



APAR

Tomorrow's solutions today

WINDING SOLUTIONS

CTC/PICC CONDUCTORS



ABOUT

APAR

APAR Industries Limited, founded by Late Mr. Dharmsinh D. Desai in the year 1958 is one among the best established companies in India operating in the diverse fields of electrical, metallurgical and chemical engineering. Over the ensuing years it has evolved to be a 1 Billion US Dollar diversified company offering value added products and services in Power Conductors, OPGW Products, Wire & Cables, Copper Products and Petroleum Specialities.

A technology - driven and customer - focused vendor to some of the most brand enhancing power companies in India and abroad, APAR has strengthened the business of its customers through proactive product development, timely product delivery and superior product attributes by

reinforcing product innovation, cost leadership and premium quality and living its vision 'Tomorrow's Solution Today' resulting in Reliability, Respect, Reputation and Repeat business across customers of Power Conductors, OPGW, Wire & Cables, Copper Products and Petroleum Specialities.



APAR

CONDUCTORS CTC

CONTINUOUSLY TRANSPOSED CONDUCTOR



CTC gives several advantages in the design & construction of transformer compared to conventional paper covered conductors.



- ✓ Reduction in Electrical losses,
- ✓ Uniform distribution of temperature,
- ✓ Increase in space factor,
- ✓ Reduced winding time,
- ✓ Reduction in size of transformer,
- ✓ Reduction in total cost.



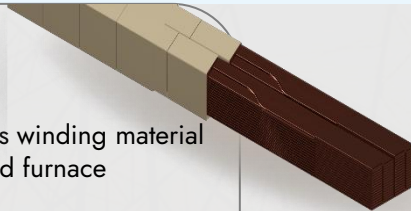
Copper & Copper Alloys:

CU-ETP, CU-Ag0.1 & OFC according to ASTM B-49-17

CTC COPPER

Copper CTCs are typically used as winding material for power distribution, traction and furnace transformers.

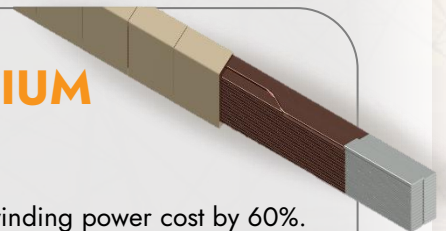
Variants: continuously transposed conductor, twin CTC, special protection paper-covered CTC, netting tape CTC



CTC ALUMINIUM

Aluminium CTCs reduce winding power cost by 60%.

Variants: continuously transposed conductor, twin CTC, special protection paper-covered CTC, netting tape CTC



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CONDUCTORS CTC

CONTINUOUSLY TRANSPOSED CONDUCTOR

Types of enamel and epoxy for individual strip:

Code	Type of Enamel	Class
PVA	Poly-vinyl Formal Resins	120°C
PEI	Poly-ester-imide	180°C
PEI+PAI	Poly-ester-imide + Poly-amide-imide	200°C
Epoxy	Standard B-Stage Epoxy	120°C
Epoxy (HS)	Special B-Stage Epoxy	120°C

Advantages of Epoxy Coated CTC:

The bonding resins of epoxy give high bonding strength & increases short circuit resistance.

Production Range CTC

Parameter	Range
Number of strands	5 to 83
Width (Single Strip)	3.15 mm to 11.50 mm
Thickness (Single Strip)	0.90 mm to 3.00 mm
Number of layers	Maximum 24
Transposing factor (Ft)	6 to 12

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CONDUCTORS CTC

CONTINUOUSLY TRANSPOSED CONDUCTOR**Work Hardening:** Proof stress at Rp0.1% & Rp0.2%

Proof stress code	Range
CPR A	80 to 110 MPa
CPR B	90 to 120 MPa
CPR 1	140 to 200 MPa
CPR 2	170 to 220 MPa
CPR 3*	220 to 260 MPa

**CPR > 240 MPa, we recommend Cu-Ag0.1 (Silver Bearing)*

Insulation for CTC Bundle:

Paper type
Kraft Paper
Thermally Upgraded kraft Paper
High density Crepe Paper (Dennison-22HCC/Cindus-42HCF)
Nomex®
Polyester netting tape

Furthermore, our state of art manufacturing process at **APAR** offers additional specific advantages like:

- Accurate transposition enabling limited tolerance in measurement.
- Extreme flexibility through very small pitches.
- Excellent windability and simple handling of Conductors.

Continuously transposed cables are used in transformers having very high cost and reliability factor. So a strict control in quality is required during production run.

