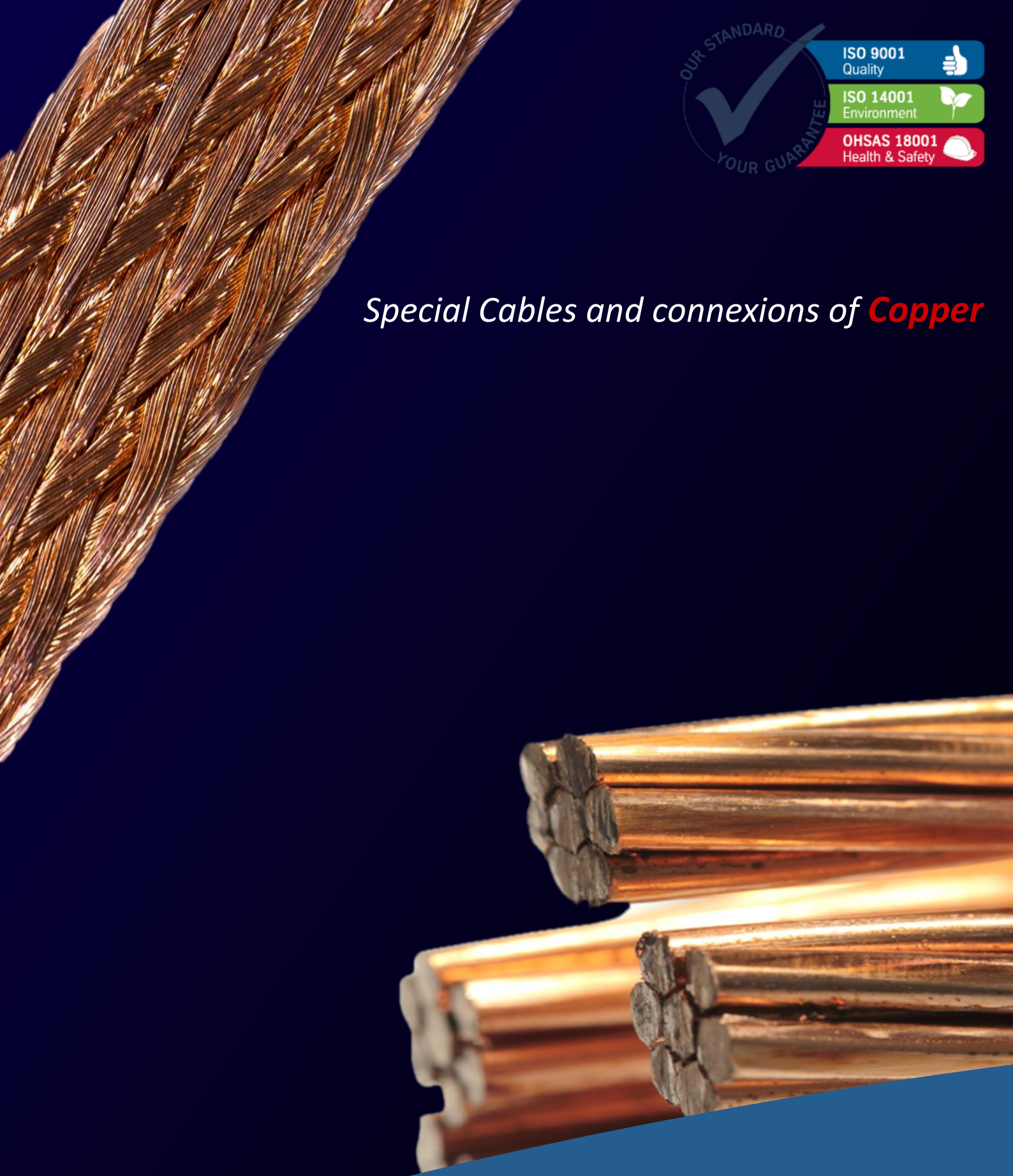

OUR STANDARD YOUR GUARANTEE

ISO 9001 Quality

ISO 14001 Environment

OHSAS 18001 Health & Safety

Special Cables and connexions of ***Copper***

TESORAX

www.tesorax.fr

Tél. : +339 81 16 35 63

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TESORAX Cables and Copper

Braids Flexible Connections | Copper flexibles cables | Shunts | Litz Wires and Cables

EXAMPLES OF APPLICATION DOMAINS

Energy production / Distribution

Railway

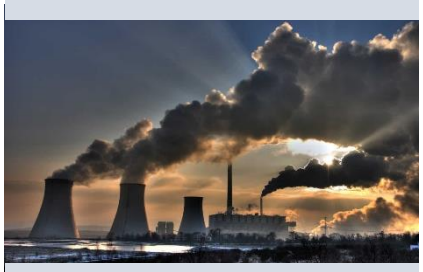
Industry

Clean Energies

Automotive

Electronics

Rotating Machinery



Chimical Industry

Nuclear

INTRODUCTION

This catalogue presents our 4 product families: copper braids, flexible copper cables, braid connectors, and Litz wires/cables, intended for the electrical field. Copper braids are intertwined conductors that allow for great electrical flexibility. TESORAX stands out in the market in its ability to provide a customized technical solution to its customers. We consider each product as a project, where the customer is accompanied and advised from the product design to the application of the solution.

We are able to work from wires of 0.04mm diameter to 0.25mm, allowing to offer a wide range of sections. Our products are manufactured in our factory in Spain, 100 years of expertise at the service of our customers.

The products described in this catalogue are given as an indication, because we can, on request, manufacture any variant.

Example of applications: Electrical equipment (circuit breakers, sectioners, contactors, surge protectors, processing stations, etc.); Grounding; Protection of electrical equipment; Junction between distribution bars and vibrating machines; Expansion joints between sets of bars; Equipment for welding stations; Pest-control braids; Electrolysis; Mass points; Cables for engines, alternators, etc.; Cables for thyristors, relays and capacitors; Cables for induction ovens; Cables for powering electromagnets; Cables for temperature measurements (extension or clearing cables); Cables for high-frequency coils (Litz Wire).

CONTENTS

Family 1: FLEXIBLE COPPER BRAIDS

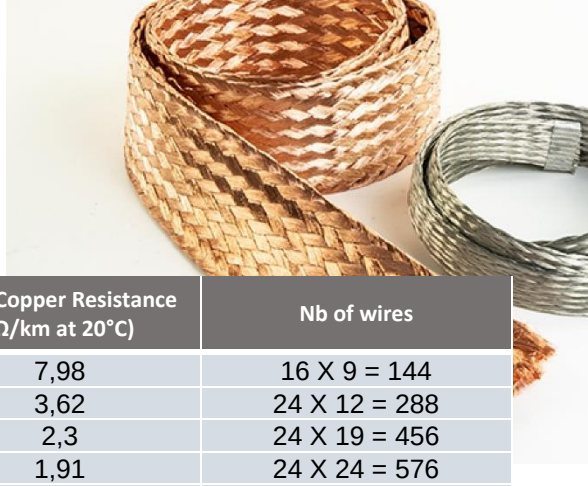
The actual section is obtained by adding all the sections of each wire that makes up the braid.

The apparent section is equal to the section that results from the outer dimensions of the braid and is equal to about 2 times the actual section.

Flexibility: it depends mainly on the mechanical strength of the material used as well as its diameter. Generally, electrical applications require annealed, electrolytic, red or tinned copper.
Extra flexible: elementary wire with diameters of 0.05 - 0.07mm
Semi-flexible: elementary wire with diameters of 0.25 - 0.30mm

