PYROMETRY CABLES

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LES CABLES DE L'EXTREME


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Ultimately, this catalogue is the result of the passionate endeavours of an entire team, who have displayed great talent in writing it for you.

It is designed to be a simple and concise working tool for you, serving as a reference document that is able to meet the majority of your needs.

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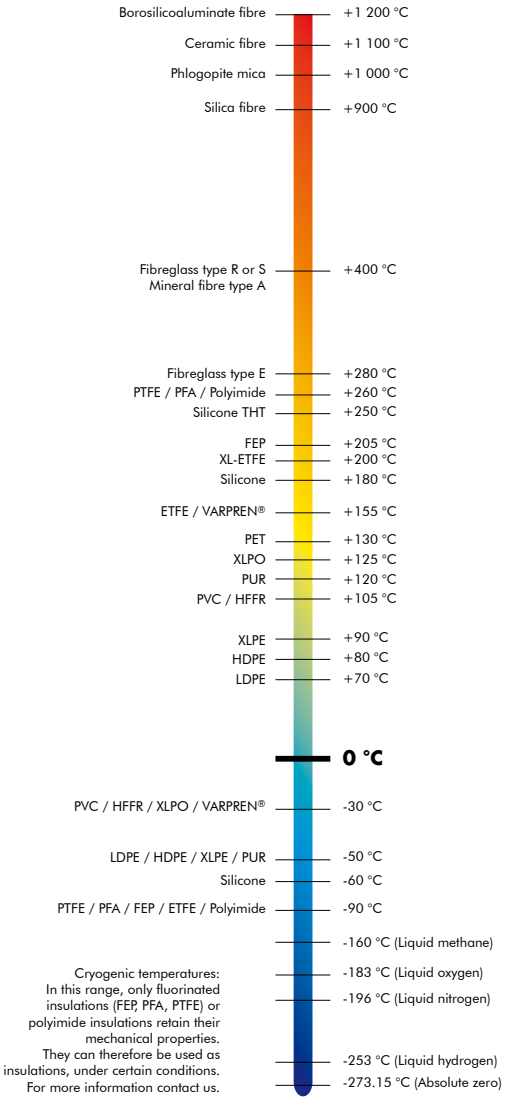
Thermal classification of insulations



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COUPLIX®

Thermocouple cables, general information

General - definitions

- Thermocouple: a thermocouple features a pair of conductors of different metals connected to their ends (measurement junction and reference junction) to measure a temperature by thermoelectric effect.
- Thermoelectric effect (Seebeck): the thermoelectric effect is an electromotive force (FEM) produced by the temperature difference between the two junctions of the metal conductors on the thermocouple.
- 1- Measurement junction (T1): thermocouple junction placed and subjected to the temperature to measure.
- 2- Reference junction (T2): thermocouple junction of which the temperature is known (reference temperature).

Thermocouple tolerances

According to standard EN 60584-1, the tolerance is the maximum admissible initial difference in relation to the specified electromotive force. Except for types C and A, it is expressed in the form of a difference in degrees Celsius (°C) or as a function of the temperature t. The highest value is applied.

Principle of operation of a thermocouple

In the circuit formed by the two thermocouple conductors, where the junctions are raised to different temperatures T1 and T2, a current I is created and generates a measurable electromotive force (FEM) (figure 1) by thermoelectric effect, which itself depends on the temperature difference between T1 and T2 (T1: measurement junction, T2: reference junction) and the thermocouple used.

Also, if the metals are identical, the wires can cross zones of different temperatures without disrupting the temperature measurement between the two ends (T3 and T4 have no influence on the measurement), figure 2.
The measurement instruments are designed to accommodate the thermocouple directly on their terminals that represent the reference junction.

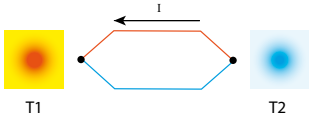

Figure 1

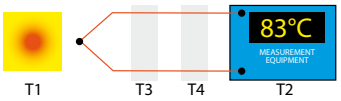

Figure 2

The relationship between the electromotive force and (T1-T2) is not exactly linear. The relationship between the electromotive force and the temperature in degrees is therefore expressed by polynomes FEM=f(t°C), where the reference junctions of the thermocouples are set to 0°C.
These polynomes are defines in standard EN 60584-1 for each of the standardised thermocouples.
Each type of thermocouple is used on a limited temperature range, fixed by the standard according to its nature and the environmental constraints.

TYPE OF THERMOCOUPLE Nature of metals (1)			TOLERANCE VALUES (TEMPERATURE VALIDITY LIMITS)		
Symbol	Positive conductor	Negative conductor	Class 1	Class 2	Class 3 (2)
J	Iron	Cupronickel J	± 1.5 °C or ± 0.004.t *(-40 at +750 °C)*	± 2.5 °C or ± 0.0075.t *(-40 to +750 °C)*	–
K	Nickel-chromium	Nickel alloy	± 1.5 °C or ± 0.004.t *(-40 at +1000 °C)*	± 2.5 °C or ± 0.0075.t *(-40 to +1200 °C)*	± 2.5 °C or ± 0.015.t *(-200 to +40 °C)*
T	Copper	Cupronickel T	± 0.5 °C or ± 0.004.t *(-40 at +350 °C)*	±1.0 °C or ± 0.0075.t *(-40 to +350 °C)*	± 1.0 °C or ± 0.015.t *(-200 to +40 °C)*
E	Nickel-chromium	Cupronickel E	± 1.5 °C or ± 0.004.t *(-40 at +800 °C)*	±2.5 °C or ± 0.0075.t *(-40 to +900 °C)*	± 2.5 °C or ± 0.015.t (-200 to +40 °C)
N	Nickel-chromium Silicium	Nickel-silicium	± 1.5 °C or ±0.004.t *(-40 at +1000 °C)*	± 2.5 °C or ± 0.0075.t *(-40 to +1200 °C)*	± 2.5 °C or ± 0.015.t *(-200 to +40 °C)*
R	Platinum 13% Rhodium	Platinum	±1.0 °C *(0 to +1100 °C)* AND ± [1 + 0.003 x (t -1100)]°C *(+1100 to +1600 °C)*	± 1.5 °C or ± 0.0025.t *(+600 to +1700 °C)*	–
S	Platinum 10% Rhodium	Platinum	±1.0 °C *(0 to +1100 °C)* AND ± [1 + 0.003 x (t -1100)]°C *(+1100 to +1600 °C)*	± 1.5 °C or ± 0.0025.t *(+600 to +1700 °C)*	–
B	Platinum 30% Rhodium	Platinum 6% Rhodium	–	± 1.5 °C or ± 0.0025.t *(+600 to +1700 °C)*	± 4.0 °C or ± 0.0025.t *(+600 to +1700 °C)*
C	Tungsten 5% Rhenium	Tungsten 26% Rhenium	–	± 0.01.t *(+426 to +2315 °C)*	–
A	Tungsten 20% Rhenium	Tungsten 20% Rhenium	–	± 0.01. t *(+1000 to +2500 °C)*	–

(1) No standard composition has been established for thermocouple alloys of ordinary metals, except for type N.
Nonetheless the composition itself is less critical than the selection of positive and negative conductors. The positive conductor and negative conductor must be paired.
In particular, the negative conductors on thermocouples J, E and T are not generally interchangeable.

