTRODUCTION OF CTC :

Sr. No.	Description	Type of Enamel Insulation and Thermal Class °C	Type of Insulating Paper
5.	PRECIMESH	PVA, Class-120 or PVA+Epoxy, Class 120 (The Epoxy Coating is cured to B-stage and is tack free)	Paperless with Polymer Mesh Tape
	Remarks	The CTC design is generally considered for Helical winding especially for Low Voltage Winding.	
	Advantages	<ul style="list-style-type: none"> • Better Windability • No Bulging of paper • CTC Free from oil pocket among the windings. • Better Space factor of the winding allowed by reduction of all ducts. • Better cooling efficiencies. 	

Remarks :

- The copper conductor used is Electrolytic Tough Pitch (ETP) or Oxygen Free Copper with high conductivity, for controlled low losses in electrical machines.
- The number of strands includes all numbers between 5 to 72 ; odd numbers give higher cross section area in CTC. Paper tapes up to 24 wrapping is applied as external insulation over the transposed conductor bunch.
- The increase in insulation dimensions can be used as a guideline. Specific requirements can be executed as per customer request.
- Besides fully annealed copper conductor, PRECITRANS CTC is available with copper conductor having controlled proof stress for increased mechanical strength as under -

CONTROLLED PROOF STRESS CTC, REF STANDARD EN 13601:2002 OR BS 1432		
Grade	R _p (0.1%) MPa	Special grades supplied against customer requirement
CPR-1	140-200	
CPR-2	170-220	
CPR-3	220-260	
FULLY ANNEALED		
Annealed	R _p (0.2%) 60-100	Standard grade supplied



CTC MANUFACTURING RANGE :

CONSTRUCTION DETAILS		
No of Single conductors (Strands) in CTC	5 - 72	Generally odd nos.
Min. dimensions of conductor (mm)	Thickness : 1.00 Width: 3.30	
Max. dimensions of the single conductor (mm)	Thickness : 3.00 Width : 12.00	
Width to thickness ratio (Preferred) for Single Conductor	From 2.20 min to 6.0 max.	
Height to Width ratio (Preferred) of CTC		Preferred height to width ratio of CTC will be intimated during contract review stage
Inter column separator	0.1 mm thick	Other thickness on request
Inner paper wrapping	Generally 0.050-0.100 mm kraft paper max 22 nos.	Other thickness on request
Outer paper wrapping	Generally 0.080 mm thermally upgraded/ high density crepe paper, last 2 paper coverings	Other thickness on request
Packing on Wooden/ MS drums	From 250-6000 kg with or without separators (refer Delivery Spools IV)	As per customer requirement

ENAMELLED RECTANGULAR WINDING WIRES USED IN CTC :

Enamelled Rectangular Winding Wires are one of the key ingredients of CTC. Wire Enamel being a critical input of Enamelled Rectangular Winding Wires is carefully chosen to give the desired properties like abrasion resistance, transformer oil resistance, temperature resistance, dielectric strength, etc.

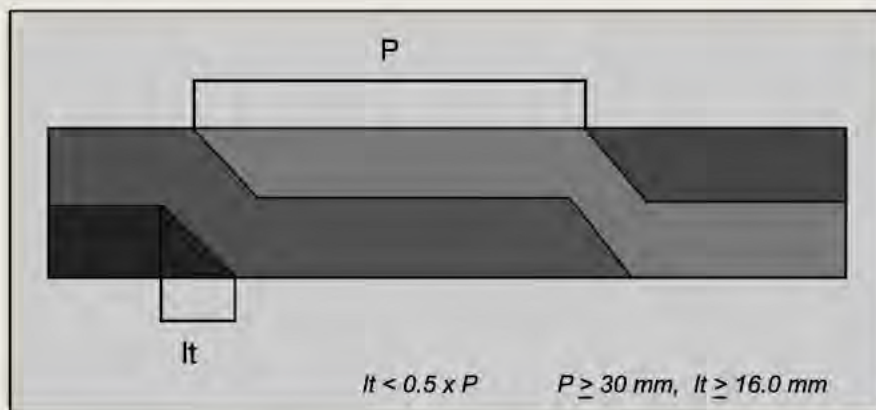
DEFINITIONS :

TRANSPOSING PITCH :

Transposing pitch "P" is the distance between two transposing.

TRANSPOSING LENGTH :

Transposing length "lt" is the length measured on the CTC between two points where the stand goes from one side to the other side of the CTC stack. The transposing length is generally less than 50% of the Transposing Pitch "P".



MINIMUM WINDING DIAMETER AND TRANSPOSING PITCH:

The first property to be satisfied during the manufacture and use of the CTC is the windability on the transformers core.

Generally the length in which there is a complete transposing of one strand (called stranding pitch) should be less than the circumference of the transformer core.