CHARACTERISTICS OF BRAIDS			
TYPE	**CONSTRUCTION**	**CHARACTERISTICS**	**APPLICATIONS**
FLAT BRAIDS	▪ Conductor: Bare or tinned annealed electrolytic copper. Training according to EN 13602 ▪ Wiring: conductors wired in studs and twisted together, with a pitch according to the section or the coverage	Copper braids made of fine annealed electrolytic copper wires. High flexibility and reduced bending radius. It is manufactured with Ø 0.10 mm and Ø 0.25 mm individual wires, which can make sections from 0.75 mm² to 500 mm² On request, we can serve them coated, with different materials: Plastics (PVC or LSHF). // Textile (nylon, polyester, etc.)	Flat braids can be applied for: Connections, manufacture of electrical equipment, protective and earthing equipment, plugs, lightning rods, transformation centers, etc
ROUND BRAIDS	▪ Conductor: Annealed electrolytic bare or tinned copper. According to / EN 13602 ▪ Braid: conductors cabled in studs and twisted together, with a pitch according to the section or the cover	Braids made of fine annealed electrolytic copper wires. High flexibility and reduced bending radius. Manufactured with Ø 0.10 mm and Ø 0.25 mm single wires. The spiral copper braid gives more firmness to the final cable and geometry. On order, we can produce and insulate, with different materials: Plastics (PVC or LSHF) // Textile (nylon, polyester, etc.)	Connectors, manufacture of electrical equipment, electrical ground connection, energy industry for wind turbines, generators, substations, transformers, switchgear, hydraulic turbines, circuit breakers and rectifiers. Also used in the automotive, aerospace, information technology and military sectors
INSULATED BRAIDS	▪ Conductor: Annealed electrolytic bare or tinned copper. According to / EN 13602 ▪ Braided: copper conductors, wired and twisted together, with a pitch according to the section or the cover ▪ Insulation: PVC - Type TI-1 UNE-EN_50363-3 // LSHF - Type TI-7 UNE-EN_50363-7	Braids made of fine annealed electrolytic copper wires. High flexibility and reduced bending radius. It is manufactured with Ø 0.10 mm and Ø 0.25 mm single wires. The spiral copper braid gives more firmness to the final cable and geometry. Product isolated with different materials: Plastic (PVC or LSHF). Textiles (nylon, polyester, etc.)	Connectors, manufacture of electrical equipment, electrical ground connection, energy industry for wind turbines, generators, substations, transformers, switchgear, hydraulic turbines, circuit breakers and rectifiers. They are also used in the automotive, aerospace, information technology and military industries
SQUARE BRAIDS	▪ Conductor: Annealed electrolytic bare or tinned copper. According to / EN 13602 ▪ Braided: copper conductors, stranded together, with custom section. Machine-compacted square shape	Braids made of fine annealed electrolytic copper wires. High flexibility and reduced bending radius. It is manufactured with Ø 0.10 mm and Ø 0.25 mm single wires, which can make sections from 1 mm² to 95 mm². More sections on request. On order, we can produce and insulate, with different materials: Plastics (PVC or LSHF) // Textile (nylon, polyester, etc.)	The energy industry for wind turbines, generators, substations, transformers, switchgear, hydraulic turbines. They are also used in the automotive, aerospace, military and railway connection industries
EXTRA FLEXIBLE BRAIDS	▪ Conductor: Annealed electrolytic bare or tinned copper. According to / EN 13602 ▪ Braided: copper conductors, stranded together, section on request	Very small braids made of fine annealed electrolytic copper wires. Great flexibility. It is manufactured with single wires Ø 0.05 mm and 0.10 mm	These small sized braids are intended for electronic applications, such as speaker coils, earth connections for small motors (miniature cars), earth connection for screens, etc
ROUND CONDUCTORS	▪ Conductor: Annealed electrolytic bare or tinned copper. According to / EN 13602 ▪ Braided: copper conductors, braided together, diameter on request	These cables are a combination of an internal braided cable which has an outer tubular braid to provide greater mechanical stability. The general tubular braid holds the cable with possible breakage which can be caused by series movements. The general tubular braid also provides a larger cross section than nominal	Electric welding service and electric ovens
BRAIDS FOR SHIELDED CABLES	▪ Conductor: Annealed electrolytic bare or tinned copper. According to / EN 13602 ▪ Braided: copper conductors, stranded together, diameter on request.	Braids made of fine annealed electrolytic copper wires. High flexibility and reduced bending radius. It is manufactured with Ø 0.10 mm and Ø 0.25 mm single wires	For shielding cables, cable harnesses (automotive), as well as interference grounds. wiring braids can be used for armour cables, cable bundles (automotive), and pest control weights

FLAT BRAIDS



BARRE COPPER

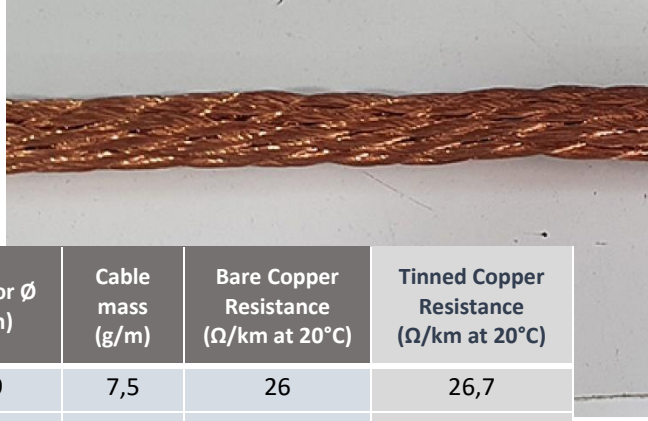
Reference Code Bare Copper	Section (mm²)	Exterior Ø (mm)	Cable mass (g/m)	Bare Copper Resistance (Ω/km at 20°C)	Nb of wires
NF-16 Nº 1	2,5	5x1	25	7,98	16 X 9 = 144
NF-16 Nº 2	5	8x1	50	3,62	24 X 12 = 288
NF-16 Nº 3	8	8x1,5	80	2,3	24 X 19 = 456
NF-16 Nº 4	10	10x1,5	100	1,91	24 X 24 = 576
NF-16 Nº 5	16	15x2	160	1,21	32 X 28 = 896
NF-16 Nº 6	20	20x2	200	0,95	32 X 35 = 1120
NF-16 Nº 7	25	25x2	250	0,78	32 X 44 = 1408
NF-16 Nº 8	30	25x2,5	300	0,54	32 X 53 = 1696
NF-16 Nº 9	40	25x3	400	0,47	32 X 70 = 2240
NF-16 Nº 10	50	30x3,5	500	0,386	32 X 88 = 2816
NF-16 Nº 11	60	30x4	600	0,32	32 X 107 = 3424
NF-16 Nº 12	75	30x5	750	0,25	32 X 132 = 4224
NF-16 Nº 13	90	35x5	900	0,21	32 X 159 = 5088
NF-16 Nº 14	100	40x5	1000	0,19	32 X 176 = 5632
NF-16 Nº 15	120	50x5	1200	0,161	48 X 80 = 3840
NF-16 Nº 16	150	60x5	1500	0,129	48 X 100 = 4800
NF-16 Nº 17	200	65x5	2000	0,0948	48 X 132 = 6336
NF-16 Nº 18	250	70x8	2500	0,0759	48 X 164 = 7872
NF-16 Nº 19	300	70x10	3000	0,0641	48 X 200 = 9600
NF-16 Nº 20	400	80x10	4000	0,0474	48 X 266 = 12768
NF-16 Nº 21	500	100x10	5000	0,0379	48 X 332 = 15936

TINNED COPPER

Reference Code Copper	Section (mm²)	Exterior Ø (mm)	Cable mass (g/m)	Tinned Copper Resistance (Ω/km at 20°C)	Nb of wires
NF-16 Nº 1E	2,5	5x1	25	8,21	16 X 9 = 144
NF-16 Nº 2E	5	8x1	50	3,95	24 X 12 = 288
NF-16 Nº 3E	8	8x1,5	80	2,47	24 X 19 = 456
NF-16 Nº 4E	10	10x1,5	100	1,95	24 X 24 = 576
NF-16 Nº 5E	16	15x2	160	1,24	32 X 28 = 896
NF-16 Nº 6E	20	20x2	200	0,983	32 X 35 = 1120
NF-16 Nº 7E	25	25x2	250	0,795	32 X 44 = 1408
NF-16 Nº 8E	30	25x2,5	300	0,658	32 X 53 = 1696
NF-16 Nº 9E	40	25x3	400	0,494	32 X 70 = 2240
NF-16 Nº 10E	50	30x3,5	500	0,393	32 X 88 = 2816
NF-16 Nº 11E	60	30x4	600	0,329	32 X 107 = 3424
NF-16 Nº 12E	75	30x5	750	0,263	32 X 132 = 4224
NF-16 Nº 13E	90	35x5	900	0,219	32 X 159 = 5088
NF-16 Nº 14E	100	40x5	1000	0,197	32 X 176 = 5632
NF-16 Nº 15E	120	50x5	1200	0,164	48 X 80 = 3840
NF-16 Nº 16E	150	60x5	1500	0,132	48 X 100 = 4800
NF-16 Nº 17E	200	65x5	2000	0,0987	48 X 132 = 6336
NF-16 Nº 18E	250	70x8	2500	0,079	48 X 164 = 7872
NF-16 Nº 19E	300	70x10	3000	0,0654	48 X 200 = 9600
NF-16 Nº 20E	400	80x10	4000	0,0494	48 X 266 = 12768
NF-16 Nº 21E	500	100x10	5000	0,0395	48 X 332 = 15936

* made with 0.20 mm diameter wires

Packaging: Crowns of 6, 10, 15, 20, 25, 50, 100 and 200 meters
Approximate weight: About 10 grams per meter per mm². Example: 5 mm² = 50 g / meter.
Dimensions: Possibility of manufacturing braids of other dimensions, according to specifications. On order, we can also manufacture the braids in PVC. These specifications are given for information only and are subject to change.