(2) The materials used on type T, E, K and N thermocouples are normally supplied in respect of the tolerance values specified for temperatures above -40 °C. The materials used are permitted to not satisfy the tolerance values for temperatures below -40 °C indicated in class 3.
If thermocouples must satisfy the limits of class 3 along with those of classes 1 or 2, the buyer must specify this, as it will normally be necessary to select specific materials.

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Extension and compensation cables, general information

General - definitions

Extension cables and compensation cables serve to connect the open ends of the two wires of a thermocouple at the reference junction in equipment where the thermocouple is not directly connected to the reference junction.

Extension cables

Extension cables are manufactured with wires of the same nominal metallurgic composition as the corresponding thermocouples. They are identified by the letter "X" placed after the thermocouple code, e.g. "JX". The tolerance class is defined by the figures 1 or 2 placed after the extension cable symbol, e.g. "KX1".

Compensation cables

Compensation cables are manufactured with wires of a different nominal metallurgic composition as the corresponding thermocouples. They are identified by the letter "C" placed after the thermocouple code, e.g. "KC". In certain cases, different tolerances apply to different temperature ranges for the same thermocouple. They are distinguished by additional letters, e.g. KCA, KCB.

Tolerance values

The tolerance of an extension cable or compensation cable is the maximum additional difference expressed in microvolts, due to the presence of an extension cable or compensation cable in the temperature measurement circuit.

Principle of use

In most cases, thermocouples are located at quite a long distance from the measurement equipment, control equipment or recording equipment.

Therefore extension cables or compensation cables are used to connect the thermocouple to the equipment. These cables serve to transport the data originating from the thermocouple (figures 3 and 4).
The properties of these cables are similar to those of the corresponding thermocouples, but within a smaller temperature range and with different tolerances (see table).
The precision of the measurement is less when an extension cable or compensation cable is used.

Figure 3
(direct assembly)

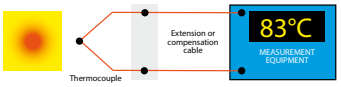

Figure 4
(assembly with extension cable or compensation cable)

Identification and tolerance values for extension cables and compensation cables

Tolerance values are expressed in microvolts. The table also indicates, between brackets, the equivalent close tolerance in degrees Celsius. As the FEM-temperature relationship is not linear, the tolerance value in degrees Celsius depends on the temperature of the measurement junction on the thermocouple. The table data correspond to the "Temperature of the measurement junction" in the last column.
In most cases, the error expressed in degrees Celsius will be larger at lower measurement junction temperatures.
The junction between the thermocouple and the extension cable or compensation cable must be made in a zone compatible with the cable's temperature range.

Type of cable	Nature of conductor metals	Class 1 Identification	Class 1 Tolerance	Class 2 Identification	Class 2 Tolerance	Cable temperature range (1)	Measurement junction temperature
EXTENSION CABLES							
JX	Iron / Cupro-Nickel JX	JX1	± 85 µV (± 1.5 °C)	JX2	± 140 µV (± 2.5 °C)	–25 to +200 °C	500 °C
TX	Copper / Cupro-Nickel TX	TX1	± 30 µV (± 0.5 °C)	TX2	± 60 µV (± 1.0 °C)	–25 to +100 °C	300 °C
EX	Nickel-chromium / Cupro-Nickel EX	EX1	± 120 µV (± 1.5 °C)	EX2	± 200 µV (± 2.5 °C)	–25 to +200 °C	500 °C
KX	Nickel-chromium / Nickel alloy	KX1	± 60 µV (± 1.5 °C)	KX2	± 100 µV (± 2.5 °C)	–25 to +200 °C	900 °C
NX	Nickel-chromium-Silicium / Nickel-Silicium	NX1	± 60 µV (± 1.5 °C)	NX2	± 100 µV (± 2.5 °C)	–25 to +200 °C	900 °C
COMPENSATION CABLES							
KCA	Iron / Cupro-Nickel KCA		-		± 100 µV (± 2.5 °C)	0 to +150 °C	900 °C
KCB	Copper / Cupro-Nickel KCB		-		± 100 µV (± 2.5 °C)	0 to +100 °C	900 °C
NC	Nickel-chromium-Silicium / Nickel-Silicium		-		± 100 µV (± 2.5 °C)	0 to +150 °C	900 °C
RCA	Copper / Cupro-Nickel RCA		-		± 30 µV (± 2.5 °C)	0 to +100 °C	1000 °C
RCB	Copper / Cupro-Nickel RCB		-		± 60 µV (± 5.0 °C)	0 to +200 °C	1000 °C
SCA	Copper / Cupro-Nickel SCA		-		± 30 µV (± 2.5 °C)	0 to +100 °C	1000 °C
SCB	Copper / Cupro-Nickel SCB		-		± 60 µV (± 5.0 °C)	0 to +200 °C	1000 °C
BC	Copper / Copper alloy (2)		-		± 40 µV (± 3.5 °C)	0 to +150 °C	1400 °C

(1) The temperature range of cables may be reduced to values below those indicated in the table due to the limit temperature of the insulation.

(2) A cable comprising two copper conductors may also be used with type B thermocouples; in this case the temperature range is reduced to: 0 °C to +100 °C.