The requirement is due to the flexibility of the CTC in order to avoid any damage of the CTC structure.

Minimum winding diameter is in relationship with the dimensional characteristics and the stranding pitch by the following formula :

$$\pi \times Di = S \times n \quad \text{stranding pitch}$$

$$S = M \times h \quad \text{transposing pitch}$$

Where :

S = Transposing distance (Transposing pitch), distance between two transpositions

M = S/h = Proportionality coefficient - transposing factor (if less than 6, the maximum plus tolerance in radial dimension shall be 'k').

If M is lower than 6 it can be difficult to produce the CTC for strand width greater than 6mm, because the pitch can be too small for the transposing machine. If n is large, the pitch must be short but not too short to get M lower than 6.

CTC DIMENSIONS

CTC DIMENSIONAL DATA

Calculation of the cable outer dimensions

Maximum dimension in axial direction :

$$H = 2x(h + iE) + ip + ic + Kh$$

Maximum dimension in radial direction

$$B = \left[\left(\frac{n+1}{2} \right) x (b + iE) \right] + ic + Kb$$

Where :

H = Axial cable dimension;

B = Radial cable dimension

h = Axial strand dimension;

b = Radial strand dimension

Kh = Maximum plus tolerance 0.10 mm for axial dimension

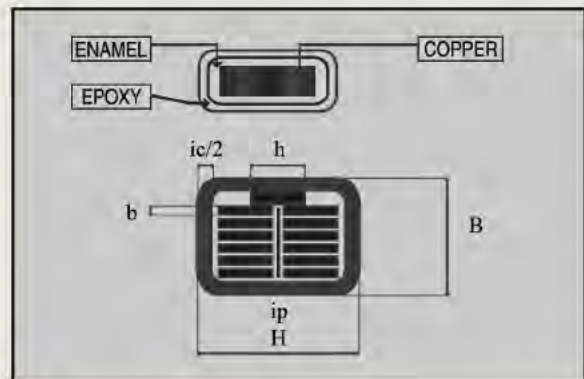
Kb = Maximum plus tolerance for radial dimension (values in table)

n = Number of strands in the cable

iE = Increase in dimensions due to enamel (0.13 for pva and 0.19 for pva plus epoxy)

ip = Thickness of separator between the strands stacks.

ic = Paper covering (in case of cable without paper ic/2 is the thickness of the plastic wire)



Measurement of CTC

Table : Kb values

Numbers of strands	s/h ≥ 8 and b < 2 mm and Rp 02 < 180 MPa	All others cases
Up to 21	0.20	0.30
From 23 to 27	0.25	0.50
Form 29 to 35	0.35	0.60
Greater than 35	0.70	1.00

S = Transposing distance (Transposing pitch), distance between two transpositions.

CTC dimensions are tested under pressure of $1\text{N}/\text{mm}^2$ or as per customer specific requirement. Jaw length of min 120 mm of the measuring device is preferred.

INTERCOLUMN SEPARATOR :

An intercolumn separator between the two stacks of CTC conductors is inserted, for all stack heights more than 10 mm, unless otherwise agreed to with the user.

The standard paper thickness for this is 0.100-0.125 mm thick.

Intercolumn paper is generally inserted if :

$$W = \frac{(n-3) \times (b+E)}{2} > 10 \text{ for PVA CTC}$$

PAPER ARRANGEMENT :

Transposed Enamelled Conductors / Strands are wrapped with multiple layers of oil resistant Kraft and/or other special papers to give high dielectric and mechanical strength to the CTC. The paper rolls can be slitted into required width tapes.

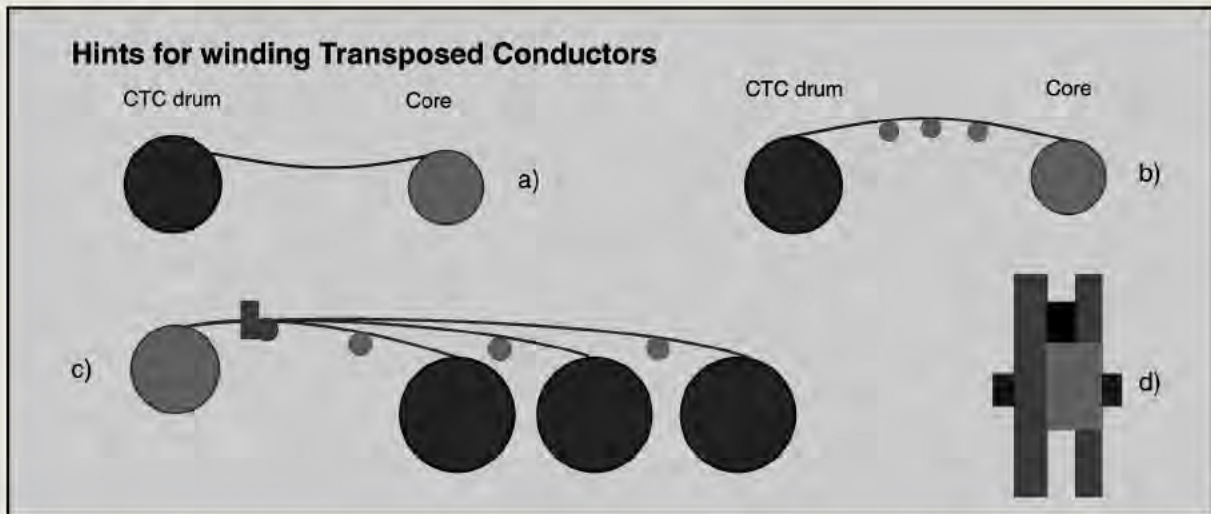
TYPES OF PAPERS :