ROUND BRAIDS

Wires - 0.10 mm		Wires - 0.25 mm						
Reference Code Bare Copper	Reference Code Tinned Copper	Reference Code Bare Copper	Reference Code Tinned Copper	Section (mm²)	Exterior Ø (mm)	Cable mass (g/m)	Bare Copper Resistance (Ω/km at 20°C)	Tinned Copper Resistance (Ω/km at 20°C)
F-14 N°1	F-14 N°1E			0,75	0,9	7,5	26	26,7
F-14 N°2	F-14 N°2E			1	1	10	19,5	20
F-14 N°3	F-14 N°3E			1,5	1,5	15	13,3	13,7
F-14 N°4	F-14 N°4E			2,5	2,3	25	7,98	8,21
F-14 N°5	F-14 N°5E			4	3	40	4,95	5,09
F-14 N°6	F-14 N°6E			6	4	60	3,3	3,39
F-14 N°7	F-14 N°7E	TRS-10	TRS-10E	10	5	100	1,91	1,95
F-14 N°8	F-14 N°8E			16	6,5	160	1,21	1,24
		TRS-16	TRS-16E	16	6	160	1,21	1,24
F-14 N°9	F-14 N°9E			25	8	250	0,78	0,795
		TRS-25	TRS-25E	25	7	250	0,78	0,795
		TRS-35	TRS-35E	35	9	350	0,554	0,565
		TRS-50	TRS-50E	50	10	500	0,386	0,393
		TRS-70	TRS-70E	70	12	700	0,272	0,277
		TRS-95	TRS-95E	95	14	950	0,206	0,216
		TRS-120	TRS-120E	120	16	1200	0,161	0,164
		TRS-150	TRS-150E	150	18	1500	0,129	0,132

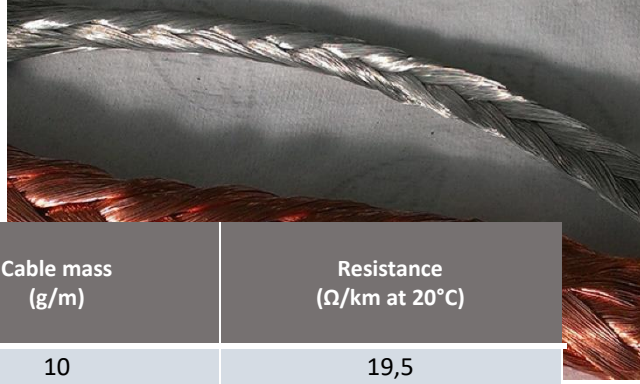
Packaging: Crowns of 6, 10, 15, 20, 25, 50, 100 and 200 meters
Approximate weight: About 10 grams per meter per mm². Example: 5 mm² = 50 g / meter.
Dimensions: Possibility of manufacturing braids of other dimensions, according to specifications. These specifications are given for information only and are subject to change.

INSULATED BRAIDS

Reference code	Section (mm²)	Exterior Ø (mm)	Cable mass (g/m)	Resistance (Ω/km at 20°C)
TRS-18-2.5	2,5	3,5	25	7,98
TRS-18-4	4	4	40	4,95
TRS-18-6	6	4,5	60	3,3
TRS-18-10	10	6	100	1,91
TRS-18-16	16	8	160	1,21
TRS-18-25	25	10	250	0,78
TRS-18-35	35	12	350	0,554
TRS-18-50	50	15	500	0,386
TRS-18-70	70	18	700	0,272
TRS-18-95	95	22	950	0,206
TRS-18-120	120	24	1200	0,161
TRS-18-150	150	26	1500	0,129

Packaging: Crowns of 6, 10, 15, 20, 25, 50, 100 and 200 meters
Approximate weight: About 10 grams per meter per mm². Example: 5 mm² = 50 g / meter.
Dimensions: Possibility of manufacturing braids of other dimensions, according to specifications. These specifications are given for information only and are subject to change.

SQUARE BRAIDS



Reference code	Section (mm²)	Exterior Ø (mm)	Cable mass (g/m)	Resistance (Ω/km at 20°C)
NF-20 N°1	1	1.2 x 1.2	10	19,5
NF-20 N°2	1,5	1.5 x 1.5	15	13,3
NF-20 N°3	2,5	2.1 x 2.1	25	7,98
NF-20 N°4	4	2.8 x 2.8	40	4,95
NF-20 N°5	6	3.3 x 3.3	60	3,3
NF-20 N°6	10	4.3 x 4.3	100	1,91
NF-20 N°7	16	5.4 x 5.4	160	1,21
NF-20 N°8	25	7 x 7	250	0,78
NF-20 N°9	35	8 x 8	350	0,554
NF-20 N°10	50	10 x 10	500	0,386
NF-20 N°11	70	12 x 12	700	0,272
NF-20 N°12	95	14 x 14	950	0,206

We can manufacture square braids of other sizes and sections on request.

Packaging: 50 or 100 meters coils, plastic reels according to DIN 46.399 or wooden reels
Approximate weight: About 10 grams per meter per mm². Example for a section of 35 mm²: 350 g / meter.
Dimensions: data for information only and subject to change.

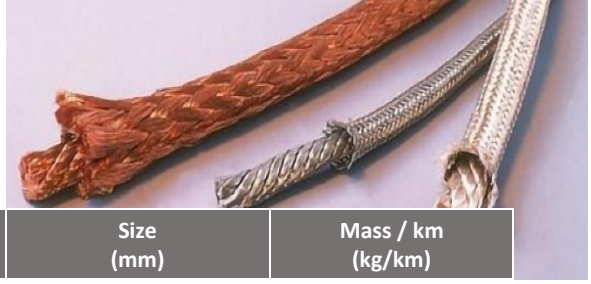
EXTRA FLEXIBLE BRAIDS

Wire 0.05 mm	Wire 0.10 mm				
Reference code	Reference code	Nominal section (mm²)	Width (mm)	Type of copper	Mass (g/m)
F-9 B		0,13	1	Bare	1,3
F-9 D		0,2	1	Bare	2
	F-7 AC / F-7 AE	0,5	2	Bare / Tinned	5
	F-7 C / F-7 E	1	3	Bare / Tinned	10
	F-8 C / F-8 E	2	4	Bare / Tinned	20

Other sections on request

Packaging: Rolls of 100, 200 or 500 meters according to DIN 46.399, depending on the section
Approximate weight: About 10 grams per meter per mm². Example: 1 mm² = 10 g / meter.
Dimensions: Specifications are given for information and are subject to change

ROUND CONDUCTORS



Reference code	Nominal section (mm²)	Effective section (mm²)	Size (mm)	Mass / km (kg/km)
CT-0.5-05/01	0,5	0,5	1,1	5,1
CT-0.75-05/01	0,75	0,75	1,4	7,7
CT-1-05/01	1	1	1,5	10
CT-1.5-05/01	1,5	1,5	2	15
CT-2.5-07/01	2,5	3	2,9	30
CT-4-07/01	4	4,5	3,6	46
CT-6-07/01	6	6,8	4,5	70
CT-10-07/01	10	11	5,5	110
CT-16-01/01	16	17,5	7	175
CT-25-01/01	25	27	8,9	265
CT-35-01/01	35	37	10,5	370
CT-50-01/01	50	53.5	12,5	535
CT-70-01/01	70	73	14,7	730

Packaging: According to DIN 46.399, 100 meters rolls or wooden reels depending on the section.
Approximate weight: We consider +/- 12% of the effective section up to 16mm², +/- 8% of the effective section from 25mm² to 50mm2 and +/- 6% of the effective section above 70mm².
Dimensions: The characteristics are given for information only and may be modified. They can be made of tinned copper to specific order.

BRAIDS FOR SHIELDED

Reference code	Diameter Ø (mm)	No strands (Ud,)	Mass (g/m)
TA - 2	2	24	6
TA - 4	4	24	15
TA - 8	8	32	30
TA - 12	12	32	42
TA - 16	16	32	72
TA - 20	20	32	85
TA - 25	25	32	135
TA - 30	30	32	225
TA - 40	40	32	270
TA - 50	50	32	560
TA - 60	60	48	660

Other diameters on request
Packaging: Crowns or rolls according to DIN 46.399 and depending on the diameter
Dimensions: Specifications are given for information and are subject to change

Family 2: COPPER BRAIDS FLEXIBLE CONNECTORS

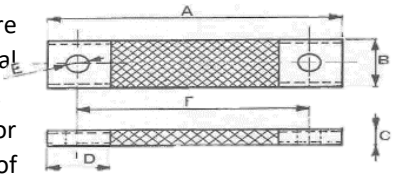
Description: Flexible braided copper connectors are made of electrolytic copper wires. We can make them to different measurements (mm), sections (mm²) and shapes, depending on each installation need (**section x width x height x length**). We also offer a wide variety of terminals (metrics and different quantities).
It is possible to make it with polished or tinned copper.