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COUPLIX®

Recap table and standardised colour codes

THERMOCOUPLES

Symbols	Nature of metals +	Nature of metals -	Temperature range (°C)	FEM at 0 °C (µV)	Seebeck coefficient at 0 °C (µV/°C)
T	Copper	Cupro-nickel T	-40 °C to +350 °C	0.4	38.7
J	Iron	Cupro-nickel J	-40 °C to +750 °C	0.5	50.4
E	Nickel-chromium	Cupro-nickel E	-40°C to +900 °C	0.6	58.7
K	Nickel-chromium	Nickel alloy	-40°C to +1200 °C	0.4	39.5
N	Nickel-chromium Silicium	Nickel Silicium	-40°C to +1200 °C	0.3	25.9
R	Platinum 13% Rhodium	Platinum	0°C to +1600 °C	0	5.3
S	Platinum 10% Rhodium	Platinum	0°C to +1600 °C	0	5.4
B	Platinum 30% Rhodium	Platinum 6% Rhodium	+600 °C to +1700 °C	0	-0.2
C	Tungsten 5% Rhenium	Tungsten 26% Rhenium	+426 °C to +2315 °C	0.1	13.4
A	Tungsten 5% Rhenium	Tungsten 20% Rhenium	1,000 °C to +2500 °C	0.8	12.0

EXTENSION - COMPENSATION

Symbols: Extension Class 1	Symbols: Extension class 2 or compensation	Nature of metals +	Nature of metals -	Colour code (1) (2): EN 60584-3 - IEC 60584-3	Colour code (1) (2): ANSI-MC96.1 (1982)	Colour code (1) (2): JIS C 1610 (1995)
TX1	TX2	Copper	Cupro-nickel TX			
JX1	JX2	Iron	Cupro-nickel JX			
EX1	EX2	Nickel-chromium	Cupro-nickel EX			
KX1	KX2	Nickel-chromium	Nickel alloy			
	KCA	Iron	Cupro-nickel KCA			WX
	KCB	Copper	Cupro-nickel KCB		(5)	VX
NX1	NX2	Nickel-chromium Silicium	Nickel Silicium		(5)	
	RCA (3) OR RCB	Copper	Cupro-nickel RCA or RCB		SX	RX
	SCA (3) OR SCB	Copper	Cupro-nickel SCA or SCB			SX
	BC	Copper	Copper alloy (4)		BX	BX
	CC	Cupro-Nickel Iron CC	Cupro-nickel CC		(5)	
	AC					

(1) The colour codes represented are those for extension cables and compensation cables. Concerning thermocouple cables:
- According to IEC / EN 60584-3 and JIS C 1610, the colour code supplied by OMERIN is the same as these standards do not define a colour code for thermocouples.
- According to ANSI-MC96.1, the colour of conductors is the same but the external colour is brown.

(2) The colour codes of former standards NF C 42-323 and 42-324 (1985), BS 1843 (1952) and DIN 43714 (1979) are still used on rare occasions (contact us).

(3) The materials used to manufacture SCA compensation cables are compatible with the temperature ranges and tolerance values of SCB, RCA and RCB. The standard manufactured by OMERIN is therefore SCA type, which can be used for the four applications.

(4) When the thermocouple junction B / compensation cable BC remains at a temperature below 100 °C, the core of the two compensation cable conductors may be made of copper.

(5) Although not described in the standards cited above, these colour codes are commonly used by the profession and therefore constitute our production standard.

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COUPLIX®

User guide and selection guide for pyrometry cables

Thermocouples

The choice of a thermocouple may be enforced, beyond the stipulations of IEC / EN 60584-1, by such aspects as the environment, the application, the temperature range required, the construction of the thermocouple, etc.
The tables below provide guidelines for use taken from the main thermocouple standards, limited to the products that we manufacture:
Table 1 (see next page) = Maximum recommended temperatures according to strand diameter.
Table 2 (see next page) = Environmental limits and recommendations.

The line resistance of the thermocouple has little effect on the precision of the measurement. Nonetheless it is important that the loop resistance of the cable (sum of the linear resistance of the two conductors multiplied by the length of the thermocouple cable) is below 100 ohms.
A greater cable cross-section is therefore needed if the cable is longer (see table 3 on next page).

Extension and compensation

When the thermocouples are located at a long distance from the measurement equipment, control equipment or recording equipment, it is possible to use extension cables or compensation cables to connect the thermocouple to the equipment.
In general these cables are more economical but they introduce additional imprecision in the measurement made.

Temperature limits

Furthermore, they have a more limited temperature range. It is therefore essential that the junction between the thermocouple and the extension cable or compensation cable lies within the temperature range of the cable. Similarly, in no case should the cable pass through a zone where the temperature exceeds the cable's temperature range.

Environmental limits

The cable environment must be taken into consideration. The cable must be protected against impacts, vibrations, mechanical stresses, etc.

Electromagnetic disturbances

The signals transmitted by these cables are very low voltages and are therefore sensitive to electromagnetic disturbance. They should not therefore be installed near to sources of disturbance (power cables, motors, etc.). It is recommended to use cables with an electrical screen (copper braid or aluminium tape).

Lengths

As indicated for thermocouples, the line resistance has little effect on the precision of the measurement, as the currents and voltages involved are very low. Nonetheless, imprecisions may be introduced into the signal if the run is too long or if the cross-sections used are too small, in particular due to external electromagnetic disturbance and the inevitable imperfection of the insulation used.
It is therefore important to adapt the cable cross-section to the length of the run, so to avoid introducing excessive loop resistance into the circuit in addition to that of the thermocouple.
A rule of thumb is that the loop resistance of the full circuit (sum of resistance to ohms of each conductor multiplied by the total length of the run) is less than 100 ohms, and in all cases at least a factor of 1000 less than the input resistance of the measurement equipment. Table 3 (see next page) indicates the main loop resistances of thermocouples, extension cables and compensation cables, to guide the user in their product selection.

In all cases

The limit temperatures and temperature ranges indicated in the tables are those specified by the applicable standards and supported by the constituent metals of the cable conductors.
The temperature range of cables therefore may be reduced to lower values due to the limit temperature of the insulation used.
It is therefore important to adapt the choice of insulation to ensure it is compatible with the cable temperature ranges, or to restrict the use of a pyrometry cable to temperatures that are compatible with both the authorised temperature range and the limits of its insulation.

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TABLE 1
Maximum recommended temperatures (Tmax) in °C according to the strand diameter (1)

Strand diameter (mm)	J	K	T	N	E
0.2	-	-	-	-	-
0.3	-	-	200	-	-
0.5	-	-	200	-	-
0.65	400	750	215	850	440
0.8	425	800	225	900	470
1.6	500	950	300	1050	570

(1) Tmax = temperature specified so that under normal use, the expected deviation is 0.75% of Tmax after 10,000 hours of continuous exposure in clean air.
The standard does not define any limits for small-diameter thermocouples, but whatever the situation this is less than that for thicker strands.