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CONTINUOUSLY TRANSPOSED CONDUCTOR

Transposing

Transposition:

For a given one turn on the smallest winding diameter D, all the strips change their position at least once. The pitch P may be shorter than calculated one:

$$P = D \times \pi / n.$$

For stability of winding, the pitch cannot be chosen at random. The transposing factor considers the width of individual conductor. The transposing factor Ft should not be less than 5:

$$F_t = D \times \pi / b \times n.$$

Dimension calculation:

Nominal axial width is calculated as

$$Ab = 2 * (b + E) + I + R$$

The radial dimension of odd numbered CTC is calculated as

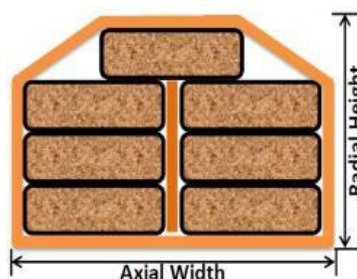
$$Rh = (n + 1)/2 * (a + E) + R$$

or for CTC with an even number of strands

$$Rh = (n + 2)/2 * (a + E) + R$$

Where

- n** Number of strips
- a** Thickness of bare wire
- b** Width of bare wire
- E** Nominal increase due to enamel Inter
- I** Column separator
- R** Nominal paper insulation



Dimensional Measurement of CTC is done on straight specimen of approximately 400mm length with open ends under a pressure of 1 N/mm².

Each CTC is supplied with electrically continuous strips for the entire length of the cable on the drum. Prior to shipment the insulation of strips is tested.

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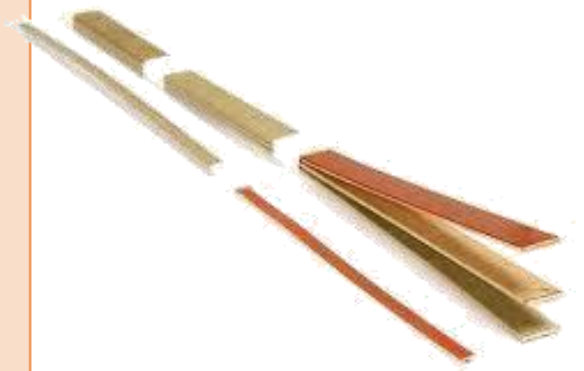
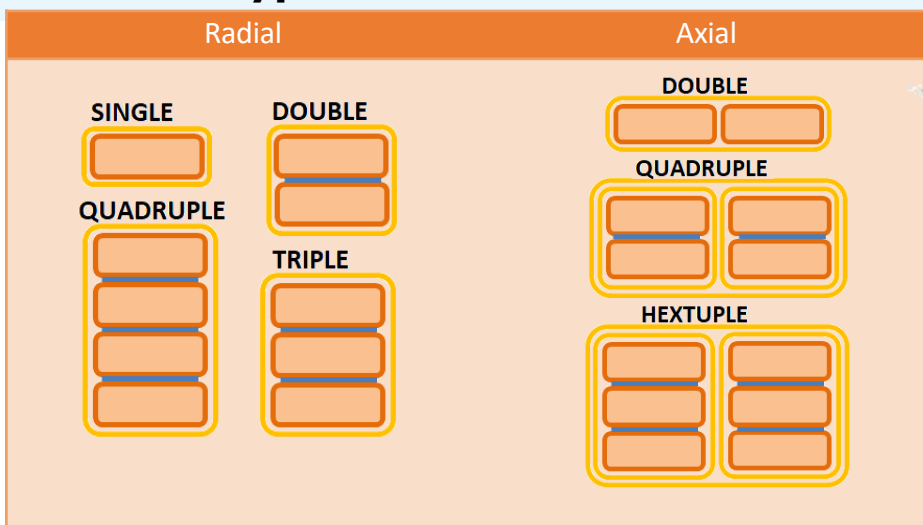
CONDUCTORS PICC

PAPER INSULATED COPPER CONDUCTOR

**(Double Bunched/Triple Bunched/
Quadruple Bunched/Enameled Bunched etc.)**

Parameter	Range
Width (Single Strip)	3.00 mm to 16.00 mm
Thickness (Single Strip)	1.00 mm to 5.00 mm
Number of layers	Maximum 16

Different Types of Construction:



C) Enameled Copper Strips:

Code	Type of Enamel	Class
PVA	Poly-vinyl Formal Resins	120°C
PEI	Poly-ester-imide	180°C
PEI+PAI	Poly-ester-imide + Poly-amide-imide	200°C
Width Single Strip:	3.00 mm to 12.50 mm	
Thickness Single Strip:	0.90 mm to 3.25 mm	



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CONDUCTORS PICC

PAPER INSULATED COPPER CONDUCTOR

Factory Infrastructure includes a large range of equipment's like:

- Wire Drawing machines
- Flat Rolling Mills
- Enameling Lines
- Paper Wrapping machines
- Transposing machines
- Laboratory and detection tools

Instruction for Storage and Handling:

The conductors must be stored covered and protected from weather conditions like rain or direct sunshine. Keep away from acids or unknown/flammable liquids. CTC drums must be loaded and stored on their horizontal axis. Transposed conductors with epoxy layer to be stored in good condition with a temperature lower than 30° C.

Marking:

Each drum is to be clearly marked clearly with following information · Supplier's name

- Customer's Job Reference
- Number and size of strands
- Drum number
- Gross weight
- Length of cable

Ordering specification:

Following details to be furnished in Inquiry:

- Conductor size
- Number of strands
- Nominal insulation increase due to paper covering
- Inter column separator, if applicable (only for CTC)
- Smallest winding diameter of transformer coil (only for CTC)
- Length per drum and compartment (if partition drum is required)
- Number of drum
- Approximate total weight of cable



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