On request, connectors can also receive a silver bath to improve resistance. We can make sections from 1.5 mm² to 5000 mm².
We also can insulate the connectors with different plastic materials.

FLAT GROUND BRAIDS

– with round or square terminals

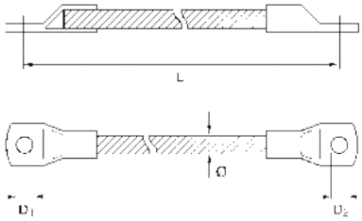
- Flat copper braid (tinned or bare copper) with connection terminal or sealed terminal for connection.
- The mass braids are intended for grounding, interconnection of metal equipment.



	Reference code	Section (mm²)	Length F (from hole centers) (mm)	Width B (mm)	Hole E Ø (mm)	Max Intensity (A)
Flat rolled braid with tinned terminals. Rounded end connection holes	F-17 16X150	16	150	15	6	120
	F-17 16X250	16	250	15	6	120
	F-17 25X150	25	150	25	8	150
	F-17 25X250	25	250	25	8	150
	F-17 25X300	25	300	25	8	150
	F-17 35X250	35	250	25	10	215
	F-17 35X300	35	300	25	10	215
	F-17 50X250	50	250	30	10	250
	F-17 50X300	50	300	30	10	250
Flat rolled braid with flat terminals	FT-17 10X150	10	150	15	6	100
	FT-17 10X200	10	200	15	6	100
	FT-17 10X250	10	250	15	6	100
	FT-17 10X300	10	300	15	6	100
	FT-17 16X150	16	150	15	6	120
	FT-17 16X200	16	200	15	6	120
	FT-17 16X250	16	250	15	6	120
	FT-17 16X300	16	300	15	6	120
	FT-17 25X150	25	150	25	8	150
	FT-17 25X200	25	200	25	8	150
	FT-17 25X250	25	250	25	8	150
	FT-17 25X300	25	300	25	8	150
	FT-17 35X200	35	200	25	10	215
	FT-17 35X250	35	250	25	10	215
	FT-17 35X300	35	300	25	10	215
	FT-17 50X200	50	200	30	10	250
	FT-17 50X250	50	250	30	10	250
	FT-17 50X300	50	300	30	10	250

ROUND GROUND BRAIDS

- Copper braids formed of a bare or tinned copper conductor with terminals for connection. The braids are made with sections from 0.75 mm² to 1200mm², according to CEI 60228. Possibility to insulate
- Designed for energy distribution or grounding. Medium voltage electrical equipment (cabinets, circuit breakers, inverters). Connection of transformers



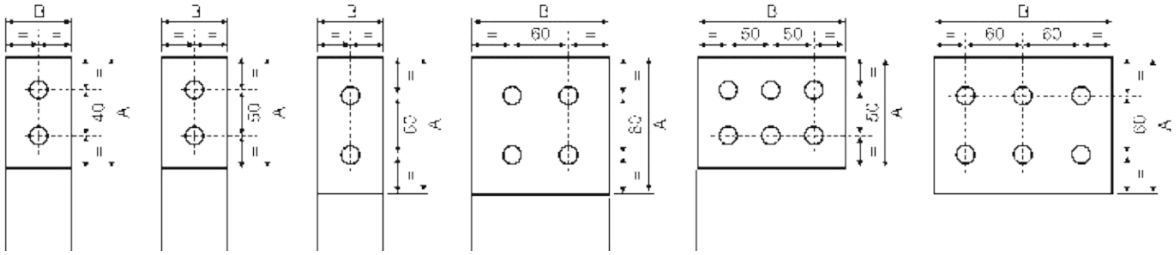
Codification						
Round connector	**Copper**	**Insulating (if desired)**	**Section in mm² (4 digit)**		**Length L (in mm)**	**Terminals/Metric**
cr	PU (bare copper)	T (Termorretractil)	0	X	0	8-8
	SN (tinned copper)	S (Silicone)				
		F (FV - Silicone)				
		G (Rubber)				
		V (Wire-glass)				
		P (Polyamide)				

FLAT COPPER BRAIDS

- Made up of one or more flat braids in bare or tinned copper with connection terminals. It is manufactured with sections from 10 to 5000 mm² (see table)
- This type of connection is manufactured at the customer's request, to measure, due to the type of copper, width, distance, connector, etc. We can also insulate it with different materials: silicone, fiberglass, etc
- For grounding connections, vibrating machines, transforming connection bridges, in the manufacture of electrical equipment

PERÇAGES STANDARD

STANDARD DRILLINGS



FLEXIBLE BARS

- We can insulate any type of connections from the ones we make:
  - Mass braid with flat terminals (FT-17)
  - Round connector with terminal
  - Steel connector
  - Custom flat braids

  With different materials: PVC, LSHF, SILICONE, PE, nylon, Nomex, polyester, Kapton, mica glass, fiberglass, etc.)
- Custom dimensions. The braids are insulated for different reasons: environment, temperature, tension, possibility of contact
- For grounding connections, vibrating machines, transforming connection bridges, electrical equipment manufacturing

COPPER LAMELLAR SHUNTS

- Polished copper sheets, with a thickness of 0.10 or 0.30 mm. 2 copper plates placed at the ends, for connecting holes. Sections to 5,000 mm².

Possibility of insulating with different materials and heat-shrinkable sleeves

- Copper bare steels (Cu-ETP) according to the UNE-EN 13599 standard
- For welding equipment, where a very large cross section is required and moves in only one direction. They are also used in electrical panels, replacing traditional cables (insulated, in this case)

Designation	Cu-ETP
Cu conditions	Electrolytic annealing
Cu Purity	99,90%
Resistance at 20°C	1.7241 μΩ.cm
Conductivity	58 (100% IACS)
Load break	> 200 MPa
Lengthening	> 30%

WATER-COOLED CONNECTORS

- These connections consist of a braid with a copper spring core, covered with a neoprene tube and some connectors that have electrical and water connection. The fundamental characteristic is the elimination of the heat produced by the high intensity that circulates in the moments of welding, by the passage of water, through the interior of the cable
- Copper square braid with a section determined by the amperage and an internal hole for the passage of water. With electrolytic copper EN 13602
- Main applications of water-cooled cables: electrochemistry, welding, induction furnaces, electrothermia, electromagnet supply, etc

Family 3: FLEXIBLE COPPER CABLES

Description: Our copper cables are made of thin wires (diameters from 0.05 to 2.5 mm), braided or not of bare annealed or tinned electrolytic copper. It is possible to make cables with other alloys (Nickel and Silver). The cross section of our conductors can be circular or square, with a cross section of up to 1200 mm². We also manufacture American gauge sections (AWG / MCM).

We manufacture cables of non-standard sections to measure for our customers, with a very small minimum quantity of manufacture and with a delivery time of around 2/3 weeks.

Application: Our flexible braided copper cables are intended for the following applications: Connections, manufacture of electrical equipment, protection and earthing equipment, plugs, lightning rods, transformation centers, etc.

