

De Angeli Prodotti aims to be the strategic manufacturing leader in terms of **quality** and **innovation** of CTC conductors for electromechanical applications.



From **copper** or **aluminium** wire rod to final conductors.



OUR VALUES

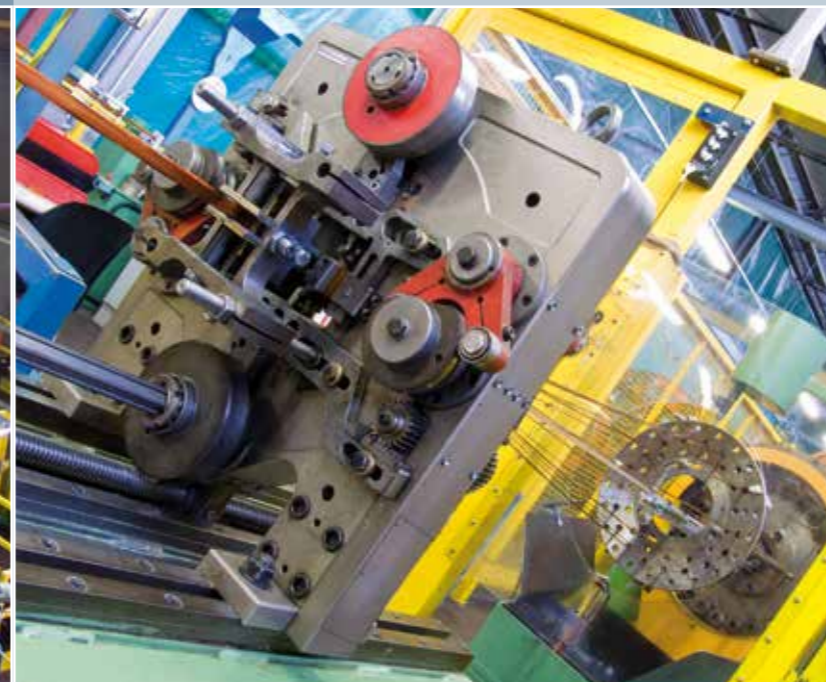


Quality, Innovation, Team Spirit, Balance and **Resilience** are our values to satisfy market needs.

Demographic changes, lack of raw materials and high cost of metals give rise to new needs.

These are the main reasons for which we spend our maximum effort in R&D and collaborate with customers to supply the best answer to their new requests.

From our plant in Italy we serve both **European** and **Mediterranean** markets for an annual production of **6.000 t.**



A large range of equipments including:

- Drawing machines
- Enamelling horizontal ovens
- Rolling Mills
- Tinning line
- Extrusion lines
- Wrapping machines
- Enamelling vertical ovens
- CTC machines
- Laboratory and detection tools

A complete step by step verified process to manufacture Continuously Transposed Cables from 5 to 85 individual **aluminium** and **copper** flat wires.

De Angeli Prodotti has 4 CTC line since 2017.





Continuously Transposed Cables used in power transformers give several advantages in the design and in the construction compared to conventional conductors:

- Reduced electrical losses – thanks to the reduction of Eddy current and a more uniform distribution of the temperature
- Reduced winding time – thanks to the simultaneous winding of many elementary conductors
- Increased space factor – thanks to the very small thickness of insulation of the single conductors

The continuous increase of power of the electrical machines requires **more efficiency** and **faster production**: this is possible because CTC cables are being used more and more on power transformers.

De Angeli Prodotti can supply a wide range of copper CTC and the company is at the cutting edge with **Aluminium CTC (Al-CTC)**, the latest **evolution** in the field of winding cables.

PRODUCTION RANGE

Copper and copper alloys: **Cu-ETP** and **CuAg0,1** according to UNI EN 1977. **NEW Cu-ETP+** (patented by De Angeli Prodotti): same strong, less price! A cheaper solution for the same task of CuAg.
Aluminium: **EN AW 1370** according to EN 573-3.