Paper Type	Thickness (Recommended) (mm)	Application	Salient Properties
Kraft Paper	0.050 - 0.100	General purpose, inner layers	High purity 5A2-1M3
Thermally upgraded paper	0.100 - 0.125	General purpose, inner and outer layers	High tensile strength
High Density Creped Kraft paper	0.075 - 0.080	Inner and outer Layres	High thermal and mechanical properties
Aramid paper (Nomex®)	0.050 - 0.080	Thermal Class 200	High temperature resistant, for dry type transformers

Special papers, depending on customers requirement can be used.

WINDING GUIDELINES FOR PRECITRANS CTC :

For optimal performance of CTC during the winding it is necessary to follow certain basic precautions.



During winding operations it is necessary to use some criteria in order to get the best winding of the Transposed Conductor on the transformer core, particularly if the CTC has a high ratio B/H.

- Goods should be handled with proper mechanised handling equipment.
- When the diameter core is greater than 25 times the radial dimension B, it is possible to wind the CTC leaving it free in the region between CTC and winding core (see figure a).
- In case of core with diameter less than 15 times the radial dimension of the CTC, is possible to wind the Transposed Conductor using the following hints :
 - Distance between transformer core and the drum axis shall be multiple of the stranding pitch S.
- CTC shall be held up and guided by rollers (see figure b) in order to avoid flexions in the length between core and drum.
- In order to avoid CTC twisting, rollers shall have adjustable flanges (see figure c and adjustable flanges d).

DRYING AND HEIGHT ADJUSTMENT PROCESSES AFTER WINDING :

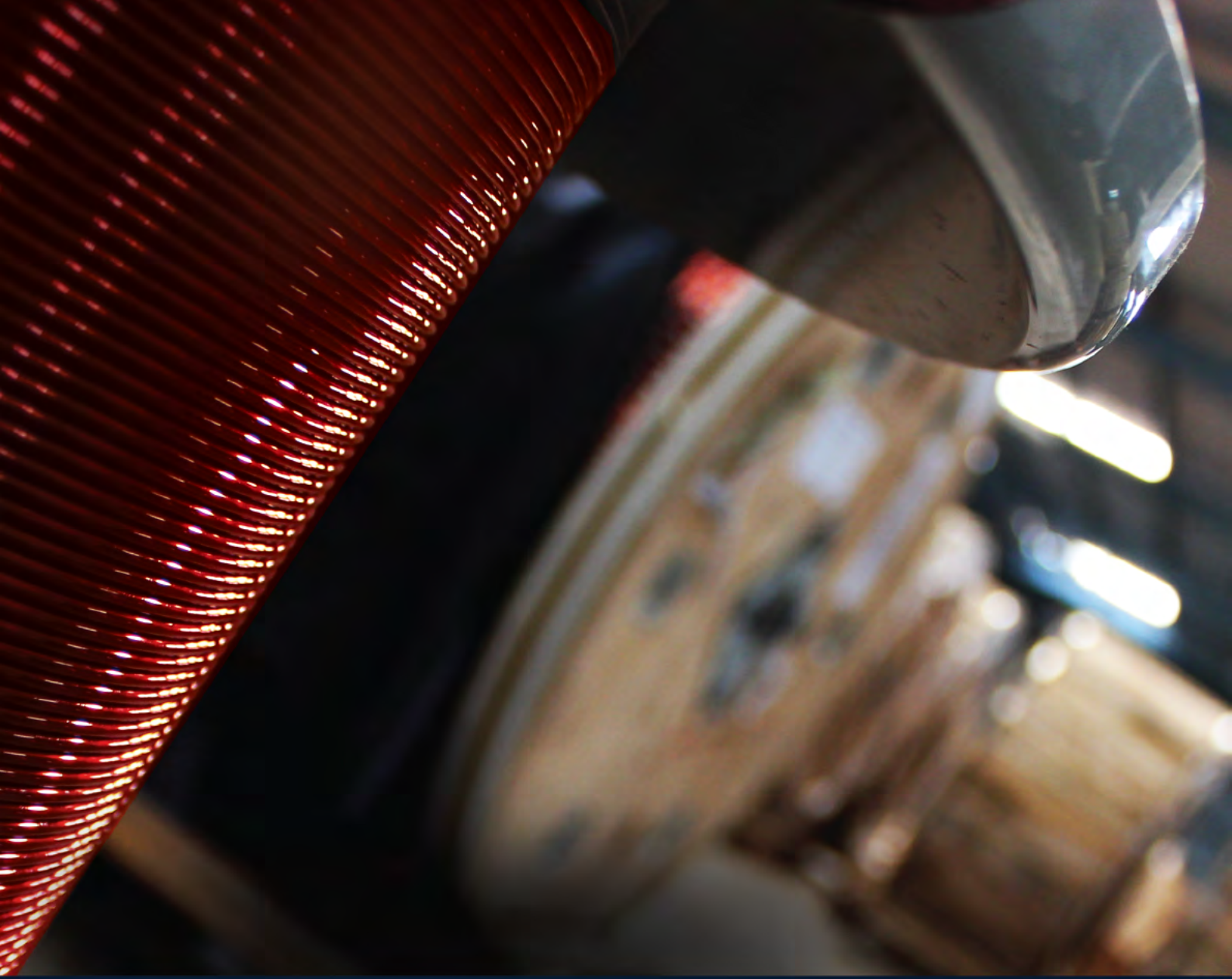
PRECIBOND CTC generally gives best bonding after curing in the range of temperature between 110°C and 130°C. In our Quality Assurance laboratory the adhesive strength test on Epoxy bond coated conductors is done by heating for 24 h at 120°C.