CHARACTERISTICS OF CABLES			
TYPE	**CONSTRUCTION**	**CHARACTERISTICS**	**APPLICATIONS**
EXTRA FLEXIBLE BARE COPPER CABLES	• Conductor: Annealed electrolytic bare or tinned copper. According to / EN 13602 • Wiring: conductors arranged in concentric layers. (7-19-37-61) in 2 wiring directions Left and Right (one per layer). The case of a single direction is called UNILAY	Annealed electrolytic copper wires conductors. The cross section of our conductors can be circular and square. Manufactured with diameters of 0.10 and 0.25 mm (unit wires) ➔ sections from 0.75 mm² to 1200 mm² (with other wires diameters). On request, we can produce and insulate, with different materials: Extrude (PVC, LSHF, SILICONE, PE, etc.) Tape and thread (nylon, Nomex, polyester, Kapton, mica glass and fiberglass)	Connectors, manufacture of electrical equipment, electrical ground connection, energy industry for wind turbines, generators, substations, transformers, switchgear, hydraulic turbines, circuit breakers and rectifiers. They are also used in the automotive, aerospace, IT and military industries
WATER COOLED CABLES	These cables consist of a copper spring core covered with a copper braid formed of wires with a diameter of 0.20 and 0.31 mm, allowing very small radius of curvature and therefore great ease of handling. The main feature is the elimination of heat caused by the high current flowing during welding, by the water flowing through the inside of the cable ▪ This cable is coated on the outside with a neoprene tube ▪ Terminals tailored to the needs of each application are soldered to the ends of the required cable length	• Conductor: copper wires 0.20 to 0.31 mm according to EN 13602 • Spring: copper wire 0.50 to 1.5 mm according to EN 13602	The main applications of water-cooled cables are electrochemistry, welding, induction furnaces, electrothermal energy, supplying electromagnets, etc
ROUND CABLES	• Conductor: Annealed electrolytic bare or tinned copper. According to / EN 13602 • Wiring: conductors arranged in concentric layers	These cables have a smooth surface and a diameter without variations, being very well compacted, since they are manufactured in concentric formation (layers). 7 (1 + 6), 19 (1 + 6 + 12), 37 (1 + 6 + 12 + 18), 61 (1 + 6 + 12 + 18 + 24). It is manufactured with a diameter of 0.07 and 0.10 mm (unit wires), which can make sections up to 500 mm²	Connectors, manufacture of electrical equipment, electrical ground connection, energy industry for wind turbines, generators, substations, transformers, switchgear, hydraulic turbines, circuit breakers and rectifiers. They are also used in the automotive, aerospace, IT and military industries
CABLES EARTH	• Conductor: Annealed electrolytic bare copper (Class 2). According to / IEC 60228 • Wiring: conductors arranged in concentric layers. (7-19-37-61) With 2 wiring directions left and right (one per layer)	Conductors made of rigid annealed electrolytic copper wires. Class 2 of standard IEC 60228. Wiring of concentric layers	They are intended for use in an earthing system. Earthing is a mandatory practice both in industrial and domestic installations, as well as in the operation of systems for the production, transmission and distribution of electrical energy

EXTRA FLEXIBLE BARE COPPER CABLES

Bare/tinned copper conductor (wire Ø 0.10 mm)

Reference Code Bare Copper	Reference Code Tinned Copper	Section (mm²)	Exterior Ø (mm)	Mass (g/m)	Bare Copper Resistance (Ω/km at 20°C)	Tinned Copper Resistance (Ω/km at 20°C)
NF-14 N°1	NF-14 N°1E	0.75	1.15	7.50	26	26.7
NF-14 N°2	NF-14 N°2E	1.0	1.40	10	19.50	20
NF-14 N°3	NF-14 N°3E	1.5	1.90	15	13.30	13.7
NF-14 N°4	NF-14 N°4E	2.5	2.30	25	7.98	8.21
NF-14 N°5	NF-14 N°5E	4.0	3.10	40	4.95	5.09
NF-14 N°6	NF-14 N°6E	6.0	4.00	60	3.30	3.39
NF-14 N°7	NF-14 N°7E	10	4.90	100	1.91	1.95
NF-14 N°8	NF-14 N°8E	16	6.30	160	1.21	1.24
NF-14 N°9	NF-14 N°9E	25	8.25	250	0.780	0.795

Packaging: Crowns of 50 or 100 or 200 meters
Approximate weight: About 10 grams per meter per mm². Example: 1mm² = 10g / meter.
Dimensions: Any modification of the composition influences the dimensions and the weight of the conductors.

Bare/tinned copper conductor (wire Ø 0.25 mm)

Reference Code Bare Copper	Reference Code Tinned Copper	Section (mm²)	Exterior Ø (mm)	Mass (g/m)	Bare Copper Resistance (Ω/km at 20°C)	Tinned Copper Resistance (Ω/km at 20°C)
NF-15 N°1	NF-15 Nº 1E	2.5	2.4	24	7.98	8.21
NF-15 N°2	NF-15 Nº 2E	4	3.5	35	4.95	5.09
NF-15 N°3	NF-15 Nº 3E	6	3.7	37	3.30	3.39
NF-15 N°4	NF-15 Nº 4E	10	5	50	1.91	1.95
NF-15 N°5	NF-15 Nº 5E	16	5.7	57	1.21	1.24
NF-15 N°6	NF-15 Nº 6E	25	8	80	0.780	0.795
NF-15 N°7	NF-15 Nº 7E	35	9.4	94	0.554	0.565
NF-15 N°8	NF-15 Nº 8E	50	11	110	0.386	0.393
NF-15 N°9	NF-15 Nº 9E	70	13.5	135	0.272	0.277
NF-15 N°10	NF-15 Nº 10E	95	16	160	0.206	0.210
NF-15 N°11	NF-15 Nº 11E	120	18	180	0.161	0.164
NF-15 N°12	NF-15 Nº 12E	150	19	190	0.129	0.132
NF-15 N°13	NF-15 Nº 13E	185	21	210	0.106	0.108
NF-15 N°14	NF-15 Nº 14E	240	23.5	235	0.0801	0.0817
NF-15 N°15	NF-15 Nº 15E	300	27	270	0.0641	0.0654
NF-15 N°16	NF-15 Nº 16E	400	31	310	0.0486	0.0495
NF-15 N°17	NF-15 Nº 17E	500	34.5	345	0.0384	0.0391

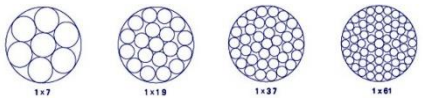
Packaging: 100 meters rolls or wood reels depending on the section
Approximate weight: About 10 grams per meter per mm². Example: 6 mm² = 60 g / meter. 300 mm² = 3000 g / m.
Dimensions: Specifications are given for information and are subject to change

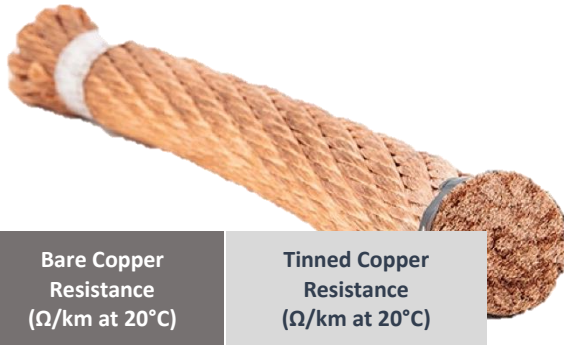
EARTH CABLES

Bare copper wire Cl.2

Reference Code Bare Copper	Nb copper wires	Section (mm²)	Diameter Ø (mm)	Mass (g/m)	Bare Copper Resistance (Ω/km at 20°C)
C-16	7	16	5	135	1.15
C-25	7	25	5.9	212	0.727
C-35	7	35	7.1	296	0.524
C-50	7+12	50	8.5	402	0.387
C-70	7+12	70	10.8	569	0.268
C-95	7+12	95	12.5	836	0.193
C-120	7+12+18	120	14.0	1036	0.153

ROUND CABLES





Reference Code Bare Copper	Reference Code Tinned Copper	Wire composition	Section (mm²)	Diameter Ø (mm)	Mass (g/m)	Bare Copper Resistance (Ω/km at 20°C)	Tinned Copper Resistance (Ω/km at 20°C)
C-10-0.07	C-10-0.07E	0.07	10	5	100	1.91	1.95
C-16-0.07	C-16-0.07E	0.07	16	6.4	160	1.21	1.24
C-25-0.10	C-25-0.10E	0.10	25	8.5	250	0.780	0.795
C-35-0.10	C-35-0.10E	0.10	35	10	350	0.540	0.565
C-50-0.10	C-50-0.10E	0.10	50	12	500	0.386	0.393
C-70-0.10	C-70-0.10E	0.10	70	13	700	0.272	0.277
C-95-0.10	C-95-0.10E	0.10	95	15	950	0.206	0.210
C-120-0.10	C-120-0.10E	0.10	120	18	1200	0.161	0.164
C-150-0.10	C-150-0.10E	0.10	150	20	1550	0.129	0.132
C-185-0.10	C-185-0.10E	0.10	185	21	1900	0.106	0.108
C-240-0.10	C-240-0.10E	0.10	240	23	2450	0.0801	0.0817

On request, we can make other sections. The lengths of the cables as well as the connection pads are made on request.

WATER-COOLED CABLES

Reference code	Section (mm²)	Core/spring (mm)	Cable mass (g/m)	Diameter (mm)
FRA-40	40	4.5	400	12
FRA-50	50	4.5	500	14
FRA-80	80	7.5	800	16
FRA-100	100	7.5	1000	19
FRA-150	150	7.5	1500	25
FRA-200	200	7.5	2000	28
FRA-250	250	7.5	2500	33
FRA-300	300	7.5	3000	35
FRA-400	400	11	4000	39
FRA-550	550	11	5500	42
FRA-700	700	11	7000	50
FRA-850	850	11	8500	53

On request, we can make other sections. The lengths of the cables as well as the connection pads are made on request.

