

Table 8-1: international colour codes for extension and compensating cables

Thermo couple		 IEC 60584-3	 DIN 43710*	 ANSI MC 96.1	 BS 4937	 NF C 42-324
Material ⊕ ⊖		Designation XC CC	Designation XC CC	Designation XC CC	Designation XC CC	Designation XC CC
T	Cu – CuNi	TX  -25 °C up to +100 °C		TX  0 °C up to +100 °C	TX  0 °C up to +100 °C	TX  -25 °C up to +100 °C
			UX  0 °C up to +200 °C			
J	Fe – CuNi	JX  -25 °C up to +200 °C		JX  0 °C up to +200 °C	JX  0 °C up to +200 °C	JX  -25 °C up to +200 °C
L	Fe – CuNi		LX  0 °C up to +200 °C			
E	NiCr – CuNi	EX  -25 °C up to +200 °C		EX  0 °C up to +200 °C	EX  0 °C up to +200 °C	EX  -25 °C up to +200 °C
K	NiCr – Ni	KX  -25 °C up to +200 °C	KX  0 °C up to +200 °C	KX  0 °C up to +200 °C	KX  0 °C up to +200 °C	KX  -25 °C up to +200 °C
	NiCr – Ni	 KCA 0 °C up to +150 °C	 KCA 0 °C up to +150 °C			 WC 0 °C up to +150 °C
	NiCr – Ni	 KCB 0 °C up to +100 °C			 VX 0 °C up to +100 °C	 VC 0 °C up to +100 °C
N	NiCrSi – NiSi	NX  NC -25 °C up to +200 °C 0 °C up to +150 °C				
R S	PtRh13 – Pt PtRh10 – Pt	 RCB SCB 0 °C up to +200 °C	 RCB SCB 0 °C up to +200 °C	 SX 0 °C up to +200 °C	 SX 0 °C up to +200 °C	 SC 0 °C up to +200 °C
	B			 BX 0 °C up to +100 °C		 BC 0 °C up to +100 °C

The stated temperature specifies the application temperature range for each type.
The application temperature range must be reduced if it is required by the insulation material used for the cable.
*DIN 43710 was withdrawn in April 1994.

XC = extension cables
CC = compensating cables

Table 8-2: temperature measurement with thermo couples

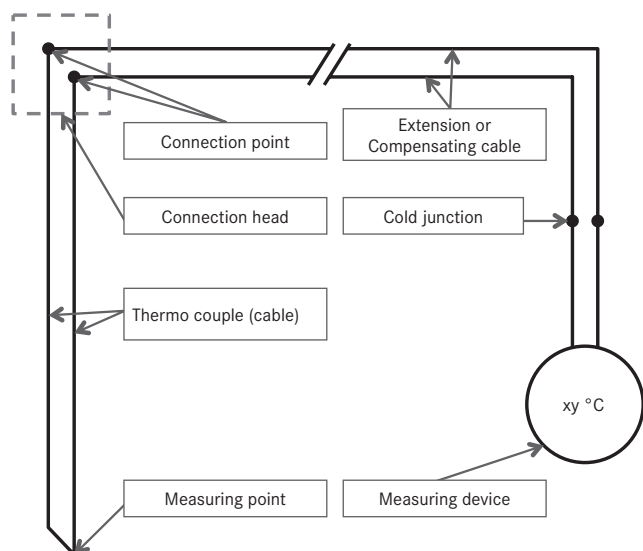
The measurement principle:

The thermoelectric effect describes a thermal voltage that arises between two different electrical conductors with a temperature difference between both ends.

This effect can be used by thermocouples, which consist of two metals or alloys that produce a specific thermal voltage as thermocouple.

By means of this thermal voltage, the temperature difference between the contact points, which are usually the measuring point and the cold junction, are determined as being associated with a temperature value for each thermocouple voltage. The cold junction must have a known and constant temperature in order to determine the temperature difference to the measurement point exactly.

For the caballing between measuring point and connection point thermo couple cables are typically used. Between connection point and cold junction extension or compensating cables are typically used to transmit the voltage signal.



Three types of cables:

Thermo couple cables:

- Type code of the thermo couple (K, R...)
- Approved for the temperature range of the thermo couple (Type K → up to +1200 °C)
- Same alloy as thermo couple (NiCr/Ni contains NiCr/Ni)
- Used as thermo couple, between measuring point and connection point or cold junction

Extension cables (XC):

- Type code of the thermo couple + "X" (KX, LX...)
- Approved for the application temperature range (Type KX → up to +200 °C)
- Same alloy as thermo couple (NiCr/Ni contains NiCr/Ni)
- Generally used as connecting cable between connection point and cold junction

Compensating cables (CC):

- Type code of the thermo couple + "C" and sometimes supplemented with code a for different compensating alloys (KCA, RCB/SCB...)
- Approved for the application temperature range (Type KCA → up to +150 °C)
- Compensating alloys (KCA (NiCr/Ni) contains special Fe/CuNi)
- Generally used as connecting cable between connection point and cold junction

These alloys are used for the cables:

Type	Positive conductor	Negative conductor
TX	Cu	CuNi
JX	Fe	CuNi
LX	Fe	CuNi
EX	NiCr	CuNi
K	NiCr	Ni
KX	NiCr	Ni
KCA	Fe	CuNi
NX	NiCrSi	NiSi
NC	Cu	CuNi
RCB/SCB	Cu	CuNi

Criteria for the selection of cable:

The thermo couple type:

Each thermo couple has its own specific thermo electric properties. If different thermocouples are mixed, measurement errors arise.

The ambient temperature to which the cable is exposed:

The ambient temperature is the decisive factor for the selection of the insulation and jacket material for the cable. The application temperature range must be reduced if it is required by the insulation material used for the cable.

Insulation and jacket material	temperature range fixed installed
PVC	-25 °C up to +80 °C
Silicone	-50 °C up to +180 °C
Glass fibre	-50 °C up to +200 °C
FEP	-100 °C up to +205 °C
E-Glass	-90 °C up to +400 °C
Ceramic yarn	up to +1200 °C

The ambient temperature at the connection point:

Each extension and compensating cable is suitable for a specific application temperature range. That means the cable has the same thermo electric properties as the thermo couple within this application temperature range. Please find the application temperature range on table T8-1.

Specialities of the cables:

- The iron conductor is often copper-coated. This should protect the conductor from corrosion. The iron conductor is magnetic and can easily be identified by this characteristic.
- For the thermo couples R and S the thermo electric properties are the same within the application temperature up to +200 °C, therefore only one compensating cable (RCB/SCB) is used for both types.