Single Strips	Cu	Al
Width of Single Strip [mm]	2,5 ÷ 12,5	5,0 ÷ 12,5
Thickness of Single Strip [mm]	0,8 ÷ 3,25	1,5 ÷ 3,25
Ratio Width/ Thickness of Single Strip	≥ 2,5:1 ÷ ≤ 7,5:1	≥ 2,5:1 ÷ ≤ 7,0:1
Cross Section of Single Strip [mm ²]	4,35 ÷ 35	8,0 ÷ 35

Bundle	Cu	Al
Number of Single Strips	5 ÷ 85	5 ÷ 85
Width of Bundle (axial) [mm]	6 ÷ 27	8 ÷ 27
Height of Bundle (radial) [mm]	5 ÷ 80	5 ÷ 80
Ratio Height/Width of Bundle	≤ 6:1	≤ 6:1
Transposing Factor (F.T.)	5 ÷ 16	7 ÷ 16

Hardness Rp0,2%	Cu	Al
Annealed	60 ÷ 100 N/mm ²	50 ÷ 80 N/mm ²
CPR A	90 ÷ 120 N/mm ²	> 80 N/mm ²
CPR B	120 ÷ 150 N/mm ²	-
CPR 1	150 ÷ 210 N/mm ²	-
CPR 2	180 ÷ 230 N/mm ²	-
CPR 3*	230 ÷ 270 N/mm ²	-

*For proof stress more than 235 N/mm² we recommend CuAg0,1 or Cu-ETP+ alloy due to the re-softening during transformer service

Dimensions outside tabulate values to be agreed on.

Enamel	Type	Class	Double side thickness
Forvest	PVF	120°C	0,06 ÷ 0,13 (±0,02)
Thervest	PEI+PAI	200°C	0,13 ÷ 0,15 (±0,02)
Epoxy	Standard B-stage	120°C	All sides 0,035 (±0,015)
Epoxy P	Standard B-stage	120°C	Only on flat 0,035 (±0,015)*
Epoxy HT	Special B-stage	>120°C	Only on flat 0,035 (±0,015)*

*Maximum in the width 0.01mm

The epoxy bonding resin gives high mechanical stiffness after curing, allowing it to **withstand** high **electrodynamics stresses**, increasing the short circuit resistance.

Special **epoxy HT** gives **superior bonding strength** and resistance to **high temperature**.

BUNDLE INSULATION

Papers used for electrical applications are in accordance with IEC 554 and DIN VDE 0311/35

Paper insulation	Type	IEC code	Properties
Kraft Type D	Natural paper	5A2-1M3 or 5A2-1H1	General purpose
Kraft Type W	Thermally upgraded paper	5A2-1M3	High thermal stability
Kraft Type F	Calandered paper	5A4-1M2	High dielectric strength
Kraft Type Z	Calandered + Thermally upgraded paper	5A4-1M2	High dielectric strength & High thermal stability
Munksjo 80 HDC	Crepe + Calandered + Thermally upgraded paper	-	Special paper with very high mechanical strength
Dennison 22HCC	Crepe + Calandered + Thermally upgraded paper	-	Special paper with very high mechanical strength
Cottrell CK125TU	Crepe + Calandered + Thermally upgraded paper	-	Special paper with very high mechanical strength
Nomex®	T 410, T 926, LT, T910	-	Very high thermal class and mechanical strength
Glass tape	glass fiber	-	For cast resin transformers
PL	Polyester wire	-	For paperless CTC
Netting	PE Net	-	For paperless CTC

Several paper thicknesses are available and could be arranged to obtain the required thickness.



Cable with PVF + Crepe TU paper

Giant CTC (up to 85 flat wires)

Lightweight CTCs: Al and Al alloy

Copper and Aluminium double CTC

Cable with PVF resin + Kraft paper

Cables with PEI+PAI resin with Nomex®/Glass tape

Cables with PVF resin + PE wire/net

Mini CTC: flat wires with thickness < 1 mm

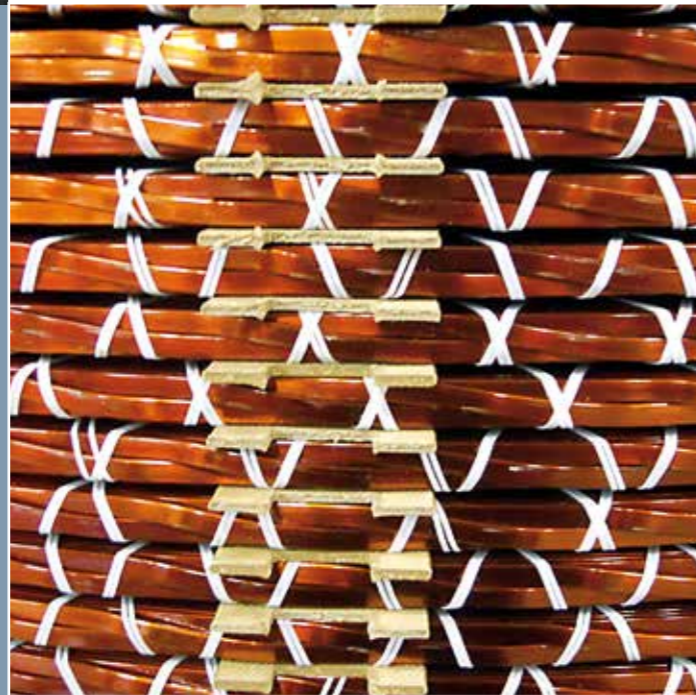


Paperless CTCs

De Angeli Prodotti can supply transposed conductors **without paper** for low voltage windings: the ideal solution for