Family 4: LITZ CABLES / WIRES

Description: Used in high-frequency applications, Litz wires and cables are constructed with small diameter enamelled copper wires (0.04 mm to 5 mm) to reduce the "skin effect" losses generated by opposite electromagnetic currents (Eddie currents).

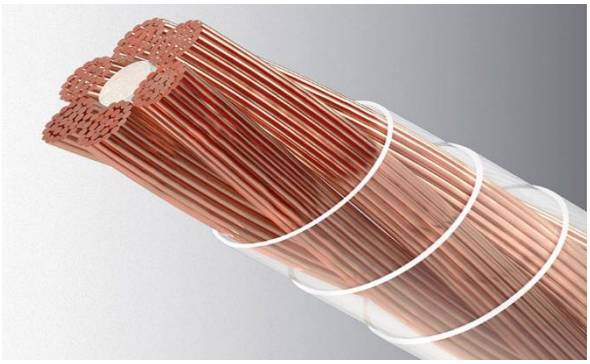
The cables are built in such a way that the losses of "proximity effect" are also reduced.

Depending on the type of varnish, the cables will be adapted to different temperature classes (120 to 240 degrees Celsius).

Applications: Mainly used for energy conversion, high-frequency transmission and reception, power electronics, inductive proximity detectors, electronic tags, multiple telephone transmission equipment, winding, flexible connections for relays, coils, transformers, engines, etc.

- The wire of Litz is an enamelled wire that can be weldable or non-weldable. The protection of the enamel is also determined by the grade: Grade 1 (1 coat of varnish) or Grade 2 (2 coats of varnish)

- The wires are assembled in braid or cable to obtain the requested section and can be covered with different types of insulation and binding materials such as polyester, Nomex, glass, Kapton, etc



CHARACTERISTICS OF THE WIRE OF LITZ			
TYPE	**CONSTRUCTION**	**CHARACTERISTICS**	**APPLICATIONS**
WIRE OF LITZ	• Conductor: Enamelled copper wire that can be weldable or non-weldable in Grade 1 (1 enamel layer) or Grade 2 (2 layers) • Wiring: Conductors wired in 7-wire studs and these wired in a perfect wiring formation (7, 19, 37) with a suitable pitch. The formation and number of threads depend on the section and the working frequency of it • Insulation: these are textile threads of different materials, depending on the temperature and their use	• Cables made of fine enamelled copper wire. Unit threads from 0.05 mm Ø to 5 mm • The choice of a single wire diameter is important for each specific application • The table below shows the relationship between the recommended single wire diameter and the frequency range	Special type of wire or enameled wire used in electronics. Litz wire is composed of several wires covered with an insulating film, twisted, and connected in parallel. The use of many wires in parallel increases the surface area of the conductive surface and thus reduces the influence of the skin effect. For them, their applications are very diverse: ▪ Electric automobile. ▪ Medicine-health (magnetic resonance equipment) ▪ Renewable energy ▪ Aeronautics / airspace ▪ Railway industry ▪ Electrical connections

Litz cables can be made in different ways according to the recommendations of the Bureau of Studies. TESORAX manufactures them with the threads assembled in the same direction and with a toron pas less than 60mm. On request, and to meet the needs of our customers, we can form them in rectangular or square sections to reduce the volume of coiling. The manufacture of our Litz cables uses materials that allow direct welding without the need to use a mechanical procedure. Before welding, Litz's cable must be immersed in a stripper and then in a tin bath (60%) and lead (40%) temperatures of 375 to 400 degrees Celsius. The immersion time depends on the number of wires and the diameter of the cable.

Losses in coiling: Losses in the coils are due to factors:

- Losses in the driver:
  - Joule effect
  - Foucault Currents
- Capacity losses
- Losses due to the hysteresis effect of the nucleus

The first two factors appear in the coils and the third in those with a ferromagnetic nucleus. We will analyze the first two factors to justify the use of the Litz cable.

Driver losses: The Joule effect is caused by electrical conductors heating up by the passage of the current, which has the effect of increasing the driver's ohmic resistance and thus reducing the possible intensity in the same section. On the surface, the section should be increased to lessen the Joule effect, but this would result in an increase in losses due to Foucault's currents. Changing the section is therefore not a solution, once it has been defined. We can do as follows: once the section of the conductor is determined, in order to eliminate the dandruff effect, we can gather enamelled cables to the calculated section; in this way we get a section that will be maintained throughout the work cycle of the reel. The thinner the wires, the better the result, due to the dandruff effect. However, this solution is expensive. We recommend the ideal calculation of the section that can be studied on a case-by-case basis by a technician.

To calculate the dandruff current, use the following formula that gives us the current level :

$$e = 503\ \frac{\rho}{\sqrt{\mu.f}}$$

e = Thick to be calculated ρ = Driver's resistance

μ = Permeability of the conductive material f = Frequency of current

For a copper conductor, the formula takes the following form:

$$e = \frac{66}{\sqrt{f}}$$

The value is given in millimeters.

THERMAL CLASS:	H155 (155°C)	H180 (180°C)	H200 (200°C)
VARNISH:	Polyurethane	Polyester or polyurethane	Polyester or polyamide
COVERING (INSULATING):	**Nylon**	Temperatures up to 120°C	
	Polyester	Temperatures up to 130°C to 155°C	
	Nomex	Temperatures up to 180°C to 200°C	
	Kapton	Temperatures up to 300°C	

The resistance of an alternating current conductor is given by:

$$R = \frac{198.10^5\sqrt{\rho\,.f}}{\mathrm{I}}\Omega/m$$

I - Mm perimeter of the driver's section.

For copper, the formula becomes:

$$R = \frac{260.10^{-6}\sqrt{f}}{\mathrm{I}}\ \Omega/m$$

Foucault Currents: When a ferromagnetic material is introduced into an alternative magnetic field, in addition to magnetization, an induced voltage is created; this produces an induced current that depends on the resistance of the material. The current induced in the material is consumed in the form of heat (Joule effect) which is given by the formula: $P = \frac{4.K}{\rho} B.c^2.f^2.V^2$

P = Puissance dissipée par les courants de Foucault K = Constant

ρ = Copper Resistance B = Maximum Induction passing through the material

c = Thickness of ferromagnetic material f = Frequency V = Volume of ferromagnetic material

Capacity losses

At the same time, two conductors with different potentials accumulate electrical energy. The wires used to make coils have this particularity, which allows us to talk about a sum of capacities distributed between the different spires of it. The coils studied are subjected to an alternative high-frequency voltage, close to the resonance frequency which gives us a very high impedance as if they were parallel with the ohmic resistance and the self-inductive coefficient of the coil. These concepts give us the conclusion that the ability of the coil alone 0.55 times the diameter in cm of it. We can change the capacity of the reel by:

- Studying its dimensions
- Seeking the best winding
- Distributing currents in the coil and isolating conductors.

The ability between two conductive wires is: $C = \frac{0,0241.گ}{\lg D/d}\ \mu F/Km$

گ = Dielectric constant of the insulation D = Diameter of the wire with the insulator d = Diameter of the bare wire

Once the insulation is chosen - which must have a very low dielectric constant and must meet our objectives - we must analyze the D/d relationship. The weaker it is, the better the capacity. The engineer must decide on the best solution, taking into account the maximum current to pass through each wire and the tension borne by the wires.

An adequate twisting of the wires forming the Litz cable will give the necessary uniformity to the capacitive distribution through this cable, in such a way as to increase the quality factor of the coil. By placing a natural silk spiral, polyester or any other fiber that meets our specifications, as a support for the shemming of enamelled yarns, we do not increase the **D**factor. In addition, the fiber's spire pitch must be perfectly sized so that Litz's cables are not too rigid, to allow for a good coil without increasing the apparent induction created between the spirals. The IgD/d relationship is a multiplying factor for induction and must be as small as possible, and is a dividing factor for the ability for which it must be as great as possible.

It is up to the engineer who calculates the coil to determine the parameters to be considered in the study of the circuit:

- Ohmic resistance
- Total induction
- Total capacity
- The end result must be a reel ready to be used in the circuit, with the best performance, the lowest volume and the best quality while having the lowest loss of resistance.
- Litz's cables allow you to:
- Reducing Losses by Joule Effect
- Reducing losses due to Foucault's currents
- Use smaller magnetic nuclei
- Get a capacity in small coils
- Getting better quality
- Easy handling of coil cables, due to wires attached to each other
- Extra-flexible cables allowing core coiling with a very low curvature radius

The chart below shows the relationship between the recommended single wire diameter and the frequency range

Min frequency (kHz)	Max frequency (kHz)	Recommended wire diameter (mm)
0,06	1	0,32
1	10	0,25
11	20	0,18
21	50	0,12
51	100	0,1
101	350	0,06
351	850	0,05
851	1400	0,04
1401	3000	0,03

Manufacturing standards

TESORAX manufactures din 46.447, and studies cables according to the criteria:

- Number of wires depending on the diameter of the cable
- The type of insulation
- The support system

The enamelled copper must be tinned. The exterior diameter and other properties of enamelled copper wire are selected by the manufacturer if the customer does not specify them formally. The outside diameter without insulation is the basis for calculating the outer diameter of the insulated cable: this is not used during reception checks.