TABLE 2
Environmental restrictions to consider in the selection of thermocouples

Type of thermocouple	Limits and recommendations
T	Can be used in oxidizing, reducing or inert atmospheres and in a vacuum. Rapid oxidisation above 370 °C. Used preferentially on couple J under negative temperatures due to better resistance to corrosion in a humid environment.
J	Can be used in oxidizing, reducing or inert atmospheres and in a vacuum. Not recommended below 0 °C (risk of increased fragility). Rapid oxidization above 540 °C and in humid environment.
E	Can be used in oxidizing or inert environment. Rapid oxidization above 540 °C and in sulphur-rich environment. Operation in vacuum not recommended.
K	Can be used in oxidizing or inert environment. Unsuitable for use in sulphur-rich environment and unstable at high temperatures. Operation in vacuum not recommended.
N	Can be used in oxidizing or inert environment. Same use as for thermocouple K, but less sensitive to sulphur-rich or oxidising environments and more stable at high temperatures.

Also note that the metals used present varying stability to transmutation caused by neutron radiation.
The least stable is thermocouple T, then E, J, K and N is the most stable.

TABLE 3
Loop resistance of main thermocouples, extension cables and compensation cables produced by OMERIN

CS (mm²)	Stranding (mm)	K	KX	KCA	KCB	J	JX	T	TX	E	EX	N	NX	SCA	BC	CC
0.03	1 x 0.2	31.25				18.37		15.61	15.61	37.1		41.37				
0.05	1 x 0.25	20.1				11.75										
0.07	1 x 0.3	13.89	13.89			8.16	8.16	6.94	6.94	16.49	16.49	18.39	18.39			8.66
0.2	1 x 0.5	4.89		2.61		2.88	2.88	2.47		5.84		6.47	6.47			
0.22	3 x 0.3	4.63	4.63	2.5	2.4	2.72	2.72	2.31	2.31	5.5	5.5		6.13	0.55	0.159	2.89
0.22	7 x 0.2	4.46	4.46	2.39		2.62	2.62	2.23	2.23	5.3						
0.32	1 x 0.65	3.01	3.01			1.77										
0.35	5 x 0.3		2.78	1.49	1.44	1.63	1.63	1.39	1.39		3.3		3.68			
0.5	1 x 0.8	1.92	1.92			1.17	1.17	0.98		2.32		2.54		0.23		
0.5	7 x 0.3	1.98	1.98	1.07	1.03	1.16	1.16	0.99	0.99		2.35		2.62	0.24	0.07	1.23
0.5	16 x 0.2	1.95	1.95			1.15	1.15						2.58			
0.75	11 x 0.3	1.27	1.27	0.68	0.65	0.74	0.74		0.63				1.67	0.15		
1	14 x 0.3		0.99	0.54	0.52		0.58		0.49		1.18		1.31	0.12	0.035	
1.34	19 x 0.3	0.73	0.73	0.39	0.38		0.43		0.36		0.87			0.087	0.025	
1.5	21 x 0.3		0.66	0.36		0.39	0.39		0.32		0.79		0.88	0.078	0.022	
2	1 x 1.6	0.48														

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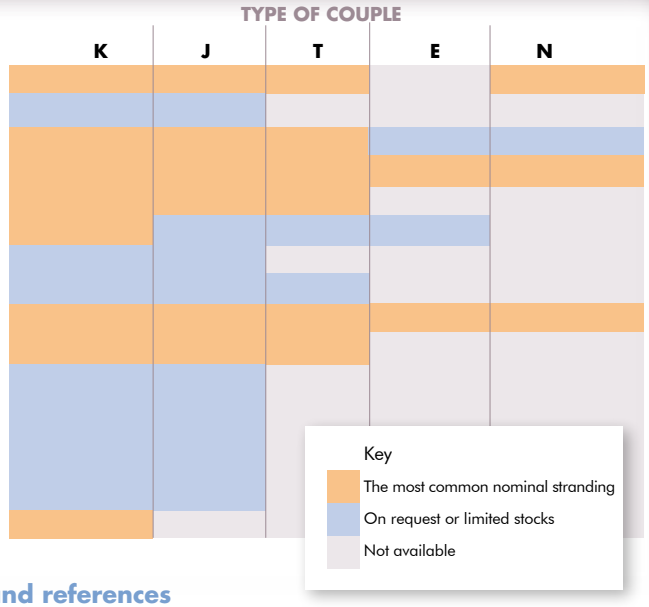
COUPLIX®

Thermocouple cables, construction and identification

Conductive cores, stranding

Cross-section (mm²)	Cross-section AWG	Stranding
0.03	32	1 x 0.20
0.05	30	1 x 0.25
0.07	28	1 x 0.30
0.2	24	1 x 0.50
0.22	24	7 x 0.20
0.22	24	3 x 0.30
0.34	22	1 x 0.65
0.34	22	5 x 0.30
0.5	20	1 x 0.80
0.5	20	7 x 0.30
0.5	20	16 x 0.20
0.75	-	11 x 0.30
1	18	14 x 0.30
1.34	16	19 x 0.30
1.5	-	21 x 0.30
2	14	1 x 1.60



Approximate external dimensions of main cross-sections and references

Insulation reference (1)	Cable shape (2)	Cross-sections (stranding) 2 x 0.03 mm² (1/0.20 mm)	2 x 0.07 mm² (1/0.30 mm)	2 x 0.2 mm² (1/0.50 mm)	2 x 0.22 mm² (7/0.20 mm)	2 x 0.5 mm² (1/0.80 mm)	2 x 0.5 mm² (7/0.30 mm)
MY2-Y2	Round	3.0	3.2	3.6	3.8	4.6	4.8
M6-6	Flat	1.1 x 1.7	1.1 x 1.8	1.3 x 2.2	1.4 x 2.4	1.8 x 3.1	2.0 x 3.4
M5-5	Flat	1.1 x 1.7	1.1 x 1.8	1.3 x 2.2	1.4 x 2.4	1.8 x 3.1	2.0 x 3.4
MV-VS	Flat	1.2 x 1.8	1.3 x 2.0	1.5 x 2.4	1.6 x 2.6	1.8 x 3.2	2.0 x 3.6
MV-VS-R	Flat	1.2 x 1.8	1.3 x 2.0	1.5 x 2.4	1.6 x 2.6	1.8 x 3.2	2.0 x 3.6
MSI-SI	flat	1.4 x 1.8	1.6 x 2.2	1.9 x 2.8	2.0 x 2.9	2.2 x 3.3	2.4 x 3.6
MNX-NX	flat	1.8 x 2.4	1.9 x 2.6	2.1 x 3.0	2.2 x 3.3	2.4 x 3.6	2.6 x 3.9
MK-K	flat	0.7 x 1.0	0.8 x 1.2	1.1 x 1.6	1.2 x 2.0	1.5 x 2.4	1.6 x 2.6

Options

- Other cross-sections and stranding: contact us.
- Other types of insulation: contact us.
- Other thermoelectric couples (R, S, B, C, A): contact us.
- Special pyrometric calibration tolerances: contact us.