- Better **cooling**
- Smaller machine **dimensions**
- Less **polluting** agents
- Better transformer **efficiency**

The transposed conductors are wound by an oil-resistant polyester wire or net, giving 0,56mm dimensional increase at 1N/mm². In order to guarantee product integrity and a safe handling, Paperless CTCs are supplied with a protection paper to remove before use.



INTERLEAVING PAPER

Type	Paper	Thickness
Standard	Presspan (IEC 641)	0,10 – 0,20mm
Thermally upgraded	Cottrell Kraft TU125	0,127mm
Thermally upgraded	Kraft Type Z	0,10mm

TOLERANCES OF BUNDLE DIMENSION

AXIAL: ±0.10mm

RADIAL as following table :

No. of single strips	F.T. ≥ 7, thickness ≤ 2mm and Rp0,2% ≤ 180N/mm ²	Other cases
5 ÷ 19	-0,10 / +0,18	-0,10 / +0,27
21 ÷ 27	-0,15 / +0,25	-0,15 / +0,45
29 ÷ 35	-0,20 / +0,35	-0,20 / +0,70
37 ÷ 55	-0,30 / +0,70	-0,30 / +1,10
55 ÷ 85	-0,50 / +1,10	-0,50 / +1,40



A LOOK INTO... R&D

CTC with thin enamel and thin strips

These elements significantly help to reduce the overall cable dimension with many advantages:

- Lower electrical losses in power transformers
- Improved filling factor
- Better cable flexibility, easing the winding process through a compact transposition pitch

CTC Alu+

Mechanical performances comparable to copper weight and price comparable to Aluminium: we transformed the best concept in reality with our award-winning Aluminium-Alloy CTC.



Giant CTC

De Angeli Prodotti expanded its CTC range and capacity through its 4th line. Now up to 85 elementary conductors available.

ETP+

De Angeli's revolution on hardened copper, giving the best mechanical performances and an outstanding annealing resistance: a great advantage compared to the current solutions available on the market.

And much more...

INSTRUCTION FOR STORAGE AND HANDLING

(Available on our website www.deangeliprodotti.com, with illustrations and dedicated videos)

The transposed conductors must be stored covered and protected from weather conditions like rain or direct sunshine. Keep away from acids or unknown liquids.

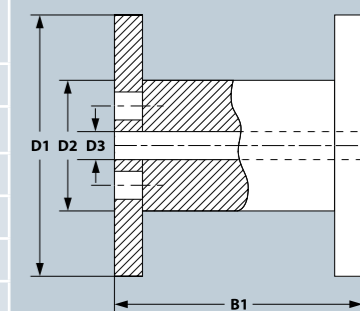
CTC drums must be loaded and stored on their horizontal axle. The usage and transportation on vertical axle voids our guarantee on the product.

Transposed conductors with epoxy layer: epoxy resin is guaranteed to maintain its bonding properties unchanged for 6 months from the production date if stored in good conditions with a temperature lower than 31° C.

DRUMS

The "D" drums are returnable, the "P" drums are for one way.

Type	One way drums, type "P"		Returnable drums, type "D"		Max content [kg]	
	D1 Ø flange [mm]	D2 Ø barrel [mm]	B1 outer width [mm]	D3 Ø bore [mm]	D drums	P drums
D75 - P75	1000	750	600	82	700	500
P75/12	1200	750	600	82	1200	
D100/400 - P100/400	1350	900	400	82	1000	700
D100/S - P100/S	1350	900	610	82	1600	
D130/S - P130/S	1650	1000	810	82	3500	2800
D130/S enlarged P130/S enlarged	1600	900	1050	82	4500	4000
D140/S - P140/S	2000	1400	1010	82	4500	4000
D140/S enlarged	2000	1300	1100	82	7000	



All drums are available with treatment ISPM-15

Special packages can be designed according to the request of the Customer.

If requested, we can use **separators** in order to supply parallel lengths in the same drum with a **maximum of seven lengths**.



www.deangeliprodotti.com



DE ANGELI PRODOTTI S.r.l.
Viale dell'Industria, 1
35023 Bagnoli di Sopra - Padova - **Italy**
tel 0039 049 9599111 - fax 0039 049 5380673
sales@deangeliprodotti.com