High-frequency cables (Litz cables) are defined by:

- Thickness of every elemental thread
- Total number of wires and grouping
- No twisting
- insulator

DIN 46.447 defines the types of cables based on each of these 4 criteria. Any questions about the actual section of the driver are defined as follows:

- Pre-set effective section: 0.70mm2
- Individual wire diameter: 0.10mm, or a 0.007854 mm2 section
- Number of corresponding threads: 0.70/0.007854 - 89.13 theoretical threads. 90 wires will be used. The cable studied will have the following composition: 90 x 0.10mm

Don't hesitate to contact us for any information: Our design office will guide you in the cable solution that will suit you best.

HIGH-FREQUENCY LITZ CABLES S/DIN 46447

Enamelled copper wire structure		Size of the strand	Ext. diameter without insulation (mm)		Ext. diameter with silk insulation (mm)				Total section	Resistance CC at 20°C (Ohm/Km)		
					1 layer		2 layers					
Nb of Wires	Nominal Ø (mm)		Min	Max	Min	Max	Min	Max	(mm²)	Nominal	Min	Max
10		1X10	0,153	0,183	0,185	0,218	0,216	0,253	0,01257	1420	1240	1610
12		1X12	0,175	0,208	0,207	0,243	0,238	0,278	0,01508	1190	1030	1340
15		1X15	0,191	0,228	0,227	0,268	0,254	0,298	0,01885	950	830	1070
20		1X20	0,218	0,26	0,254	0,3	0,281	0,33	0,02513	710	620	800
25		1X25	0,252	0,3	0,288	0,34	0,315	0,37	0,03142	570	500	640
30		1X30	0,27	0,321	0,306	0,361	0,333	0,391	0,03770	475	413	537
35		1X35	0,294	0,35	0,33	0,39	0,357	0,42	0,04398	407	354	460
45		1X45	0,336	0,4	0,372	0,44	0,399	0,47	0,05655	316	275	358
60	0,04	3X20	0,399	0,475	0,435	0,515	0,462	0,545	0,07540	237	207	268
75		3X25	0,461	0,55	0,497	0,59	0,533	0,63	0,09425	190	165	215
90		3X30	0,495	0,59	0,531	0,63	0,567	0,67	0,11310	158	138	179
105		3X35	0,538	0,64	0,574	0,68	0,61	0,72	0,13195	136	118	153
120		3X40	0,58	0,69	0,616	0,73	0,652	0,77	0,15080	119	103	134
135		3X45	0,617	0,735	0,653	0,775	0,689	0,815	0,16965	105	92	118
180		3X3X20	0,756	0,9	0,801	0,95	0,846	1	0,22619	79	69	89
225		3X3X25	0,869	1,035	0,914	1,085	0,959	1,135	0,28274	63	55	71
270		3X3X30	0,932	1,11	0,977	1,16	0,922	1,21	0,33929	52,7	45,9	59,6
6		1X6	0,156	0,186	0,188	0,221	0,219	0,256	0,01178	1520	1370	1670
8		1X8	0,172	0,205	0,204	0,24	0,235	0,275	0,01571	1150	1030	1250
10		1X10	0,19	0,226	0,226	0,266	0,253	0,296	0,01963	910	820	1000
12		1X12	0,216	0,258	0,252	0,298	0,279	0,328	0,02356	760	680	840
15		1X15	0,237	0,282	0,273	0,322	0,3	0,352	0,02945	610	550	670
20		1X20	0,27	0,322	0,306	0,362	0,333	0,392	0,03927	456	410	501
25		1X25	0,312	0,372	0,348	0,412	0,375	0,442	0,04909	365	328	401
30		1X30	0,334	0,398	0,37	0,438	0,397	0,468	0,05890	304	273	334
35		1X35	0,364	0,434	0,4	0,478	0,427	0,504	0,06872	260	234	286
45	0,05	1X45	0,416	0,496	0,452	0,536	0,479	0,566	0,08836	203	182	223
60		3X20	0,494	0,588	0,53	0,628	0,566	0,668	0,11781	152	137	167
75		3X25	0,572	0,682	0,608	0,722	0,644	0,762	0,14726	122	109	134
90		3X30	0,613	0,732	0,649	0,772	0,685	0,812	0,17671	101	91	111
105		3X35	0,665	0,794	0,701	0,834	0,737	0,874	0,20617	87	78	95
120		3X40	0,718	0,856	0,763	0,906	0,808	0,956	0,23562	76	68	84
135		3X45	0,765	0,911	0,81	0,961	0,855	1,011	0,26507	68	61	74
180		3X3X20	0,936	1,116	0,981	1,166	1,026	1,216	0,35343	50,6	45,6	57,6
225		3X3X25	1,076	1,283	1,121	1,333	1,166	1,373	0,44179	40,5	36,5	44,6
270		3X3X30	1,154	1,376	1,199	1,426	1,244	1,476	0,53014	33,8	30,4	37,1

HIGH-FREQUENCY LITZ CABLES S/DIN 46447

Enamelled copper wire structure		Size of the strand	Ext. diameter without insulation (mm)		Ext. diameter with silk insulation (mm)				Total section	Resistance CC at 20°C (Ohm/Km)		
					1 layer		2 layers					
Nb of Wires	Nominal Ø (mm)		Min	Max	Min	Max	Min	Max	(mm²)	Max	Min	Wires
3	0,07	1X3	0,158	0,184	0,19	0,219	0,221	0,254	0,01155	1550	1460	1640
5		1X5	0,197	0,23	0,233	0,27	0,26	0,3	0,01924	930	870	990
6		1X6	0,219	0,255	0,255	0,295	0,282	0,325	0,02309	780	730	820
8		1X8	0,242	0,282	0,278	0,322	0,305	0,352	0,03079	580	550	620
10		1X10	0,266	0,31	0,302	0,35	0,329	0,38	0,03848	465	437	483
12		1X12	0,304	0,354	0,34	0,394	0,367	0,424	0,04618	387	364	411
15		1X15	0,332	0,387	0,368	0,427	0,395	0,457	0,05773	310	231	329
20		1X20	0,38	0,442	0,416	0,482	0,443	0,512	0,07697	232	219	246
25		1X25	0,438	0,51	0,474	0,55	0,501	0,58	0,09621	186	175	197
30		1X30	0,468	0,546	0,54	0,586	0,54	0,626	0,11545	155	146	164
35		1X35	0,511	0,595	0,547	0,635	0,582	0,675	0,13470	133	125	141
45		1X45	0,583	0,68	0,619	0,72	0,655	0,76	0,17318	103	97	110
60		3X20	0,693	0,807	0,729	0,874	0,765	0,887	0,23091	78	73	82
75		3X25	0,803	0,935	0,848	0,985	0,893	1,035	0,28863	62	58	66
90		3X30	0,861	1,005	0,906	1,055	0,951	1,105	0,34636	51,7	48,6	54,8
105		3X35	0,935	1,09	0,98	1,14	1,025	1,19	0,40409	44,3	41,6	46,9
120		3X40	1,007	1,173	1,052	1,223	1,097	1,263	0,46181	38,8	36,4	41,1
135		3X45	1,075	1,25	1,12	1,3	1,165	1,35	0,51954	34,4	32,4	36,5
180		3X3X20	1,315	1,53	1,36	1,58	1,405	1,63	0,69272	25,8	24,3	27,4
225		3X3X25	1,51	1,76	1,555	1,81	1,6	1,86	0,86590	20,7	19,4	21,9
270		3X3X30	1,62	1,89	1,665	1,94	1,71	1,99	1,03908	17,2	16,2	18,3
315		3X3X35	1,765	2,06	1,81	2,11	1,86	2,16	1,21226	14,8	13,9	15,6
405		3X3X45	2,015	2,35	2,06	2,4	2,105	2,45	1,55862	11,5	10,8	12,2
10	0,1	1X10	0,38	0,491	0,416	0,471	0,443	0,501	0,07854	228	214	242
12		1X12	0,433	0,491	0,469	0,531	0,496	0,561	0,09425	190	179	201
15		1X15	0,473	0,537	0,509	0,577	0,545	0,617	0,11781	152	143	161
20		1X20	0,541	0,613	0,577	0,653	0,613	0,693	0,15708	114	107	121
25		1X25	0,624	0,708	0,66	0,748	0,696	0,788	0,19635	91	86	97
30		1X30	0,668	0,757	0,704	0,797	0,74	0,837	0,23562	76	71	81
35		1X35	0,728	0,826	0,764	0,866	0,8	0,906	0,27489	65	61	69
45		1X45	0,832	0,944	0,877	0,994	0,922	1,044	0,35343	50,6	47,6	53,7
60		3X20	0,988	1,12	1,033	1,17	1,078	1,22	0,47124	38	35,7	40,3
75		3X25	1,145	1,3	1,19	1,35	1,235	1,4	0,58905	30,4	28,6	32,2
90		3X30	1,228	1,395	1,273	1,445	1,318	1,495	0,70686	25,3	22,8	26,8
105		3X35	1,33	1,51	1,375	1,56	1,42	1,61	0,82467	21,7	20,4	23
120		3X40	1,435	1,626	1,48	1,678	1,523	1,718	0,94248	19	17,8	20,1
135		3X45	1,53	1,735	1,575	1,785	1,62	1,835	1,06029	16,9	15,9	17,9