Many customers use the following drying cycle with great success

- During the transformer manufacturing, drying under vacuum, a pressure of 3-5 N/mm² (on the spacers of the helical coil winding) is applied and the temperature is raised to 115°C for 48-72 h. (excluding 6-8 h preheating and 10 hours of cooling period)
- A dimensional adjustment is done at a pressure, in order to reach final dimensions
- A vapour phase drying is done at 130°C for 48 hrs. (after 2-3 hrs. preheating to reach the temperature)
- Before the heat treatment, ensure that at the two ends of the strands are separated sufficiently, to avoid undesirable bonding between them.

Delivery Spools





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Delivery Spools

I) Enamelled Round Winding Wires

PWIL make Enamelled Round Winding Wires are supplied on plastic spools, both Cylindrical Barrelled and Taper Barrelled, as per the customer demand.

These spools are generally according to specifications :

IEC 60264-2-2 : Specification for Cylindrical Barrelled plastic spools, returnable type.

IEC 60264-3-2 : Specification for Taper Barrelled plastic spools, returnable type.

Indian equivalent Cylindrical Barrelled Plastic spools, non-returnable type.

Please refer to the table below for the available spool sizes against size range of wire :

Wire sizes & Respective Spool Types :

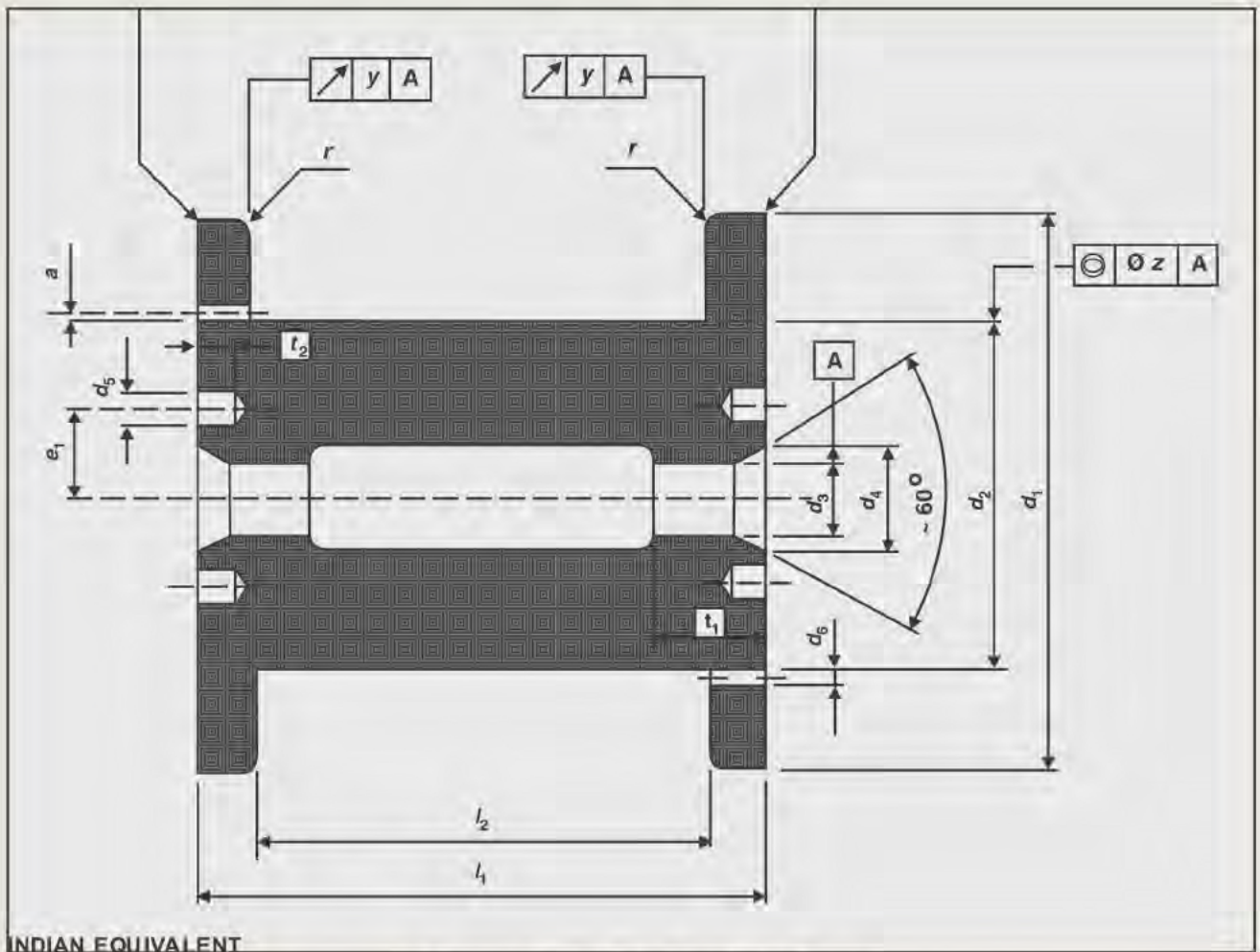
Cylindrical Barrelled Spools

Size Range (mm)	IEC 60264-2-2 (Cylindrical Barrelled Spools) (Refer figure 1)	Indian Equivalent Spools (Refer figure 4)
4.000 to 0.500	355, 265, 250 & 200	500W, 410W, 265 & 250