Identification

COUPLIX®	K	-	BIMV	-	VS	PLAT	IEC	2 x 0.5 mm²	(1 / 0.80 mm)
COUPLIX®	x	-	xxxx	-	xx	xxxx	xxx	2 x xxx mm²	(x / x.xx mm)

- Registered trademark of OMERIN
- Symbol of thermoelectric couple
- Insulation reference (see main products on next page)
- Cable shape:
  - Round (twisted conductors)
  - Flat (parallel assembly)
- Applicable standard for colour code (see table of standardised colour codes)
- Number of conductors = 2 in general:
  - Positive conductor
  - Negative conductor
- Core cross-section in mm² or AWG
- Number of strands
- Diameter of each strand (in mm)

(1) By request, all these products can be equipped with an electrical screen or flexible armour over the sheath.
- tin-plated copper electrical screen (BE symbol in front of reference): external dimensions increased by approx. 0.5 mm.
- AISI 304 stainless steel flexible armour (BI symbol in front of reference): external dimensions increased by approx. 0.6 mm.
- galvanised steel flexible armour (BG symbol in front of reference): external dimensions increased by approx. 0.8 mm.

An electrical screen (BE) may also be placed between the conductors and the outer sheath.

(2) Flat cables (parallel conductors) may also be produced in round shape. The conductors are twisted around each other with fillers if necessary. In this case, the outer diameter is equal to the largest dimension of the flat cable.
Round cables may not be produced as flat cables.

For this product, please contact:

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COUPLIX®

Thermocouple cables, main products

Diagram	Extension or compensation symbol	COUPLIX® reference	Conductor insulation	Sheathing material	Temperature of insulation at continuous operating temperature (1)
Colour represented = IEC, K couple 	**T, J, E, K, N**	- MY2-Y2 - M6-6 - M5-5	PVC 105 °C FEP PFA	PVC 105 °C FEP PFA	-30 to +105 °C -190 to +205 °C -190 to +260 °C
Colour represented = IEC, J couple 	**T, J, E, K, N**	- MV-VS	Fibreglass	Fibreglass	-60 to +300 °C
		- MV-VS-R	High temperature fibreglass	High temperature fibreglass	-60 to +400 °C
Colour represented = white (invariable) 	**E, K, N**	- MSI-SI - MNX-NX	Silica fibre Borosilicoaluminate fibre	Silica fibre Borosilicoaluminate fibre	0 to +1000 °C 0 to +1200 °C
Colour represented = amber (invariable) 	**T, J, E, K, N**	- MK-K	Polyimide	Polyimide	-190 to +350 °C
Colour represented = IEC, N couple 	**T, J, E, K, N**	- BIM-Y2 - BGM-Y2 - BEM-Y2	PVC 105 °C PVC 105 °C PVC 105 °C	Stainless steel braid Galvanized steel braid Tin-plated copper braid	-30 to +105 °C
		- BIM-FEP - BGM-FEP - BEM-FEP	FEP FEP FEP	Stainless steel braid Galvanized steel braid Tin-plated copper braid	-190 to +205 °C
		- BIM-PFA	PFA	Stainless steel braid	-190 to +260 °C
Colour represented = ANSI, K couple 	**T, J, E, K, N**	- BIMY2-Y2 - BGMY2-Y2 - BEMY2-Y2	PVC 105 °C PVC 105 °C PVC 105 °C	PVC 105 °C / Stainless steel braid PVC 105 °C / Tin-plated copper braid PVC 105 °C / Stainless steel braid	-30 to +105°C
		- BIM6-6 - BGM6-6 - BEM6-6	FEP FEP FEP	FEP / Stainless steel braid FEP / Galvanised steel braid FEP / Tin-plated copper braid	-190 to +205 °C
		- BIM5-5	PFA	PFA / Stainless steel braid	-190 to +260 °C
Colour represented = IEC, E couple 	**T, J, E, K, N**	- BIMV-VS - BGMV-VS	Fibreglass Fibreglass	Fibreglass / Stainless steel braid Fibreglass / Galvanised steel braid	-60 to +300 °C
		- BEMV-VS	Fibreglass	Fibreglass / Tin-plated copper braid	-60 to +250 °C
		- BIMV-VS-R	High temperature fibreglass	High temperature fibreglass Stainless steel braid	-60 to +400 °C

(1) Caution: the limit temperature of the insulation does not forcibly match the field of use of the thermocouple.
It may be higher or lower than required.
It is important to take into account the limits of use of the thermocouple in question and those of the insulation to calculate the possible range of use of one of our thermocouple cables.

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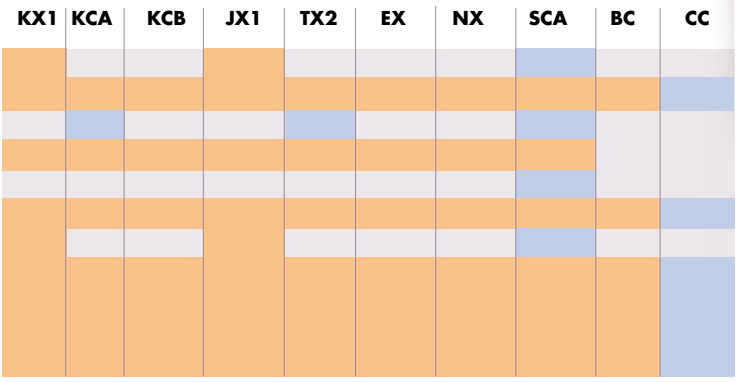
COUPLIX®

Extension and compensation cables, construction and identification

Conductive cores, stranding

Cross-section (mm^2)	Cross-section AWG	Stranding
0.22	24	7 x 0.20
0.22	24	3 x 0.30
0.34	22	1 x 0.65
0.34	22	5 x 0.30
0.5	20	1 x 0.80
0.5	20	7 x 0.30
0.5	20	16 x 0.20
0.75	-	11 x 0.30
1	18	14 x 0.30
1.34	16	19 x 0.30
1.5	-	21 x 0.30

TYPE OF EXTENSION OR COMPENSATION



Key
- The most common nominal stranding
- On request or limited stocks
- Not available

Standard products

- Our main products are described on the next page.
- The main cables we manufacture are bipolar (1 positive / 1 negative conductor).
- Possible separating tapes are not illustrated. They are nonetheless included in the cable in certain cases to facilitate production or use of the cable (separating tapes between electrical screen and conductors, between insulation and sheath, etc.).
- Outer diameters: contact us.
- When cables feature an outer braid made of galvanised steel or stainless steel, identification using coloured spiral tracers is optional.