OTHER TECHNICAL SPECIFICATIONS

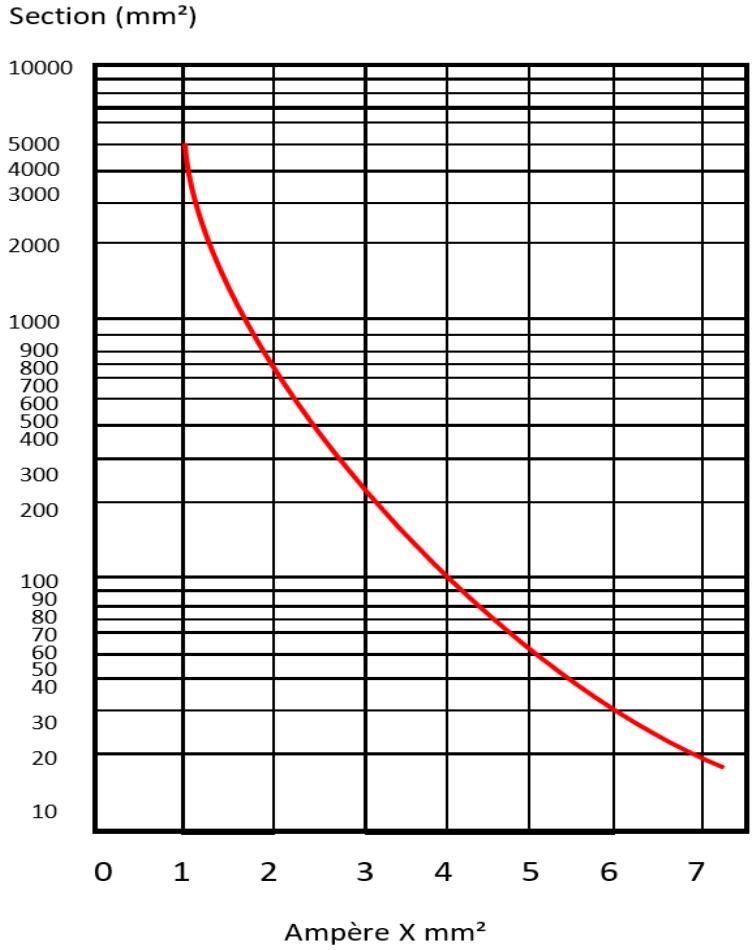
AWG INDICATOR TABLE

N° AWG	Nominal diameter (mm)	Nominal section (mm^2)	Nominal weight (Kg/Km)	Resistance at 20°C (Ohm/Km)
4/0	11,68	107,2	953,19	0,1608
3/0	10,4	85,03	755,86	0,2028
2/0	92,66	67,43	599,46	0,2556
1/0	82,52	53,48	475,5	0,3225
1	73,48	42,41	376,96	0,4065
2	65,44	33,63	299	0,5128
3	58,27	26,67	237,07	0,6463
4	51,89	21,15	188,11	0,8153
5	46,21	16,77	149,13	1,028
6	41,15	13,3	118,27	1,296
7	36,65	10,55	93,775	1,634
8	32,64	8,366	74,383	2,061
9	29,06	6,632	58,965	2,599
10	25,88	5,261	46,789	3,256
11	23,05	4,172	37,093	4,134
12	20,53	3,309	29,426	5,21
13	18,28	2,624	23,335	6,571
15	14,5	1,65	14,668	10,45
16	12,91	1,309	11,232	13,18
17	11,5	1,038	9,2281	16,61
18	10,24	0,8232	8,5171	20,95
19	0,9116	0,6527	5,803	26,39
20	0,8118	0,5176	4,602	33,3
21	0,7229	0,4105	3,649	41,99
22	0,6439	0,3255	2,895	52,95
23	0,5733	0,2582	2,295	66,8
24	0,5105	0,2047	1,82	84,22
25	0,4547	0,1624	1,444	106,2
26	0,4049	0,1288	1,145	133,9
27	0,3607	0,1021	0,9079	168,9
28	0,3211	0,0809	0,7199	212,9
29	0,2859	0,0642	0,5708	268,6
30	0,2547	0,0509	0,4227	338,6
31	0,2268	0,0404	0,3591	426,6
32	0,2019	0,032	0,2847	538,4
33	0,1798	0,0254	0,2258	678,8
34	0,1601	0,0211	0,179	856
35	0,1426	0,016	0,142	1079
36	0,127	0,0127	0,1127	1360
37	0,1131	0,01	0,0893	1716
38	0,1007	0,008	0,0708	2164
39	0,0897	0,0063	0,0561	2729
40	0,0799	0,005	0,0445	3442
41	0,0711	0,004	0,0353	4310
42	0,0632	0,0032	0,0279	5454
43	0,0564	0,0025	0,0222	6852
44	0,0503	0,002	0,0177	8621
45	0,0447	0,0015	0,0139	11135

ELIGIBLE INTENSITY DEPENDING ON THE SECTION

Section (mm²)	Admissible Intensity (A)
16,5	122
26,5	157
37	202
50	250
73	310
90	349
100	372
125	431
150	480
200	599
250	673
300	780
400	950
500	1100
625	1300
800	1500
1000	1800
1500	2200
2000	2400
3000	3000

Valid for an ambient temperature of 35 degrees Celsius and maximum temperature 70 degrees Celsius



SECTION MEASURING TABLE AND WEIGHT OF WIRES AND BARS

Ø wire (mm)	Section (mm²)	gr/m	Ø wire (mm)	Section (mm²)	gr/m
0,15	0,0176715	0,157	1,4	1,53938	13,70
0,16	0,0201062	0,179	1,6	2,01062	17,89
0,17	0,0226980	0,202	1,8	2,54469	22,65
0,18	0,0254469	0,226	2	3,14159	27,96
0,19	0,0283529	0,252	2,2	3,80133	33,83
0,2	0,0314159	0,279	2,25	3,97608	35,39
0,21	0,0346361	0,308	2,5	4,90874	43,69
0,22	0,0380133	0,338	2,8	6,15752	54,80
0,23	0,0415476	0,369	3	7,06858	62,91
0,24	0,0452389	0,402	3,8	11,34115	100,93
0,25	0,0490874	0,436	4	12,56637	111,84
0,28	0,0615752	0,547	4,5	15,90431	141,54
0,32	0,0804248	0,715	5	19,63495	174,74
0,35	0,0962113	0,855	5,8	26,42079	235,14
0,4	0,1256637	1,116	6	28,27433	251,63
0,45	0,1590431	1,413	6,5	33,18307	295,32
0,5	0,1963495	1,744	7	38,48451	342,50
0,55	0,2375829	2,111	8	50,26548	447,35
0,6	0,2827433	2,512	9	63,61725	566,17
0,65	0,3318307	2,948	10	78,53982	698,98
0,8	0,5026548	4,466	12	113,09734	1006,53
0,85	0,5674502	5,041	15	176,71459	1572,70
0,9	0,6361725	5,652	18	254,46900	2264,69
0,95	0,7088218	6,297	20	314,15927	2795,92
1	0,7853982	6,978	25	490,87385	4368,62
1,1	0,9503318	8,443	30	706,85835	6290,82
1,2	1,1309734	10,048	35	962,11275	8616,00

TESORAX
Cables and Copper

Sofiane Nacirdine
Email: sofiane.nacirdine@tesorax.fr

TESORAX
15 Route de Manom
57100 THIONVILLE | France
Tel. +339 81 16 35 63| +336 58 63 19 59
E-mail: contact@tesorax.fr
www.tesorax.fr
R.C.S. Thionville 890 372 220