0.490 to 0.350	160	160 PT-4/PT-10
0.349 to 0.200	160 & 125 PT-4/10	160 & 125 PT-4/PT-10
0.190 to 0.080	160 & 125 PT-4/10	160 & 125 PT-4/PT-10

Taper Barrelled Spools

Size Range (mm)	IEC 60264-3-2 (Taper Barrelled Spools) (Refer figure 2)	As per JIS Spools (Refer figure 3)
4.000 to 0.500	200/315, 250/400, 315/500 400/630 & 500/800	—
0.500 to 0.200	200/315, 250/400, 315/500 & 400/630	—
0.200 to 0.120	200/315, 250/400, 315/500 & 400/630	PT-10
0.120 to 0.080	—	PT-10 & PT-4

Other Spools available on request.



INDIAN EQUIVALENT

Figure 1: Cylindrical Barrelled Spool

Table 1 : Dimensions of Cylindrical Barrelled Spools (Non-returnable) (See Figure 1)

Spool Type	Dimensions (mm)																Net Weight, Max. (Kg.)	APPLICABLE SPECS.		
	d ₁	d ₂	d ₃		d ₄	d ₅	d ₆	l ₁		l ₂		a	t ₁	t ₂	z	y			e ₁	r
			Nom.	Tol.				Nom.	Tol.											
125	125	80	16	+0.20	24	7	3	125	100	0.2	1.5	25	8	0.6	0.2	20	3	3	IEC 60264-2-2	
160	160	100	22	+0.20	34	13	3	160	128	0.2	1.5	28	12	0.6	0.3	32	4	7		
200	200	125	22	+0.20	34	13	3	200	160	0.3	1.5	32	12	0.6	0.3	32	4	14		
250	250	160	22	+0.20	34	13	4	200	160	0.4	2.0	36	12	1.0	0.4	32	5	22		
265	265	160	40	+0.20	48	13	4	200	160	0.4	2.0	-	-	1.0	0.4	40	5	25		
355	355	224	22	+0.50	60	26	4	200	160	0.4	2.5	40	30	1.2	0.5	80	5	48		
125	125	65	22	+0.2	30	8	4	90	70	0.2	2.0	-	-	0.6	0.2	24	2	2.5	INDIAN EQUIVALENT	
160	160	94	36	+0.2	40	13	4	124	100	0.2	2.0	-	-	0.6	0.2	24	2	5		
250	250	112	40	+0.2	48	13	4	142	114	0.4	2.0	-	-	1.0	0.4	32	5	22		
410W	410	200	40	+0.6	50	16	6	215	175	0.6	3.0	-	-	1.2	0.5	80	6	70		
500W	500	290	40	+0.6	50	16	8	210	165	0.6	4.0	-	-	1.2	0.5	80	6	100		