Options

- Other cross-sections and stranding: contact us.
- Other insulation: contact us.
- Multi-pair cables, with or without individual screens, with or without general screens: contact us.
- Hybrid cables: contact us.

Identification

COUPLIX®	KX1	- MCBE-FEP	- IEC	- 2	x 1.34 mm²	(19 / 0.30 mm)
COUPLIX®	xxx	- xxxxxxx	- xxx	- x	x xxx mm²	(xx / xxx mm)

- Registered trademark of OMERIN
- Extension or compensation symbols
- Insulation reference (see main products on next page)
- Diameter of each strand (in mm)
- Number of strands
- Core cross-section in mm² or AWG
- 2 x: bipolar cable; n p: cable with n pairs
- Applicable standard for colour code (see table of standardised colour codes)

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COUPLIX®

Extension and compensation cables, main products

Diagram	Extension or compensation symbols	COUPLIX® reference (1)	Cable shape (2)	Conductor insulation	Sheathing material	Temperature of insulation at continuous operating temperature (3)
 Colour represented = IEC, KX1	All types	- MY2-Y2	Round	PVC 105 °C	PVC 105 °C	-30 to +105 °C
		- MC-CS	Round	Silicone	Silicone	-60 to +200 °C
 Colour represented = IEC, JX1	All types	- MY2BE-Y2	Round	PVC 105 °C	Screen (tin-plated copper braid) + PVC 105 °C	-30 to +105 °C
		- MCBE-CS	Round	Silicone	Screen (tin-plated copper braid) + silicone	-60 to +200 °C
 Colour represented = IEC, EX1	All types	- MY2BAL-Y2	Round	PVC 105 °C	Screen (PET/aluminium tape) + PVC 105 °C	-30 to +105 °C
		- MCBAL-CS	Round	Silicone	Screen (PET/aluminium tape) + silicone	-60 to +200 °C
 Colour represented = IEC, TX1	All types	- MC-FEP	Round	FEP	Silicone	-60 to +205 °C
 Colour represented = IEC, NX1	All types	- MCBE-FEP	Round	FEP	Screen (tin-plated copper braid) + silicone	-60 to +205 °C
 Colour represented = IEC, JX1	All types	- M6-6	Round	FEP	PEP	-190 to +205 °C
		- M5-5	Round	PFA	PFA	-190 to +260 °C
 Colour represented = IEC, KX1	All types	- M6BE-6	Round	FEP	Screen (tin-plated copper braid) / FEP	-190 to +205 °C
		- M5BE-5	Round	PFA	Screen (tin-plated copper braid) / PFA	-190 to +260 °C
 Colour represented = IEC, EX1	All types	- MV-PFA	Flat	PFA	Fibreglass	-60 to +260 °C
 Colour represented = IEC, KX1	All types	- BGMV-CS	Flat	Silicone	Fibreglass + Galvanised steel braid	-60 to +220 °C
 Colour represented = IEC, JX1	All types	- MV-VS	Flat	Fibreglass	Fibreglass	-60 to +300 °C
		- MV-VS-R	Flat	High temperature fibreglass	High temperature fibreglass	-60 to +400 °C
 Colour represented = IEC, SCA	All types	- BGMV-VS	Round	Fibreglass	Fibreglass + Galvanised steel braid	-60 to +300 °C
		- BIMV-VS	Round	Fibreglass	Fibreglass + Stainless steel braid	-60 to +300 °C
 Colour represented = IEC, KX1	All types	- BGMV-FEP	Round	FEP	Fibreglass + Galvanised steel braid	-60 to +205 °C
		- BIMV-PFA	Round	PFA	Fibreglass + Stainless steel braid	-60 to +260 °C
 Colour represented = IEC, JX1	All types	- MVK-KVS	Round	Polyimide / Fibreglass	Polymide / Fibreglass	-60 to +350 °C

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(1) We strongly recommend the use of extension cables or compensation cables with electrical screens as surrounding electromagnetic disturbances may be sources of imprecision in the signal carried.

(2) Flat cables (parallel conductors) may also be produced in round shape. The conductors are twisted around each other with filling as necessary. Round cables may not be produced as flat cables.

(3) Caution: the limit temperature of the insulation does not forcibly match the field of use of the extension cable or compensation cable. It may be higher or lower than required. It is important to take into account the limits of use of the extension or compensation metal components in question and those of the insulation to calculate the possible range of use of one of our extension cables or compensation cables.

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LES CABLES DE L'EXTREME

PLATINUM RESISTANCE TEMPERATURE SENSORS CONNECTION CABLES

FT No.	PRODUCT REFERENCE	PAGE
8201	SONDIX® - General	18
8202	SONDIX® - Main products	19
8203	SONDIX® - with fluorinated insulation and silicone sheath	20
8204	SONDIX® MC-ECS - with insulation and silicone sheath	21

SONDIX®
General information

Principle of operation

Sensor connection cables are used to link platinum resistance temperature sensors to measurement equipment.

OPERATION OF PLATINUM SENSORS

The electrical resistance of a metal conductor increases as the temperature rises. This change is reversible.
For sensors, the most commonly-used metal is platinum, which retains good linearity over a wide temperature range (from -200 °C to +850 °C). Its purity and chemical inertia ensure remarkable stability.
The relationship between the platinum resistance and the temperature is:

- $R_t = R_0 [1 + A.t + B.t^2 + C (t -100).t^3]$
- R_t = resistance at temperature t
- R_0 = resistance at 0 °C
- t = temperature in °C

For the quality of platinum generally used in industrial resistance thermometers, the values of the constants A, B and C are:

- A = 3.9083 x 10^{-3} °C^{-1}
- B = -5.775 x 10^{-7} °C^{-2}
- C = -4.183 x 10^{-12} °C^{-3} for negative temperatures and C = 0 for positive temperatures.

The most frequently-used resistance sensor is R_0 = 100 ohms (at 0 °C) and R_{100} = 138.5 ohms (at 100 °C).
It is usually called a Pt 100 sensor.
Applicable tolerance values are defined in IEC 60751.

Tolerance class	Tolerance (°C)
A	0.15 + 0.002 |t|
B	0.30 + 0.005 |t|

Tolerance class A is not used for sensors operating at above 650 °C.

Approvals - standards

- Cables and identification as per IEC 60 751, NF C 43-330, DIN 43760 and BS 1904.

