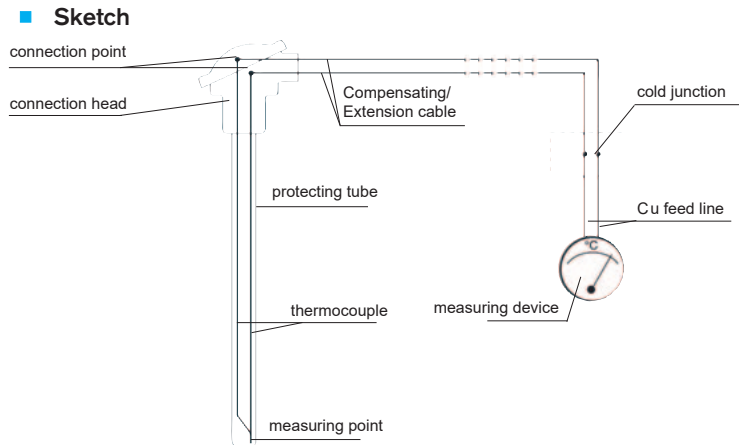


# BASICS THERMOCOUPLES / CONNECTION CABLES

Temperature is an important factor in many areas concerning the environment, scientific research and production. It is a thermo-dynamic variable that defines the heat content of a material. Material strength changes with alternating temperature. As a consequence, the characteristics of materials have to be examined at different temperatures. To obtain a temperature value, defined temperature parameters are used. Here the parameters can be defined, for example, as the freezing and boiling points of water.

For temperature measurement temperature dependent characteristics of materials have to be taken into account. These include such things as thermal expansion (expansion thermometer), the dependence of the electric resistance of metallic conductors (electrical thermometer) and electromotive force (thermocouple) etc.. A temperature measuring device with a thermocouple as a data indicator tends to consist of the thermometer itself with a measuring point, an extension cable, a cold junction with a specified constant temperature and a voltmeter.

The value of the electromotive force (EMF) produced by the thermocouple is determined by the difference between the measuring temperature and the so-called free ends of the thermocouple which are mounted in the connection head. As the connection head is usually relatively close to the measuring point, it is frequently exposed to temperature fluctuations. For this reason, a connection cable with the same thermo-electric properties as the thermocouple is used between the thermocouple and the cold junction.



## ■ Materials

We differentiate between thermocouple cable and compensating cable. Cables made of original materials are called extension or thermocouple cables, whereas conductor materials made of substitutes are known as compensating cables.

## ■ Compensating cables

The compensating wires and strands are composed of alloys which do not have to be identical with the corresponding thermocouple. Substitute material means that the thermo-electric characteristics in the allowed temperature range (usually 0 up to +200 °C) for the compensating cable must be the same as those of the corresponding thermocouple. They are identified with the letter "C" adapted to DIN IEC 584. The "C" appears behind the code letter identifying the thermocouple, for example "KC".

## ■ Extension cables

Extension cables are made of conductors with identical nominal structure to the corresponding thermocouple. They are identified with the letter "X" adapted to DIN IEC 584 which appears behind the code letter identifying the thermocouple, for example "JX". They are normally tested within a temperature range of 0 up to +200°C.

## ■ Thermocouple cables

Thermocouple cables consist of the same element material as the thermocouple and are tested for the same temperatures. These SAB special cables are manufactured on customer request. PVC, fibre-glass and SAB tex insulated or sheathed compensating and extension cables are not suitable for outdoor use. Exception: PVC sheathed solid conductors can be used for underground laying.

## Cables for resistance thermometers

Cables with copper conductors have to be laid between thermometer and measuring device. In order to keep faults by cable resistances and their temperature dependent fluctuations as small as possible, an appropriate cable section has to be chosen. Resistance thermometers are manufactured in 2-, 3-, and 4-wire circuit dependent on the required accuracy. By choosing the wire circuit it has to be considered that the cable resistance fully affects the measuring result.

The cables have to be chosen that they are appropriate for their environment that means that they resist against thermal, mechanical and chemical influences. All cable contacts have to be well done. Measuring cable shall be laid > 0,5 m away from any energy cable. In order to suppress electromagnetic or magnetic interferences, the cables shall be screened and have twisted pairs.