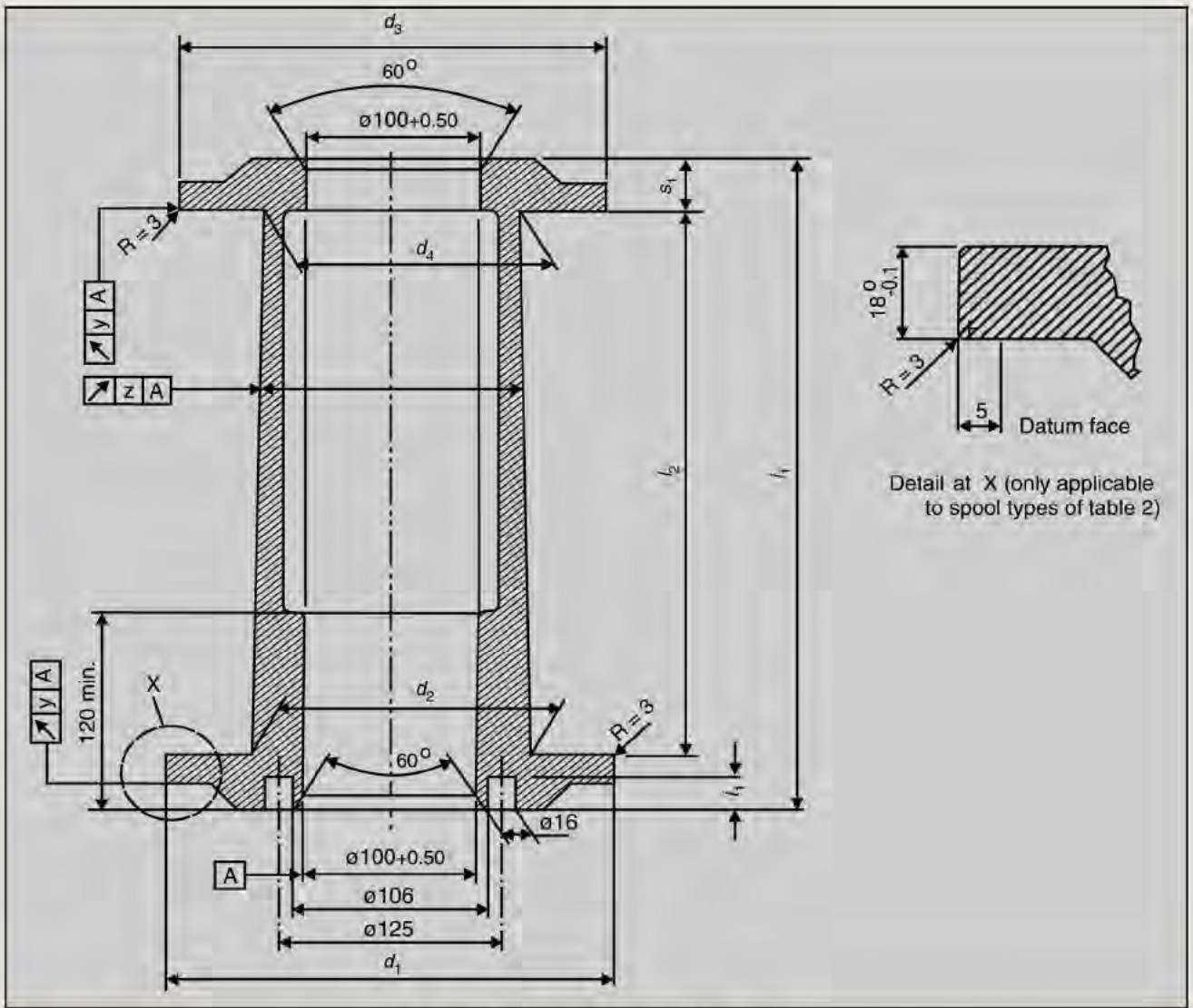


Figure 2: Taper Barrelled Spools

Table 2 : Dimensions of Taper Barrelled Spools (Returnable) (See Figure 2)