Standard products

- Cables with 2, 3 or 4 conductors, 6 or 8 more rarely.
- Standard identification: 2 conductors: red / white.
  3 conductors: 2 red / 1 white.
  4 conductors: 2 red / 2 white.
- Standard colours of silicone sheaths: grey or brick red.
- Standard colours of FEP or PFA sheaths: white.
- Standard colours of outer fibreglass sheaths: white.
- Other colours on request.
- Nature of conductive cores: bare copper, tin-plated, silver-plated or nickel-plated.
- Outer diameters: contact us.

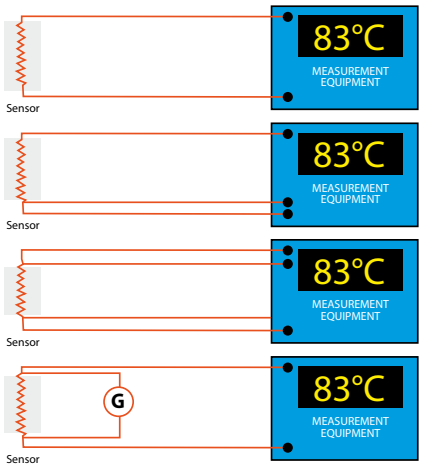
Options

- Other numbers of conductors: contact us.
- Other cross-sections and conductor metals: contact us.
- Other insulation and sheathing materials: contact us.

Applications

- Wiring of platinum resistance temperature sensors.

Assemblies used



- 2-conductor cable

Most frequently used but least precise as it introduces line resistance in the measurement.
Must not be used for class A sensors.

- 3-conductor cable - Wheatstone bridge measurement

Line wire resistance has little effect. Only contact resistances introduce an error.

- 4-conductor cable - Wheatstone bridge measurement

Line resistance is eliminated. Only contact resistances introduce an error.

- 4-conductor cable - Kelvin measurement

A current is present in the sensor. The potential difference (d.d.p) is measured at its terminals, which depends on its resistance.
For this reason, only the sensor resistance has an effect on the measurement, which is more precise than previous ones.

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SONDIX®

Main products

Diagram	SONDIX® reference	Conductor	Sheath	Operating temperature
	• MY2-Y2 • MC-CS	PVC 105 Silicone	PVC 105 Silicone	-30 to +105° C -60 to +200° C
	• M5-5 • M6-6 • M7-7	PFA FEP ETFE	PFA FEP ETFE	-190 to +260 °C -190 to +205 °C -90 to +155 °C
	• MC-FEP	FEP	Silicone	-60 to +200 °C
	• MV-PFA	PFA	Fibreglass	-60 to +260 °C
	• MV-VS	Fibreglass	Fibreglass	-60 to +300 °C
	• MV-VS-R	High temperature fibreglass	High temperature fibreglass	-60 to +400 °C
	• MV-KVS	Polymide + Fibreglass	Fibreglass	-60 to +350 °C

Conductors, cross-sections and core stranding

Number of conductors	Cross-section in mm²	Equivalence AWG	Stranding number of strands x Ø (mm)
2, 3, 4, 6 or 8	0.14	26	7 X 0.16
2, 3, 4, 6 or 8	0.15	26	19 X 0.10
2, 3, 4, 6 or 8	0.22	24	7 X 0.20
2, 3, 4, 6 or 8	0.25	24	19 X 0.13
2, 3, or 4	0.34	22	7 X 0.25
2, 3, or 4	0.34	22	19 X 0.15
2, 3, or 4	0.50	20	7 X 0.30
2, 3, or 4	0.60	20	19 X 0.20

Nature of cores
(identification / symbol in our references)

Bare copper *(CuA1 / -)*
Tin-plated copper *(CuSn / E)*
Silver-plated copper *(CuAg / A)*
Nickel-plated copper *(CuNi / CN)*
Pure silver *(Ag / Ag)*
Pure nickel *(Ni / N)*

SONDIX® with electrical screen and/or flexible outer armour

- With tin-plated copper electrical screen: ref. xxxBE-xxx.
  in nickel-plated copper: ref. xxxBCN-xxx.
  in silver-plated copper: ref. xxxBA-xxx.
- With electrical screen of PET / aluminium tape + continuity wire: ref. xxxBAL-xxx.
- With stainless steel braid flexible outer armour. ref. BIxxx-xxx.
  in galvanised steel: ref. BGxxx-xxx.
  in tin-plated copper: ref. BExxx-xxx.

Identification

SONDIX® MCBE-EFEP - 4 x 0.22 mm² (7 / 0.20 mm - CuSn)
SONDIX® xxxx-xxxx - x x x.xx mm² (x / x.xx mm - xxxx)

Registered trademark of OMERIN

Reference (example): MCBE-EFEP
SONDIX® with tin-plated copper core, FEP insulation, tin-plated copper braid electrical screen, silicone sheath

Nature of core (see table above)

Diameter of each strand (in mm)

Number of strands

Core cross-section in mm² or AWG

Number of conductors

For this product, please contact:

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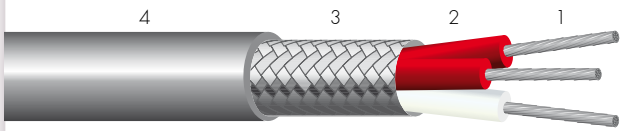
PLATINUM RESISTANCE TEMPERATURE SENSORS CONNECTION CABLES

SONDIX®

with fluorinated insulation and silicone sheath

-60 °C to +220 °C



1 • Bare, tin-plated, nickel-plated or silver-plated copper core.
2 • Fluorinated polymer ETFE, FEP or PFA.
3 • Optional electrical screen, tin-plated, nickel-plated or silver-plated copper.
4 • Silicone rubber outer sheath.

Approvals - standards

• Cables and identification as per IEC 60 751, NF C 43-330, DIN 43760 and BS 1904.

Applications

• Wiring of platinum resistance temperature sensors.

Options

• Other core cross-sections or number of conductors: contact us.
• Solid or extra-flexible cores: contact us.

Characteristics

General

• Maximum admissible temperature of cable according to insulation used:

	ETFE	FEP	PFA
Continuous operation -60 °C to:	+150	+200	+220 °C
Short period -60 °C to:	+170	+220	+260 °C

• Excellent resistance to humidity and UV.
• Excellent resistance to chemical influences.

Electrical

• Operating voltage: 300 V.

Standard products

• 2, 3, 4, 6 or 8 conductors.
• Identification: 2 conductors: 1 red / 1 white.
3 conductors: 2 red / 1 white.
4 conductors: 2 red / 2 white.
6 conductors: 4 red / 2 white.
8 conductors: 4 red / 4 white.
• Sheath colours: grey or brick red.