Spool Type	Dimensions (mm)											Net Weight, Max. (Kg.)	APPLICABLE SPECS.
	d ₁	d ₂	d ₃	d ₄	l ₁	l ₂		t ₁	s ₁	z	y		
						Max.	Nom.						
200/315	200	125	190	112	315	265	+0.30	7	25	0.4	0.3	25	IEC 60264-2-2
250/400	250	160	236	140	400	335	+0.50	15	32.5	0.6	0.4	45	
315/500	315	200	300	180	500	425	+0.80	20	37.5	1.0	0.6	90	
400/630	400	250	375	224	630	530	+1.00	30	50	2.0	1.0	180	
500/800	500	315	475	280	800	670	+2.00	30	65	2.5	1.5	400	
PT4	140	85	125	75	200	175	+0.20	-	14	0.4	0.3	4	INDIAN EQUIVALENT
PT10	180	110	160	94	225	200	+0.20	-	14	0.3	0.2	10	

Note - Center Hole - PT4 - ϕ 26 + 0.20, Center Hole - PT10 ϕ - 30 + 0.20

II) Enamelled Rectangular Copper Conductors

Dimensions of Drums (All dimensions in mm)

Flange Dia	Barrel Dia	Traverse	Flange Thick	Bore Dia	Catch hole Distance	Slot/hole on barrel	No. of iron tube	Wt. Kgs.
450 *	300	200	18	38	120	15	5	50-60
500 **	300	240	18	38	120	15	–	90-100

* Wooden Spools- Returnable Type

** Plastic Spools Returnable Type

III) Rectangular Taped Conductors

Dimensions of Drums (All dimensions in mm)

Flange Dia	Barrel Dia	Traverse	Flange Thick	Bore Dia	Catch hole Distance	Slot/hole on barrel	No. of iron tube	Wt. Kgs.
450	300	240	20/22	52	125	15	5	65
500	300	240	20/24	52	125	15	5	115
560	300	240	20/24	52	125	15	5	150
610	300	240	20/24	52	125	15	6	180
710	400	300	22/24	52	170	15	7	240
710**	560	300	22/26	52	170	15	7	120
760**	560	300	22/26	52	170	15	8	210
810**	560	300	22/26	52	170	15	10	280
850**	560	300	22/30	52	170	15	10	350
910**	560	300	24/30	52	170	15	12	400
1000**	650	350	35/35	52	170	15	14	500
1100**	650	350	40	85	170	16	8*	800
1200**	650	400	40	85	170	20	8*	1100

Notes :

1. Catch hole for all drums will be 16mm.
2. * Rods of 16 mm diameter.
3. ** One additional hole of 18mm to be provided on flange at 290mm distance from centre.

IV) Continuously Transposed Conductors (CTC)

CTC is generally supplied on returnable / non returnable wooden or MS Spools

CTC is also supplied with separators to permit two or more parallel winding of CTC on transformer coil, for improved winding efficiency at customer.

Spool Type	Flange Diameter	Barrel Diameter	Bore Diameter	Overall Width	Traverse	Capacity in Kgs.
P 650	910	560	82	440	360	500
P 900	1050	560	82	440	360	750
P 1250	1250	600	82	440	340	1250
P 1750	1350	800	82	660	560	1750
P 2200	1350	800	82	900	770	2200
P 3000	1425	850	82	920	770	3000
P 4500	1550	900	82	940	770	4500
P 5500	1700	1000	82	950	750	5500

All Dimensions are in mm.

Ordering Information

I) Ordering Information for Enamelled Round Winding Wires

Sr. No.	Description	Details
1	Wire Size (nominal diameter in MM or SWG or AWG)	
2	Conductor : Copper or Aluminium	
3	Type of Insulation e.g. Polyesterimide,	
4	Thermal class e.g. Class 180	
5	Grade of insulation (thickness, e.g. Grade 1 or 2 or 3 or Single, heavy or triple	
6	Specification reference: e.g. IEC/JIS/NEMA - Part No. -.....	
7	Packing Details/Spool Size (for specific Type please refer to Tables 1 and 2)	
8	Net Quantity in(kg)	

II) Ordering Information for Enamelled Rectangular Copper Conductors

Sr. No.	Description	Details
1	Size of conductor (Width x Thickness)	
2	Conductor : Copper or Aluminium	
3	Type of Insulation e.g. Polyesterimide,	
4	Thermal class e.g. Class 180	
5	Grade of insulation (thickness, e.g. Grade 1 or 2)	
6	Specification reference : e.g. IEC / NEMA -Part -.....	
7	Packing Details / Spool Size (for specific Type please refer to Tables above)	
8	Net Quantity(kg)	

III) Ordering Information for Rectangular Tape Conductors

A) Taped Rectangular Insulated Conductors

Sr. No.	Description	Details
1	Size of conductor (Width x Thickness)	
2	Mechanical property of the Conductor (Proof Stress Value)	
3	Type (Single / Double / Triple/ Quadruple Conductor - Axial / Radial bunching)	
4	Thickness of Insulation in mm (Overall / Radial)	
5	Type Of Tape (Kraft / Crepe / MICA / Nomex / Epoxy Paper / Thermally Upgraded)	
6	Min. No. of layers of Insulation	
7	Taping Arrangement Required.	
8	Specification reference : e.g. IEC-60317-27	
9	Length of Conductor per drum in meters	
10	Number of drums	
11	Packing Details /drum Size (for specific Type please refer to Tables above)	
12	Net Quantity(kg)	

B) Enemelled + Taped Rectangular Insulated Conductors

Sr. No.	Description	Details
1	Size of conductor (Width x Thickness)	
2	Mechanical Property of the Conductor (Proof Stress Value)	
3	Enamel Insulation Thickness in mm	
4	Grade of Insulation (Grade-1 / Grade-2)	
5	Type (Single / Double / Triple / Quadruple Conductor - Axial / Radial bunching)	
6	Thickness of Insulation in mm (Overall / Radial)	
7	Type Of (Kraft / Crepe / MICA / Nomex / Epoxy Paper / Thermally Upgraded)	
8	Min. No. of layers of Insulation	
9	Tapping Arrangement Required	
10	Specification reference	
11	Length of Conductor per drum in meters	
12	Number of drums	
13	Packing Details / drum Size (for specific Type please refer to Tables above)	
14	Net Quantity (kg)	



PRECISION WIRES INDIA LTD. Unit-II

CONTRACT REVIEW - TRANPOSED CONDUCTOR



Our Ref.No.CR/xxx-000 dtd.00/00/00

To : M/s.xxxxxx,

Your Enquiry /Order No. : xx dtd.00/00/00

Specification : xxxxx

Your Ref WO. : XX

No.of Conductors	N ^o	
Conductor Width Nom.	xx±x mm	
Conductor Thickness Nom.	xx±x mm	
Corner Radius of conductor	0.mm±xx%	
Mechanical Properties	CPR[xxxx MPa at Rp.0.2%]	
Paper / PreciMesh Types	xxxxxx	
Paper Increase	xx mm(-xx%)	
No.of Papers Min.	N ^o	
Type of Enamel	xx+xx	
Enamel Increase Nom.	Base:xx(±xx) Top:xx(±xx)mm	
Intercolumn Paper Type	xx	
Inter Column Paper Thickness		
Inner Winding Dia. Min.	xxx mm	

Overall Dimensions of CTC
(To measure at xx N/mm²)

Wmax. = xxmm

Hmax. = xxxmm

Wmin. = xxmm

Hmin. = xxxmm

N ^o of Lengths	Meters Per Length	Reel Type	N ^o of Reels	Compartments	Total Length
x	xx.	P-xx	x	x	xxmtrs.

Total Covered CTC Weight(Approx.) xxKg.

Returnable Drum

Remarks :

Drum size : Flange x barrel x Overall width mm.

Note If no tolerance level is mentioned against a particular parameter ,the relevant technical spec.will be followed for same

Continuously Transposed Conductor (also known as CTC) contains a number of Enamelled Strips depending on the design of the Transformer.

The number of Enamelled Strips contained CTC used in the manufacture of Power Transformers also depends on the electric power transmission capacity of the system. Transmission of Electric power is carried out at substantially higher KVA capacity because the same saves Electric Power losses during transmission and also renders other cost benefits such as saving of space factor etc.

In India, transmission of electric power is now carried out at increasingly higher KVA capacities which requires Copper Conductor Continuously Transposed containing a higher number of Enamelled Strips. Currently, the popular range in India is Copper Conductor Continuously Transposed containing 5 to 72 Enamelled Strips.

Some Overseas customers place orders wherein dimensions of the Enamelled Strips are written first and then last digit is shown in brackets as number of Enamelled Strips contained in CTC, such as, say, 1.70 mm x 11.5 mm x (15) where the digit 15 denotes and signifies 15 Enamelled Strips or also known as 15 Strands of Enamelled Strips contained in CTC.

Enamelled Strips contained in the CTC, after going through the basic Enamelling Process of the Bare Conductors are coated with Epoxy, which some customers also call Self Bonded/Epoxy Bonded Transposed Conductor. After transposing, the Transposed Conductor is further covered with Insulating Paper. The thickness of the Paper and dimensions may also be specified by some Manufacturers. Otherwise, only the thickness of the Insulating Paper is specified.

Due to massive electrification in most parts of India, from the design point of view and for the purpose of transmitting electric power at higher KVA, the number of Enamelled Strips which may be contained in Copper Conductor Continuously Transposed used in Power Transformers will progressively go up.

In India, Transformer Manufacturers generally stipulate size, grade and type of Copper Conductor Continuously Transposed as under:

15//10.0 X 1.40.

This signifies that the Copper Conductor Continuously Transposed contains 15 Enamelled Strips having dimensions of 10.0 mm x 1.40 mm.





Registered Office :

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