Product references

Core / screen	Unshielded cables – Insulation ETFE	Unshielded cables – Insulation FEP	Unshielded cables – Insulation PFA	Shielded cables – Insulation ETFE	Shielded cables – Insulation FEP	Shielded cables – Insulation PFA
• Bare copper (CuA1)	MC-ETFE	-	-	-	-	-
• Tin-plated copper (CuSn)	MC-EETFE	MC-EFEP	MC-EPFA	MCBE-EETFE	MCBE-EFEP	MCBE-EPFA
• Silver-plated coppe (CuAg)	-	MC-AFEP	MC-APFA	-	MCBA-AFEP	MCBA-APFA
• Nickel-plated copper (CuNi)	-	-	MC-CNPFA	-	-	MCBCN-CNPFA

Nominal cross-section (mm^2)	Insulated conductors – Nominal stranding	Insulated conductors – Outside diameter (mm)	Insulated conductors – Maximum linear resistance at 20°C (CuSn) (Ω/km)	Unshielded cables – Nominal outside diameter (mm)	Shielded cables – Diameter of braid strands (mm)	Shielded cables – Nominal outside diameter (mm)
2 x 0.14 (1)	7 x 0.16 (1)	0.8	166	2.8	0.10	3.8
3 x 0.14 (1)	7 x 0.16 (1)	0.8	166	3.2	0.10	4.0
4 x 0.14 (1)	7 x 0.16 (1)	0.8	166	3.6	0.10	4.2
6 x 0.14 (1)	7 x 0.16 (1)	0.8	166	4.2	0.10	4.8
2 x 0.22	7 x 0.20	1.0	92.5	3.2	0.10	3.8
3 x 0.22	7 x 0.20	1.0	92.5	3.8	0.10	4.2
4 x 0.22	7 x 0.20	1.0	92.5	3.8	0.10	4.4
6 x 0.22	7 x 0.20	1.0	92.5	4.5	0.10	5.0
8 x 0.22	7 x 0.20	1.0	92.5	5.2	0.10	5.6
2 x 0.34	7 x 0.25	1.15	59.2	3.5	0.10	4.2
3 x 0.34	7 x 0.25	1.15	59.2	3.8	0.10	4.4
4 x 0.34	7 x 0.25	1.15	59.2	4.0	0.10	4.6
6 x 0.34	7 x 0.25	1.15	59.2	4.8	0.10	5.2

(1) In bare copper (CuA1) the nominal cross-section and nominal stranding are : 0,12 mm^2 (7 x 0,15).

For this product, please contact:

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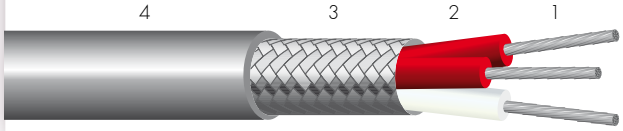
PLATINUM RESISTANCE TEMPERATURE SENSORS CONNECTION CABLES

SONDIX® MC-ECS

with insulation and silicone sheath

-60 °C to +200 °C



1 • Tin-plated copper core.
2 • Silicone rubber insulation.
3 • Optional electrical screen, tin-plated copper (ref. MCBE-ECS).
4 • Silicone rubber outer sheath.

Approvals - standards

• Cables and identification as per IEC 60 751, NF C 43-330, DIN 43760 and BS 1904.

Applications

• Wiring of platinum resistance temperature sensors.

Options

• Bare copper core, ref. MC-CS: contact us.
• Other core cross-sections or number of conductors: contact us.
• Solid or extra-flexible cores: contact us.
• Cores and optional electrical screen, nickel-plated copper ref. MC-CNCS and MCBCN-CNCS: contact us.

Characteristics

General

• Maximum admissible temperature under continuous operation: -60 °C to +200 °C.
• Excellent resistance to humidity and UV.

Electrical

• Operating voltage: 300 V.

Standard products

• 2, 3, 4, 6 or 8 conductors.
• Identification: 2 conductors: 1 red / 1 white.
3 conductors: 2 red / 1 white.
4 conductors: 2 red / 2 white.
6 conductors: 4 red / 2 white.
8 conductors: 4 red / 4 white.
• Sheath colours: grey or brick red.

	Insulated conductors			MC-ECS Unshielded cables	MCBE-ECS Shielded cables	
Nominal cross-section (mm^2)	Nominal stranding	Outside diameter (mm)	Maximum linear resistance at 20°C (Ω/km)	Nominal outside diameter (mm)	Diameter of braid strands (mm)	Nominal outside diameter (mm)
2 x 0.15	19 x 0.10	1.2	166	4.0	0.10	4.5
3 x 0.15	19 x 0.10	1.2	166	4.2	0.10	4.7
4 x 0.15	19 x 0.10	1.2	166	4.5	0.10	5.0
2 x 0.22	7 x 0.20	1.3	92.5	3.8	0.10	4.5
3 x 0.22	7 x 0.20	1.3	92.5	3.8	0.10	4.8
4 x 0.22	7 x 0.20	1.3	92.5	4.8	0.10	5.2
6 x 0.22	7 x 0.20	1.3	92.5	5.8	0.10	6.0
2 x 0.34	7 x 0.25	1.6	59.2	4.0	0.10	5.8
3 x 0.34	7 x 0.25	1.6	59.2	5.0	0.10	6.2
4 x 0.34	7 x 0.25	1.6	59.2	5.8	0.10	6.4
2 x 0.5	16 x 0.20	2.1	40.1	5.0	0.13	6.2
3 x 0.5	16 x 0.20	2.1	40.1	6.2	0.13	6.8
4 x 0.5	16 x 0.20	2.1	40.1	6.8	0.13	7.2

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LES CABLES DE L'EXTREME

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Notes

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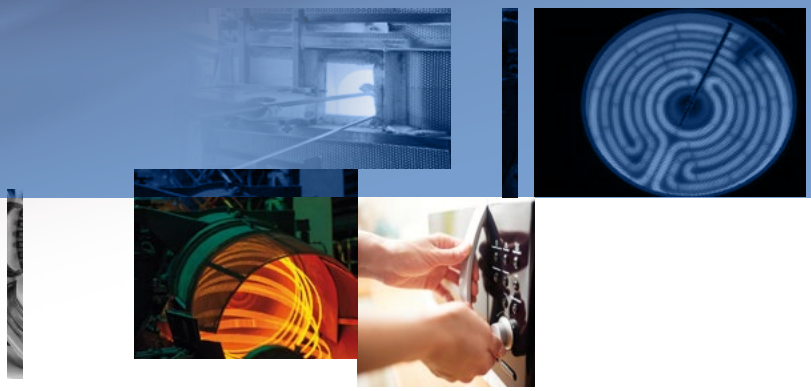
Notes



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