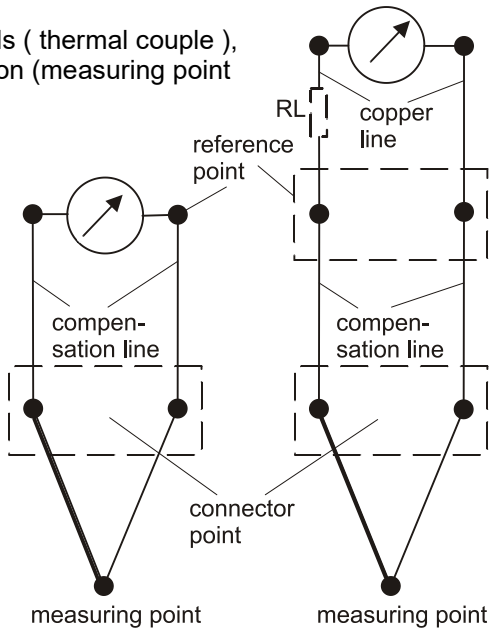
Temperature measurement with thermocouples

Measuring principle

A thermocouple consists of two electric conductors of different materials (thermal couple), which are welded at one end to form a electrically conducting connection (measuring point).
The open ends (connector point) are connected with the display unit via lines (reference point).



The thermocouple provides the thermo voltage, its level and the *difference* of the measuring temperature at *measuring point* – and the temperature the so-called free ends of the thermo legs – *reference point* – are depending on.

To measure the temperature it is necessary to know the temperature of the reference point and to keep it at a constant level. If this is not possible, it is necessary to extend the thermal element with the compensation line up to a point where the temperature is constant.

PLEASE NOTE
When connecting the line please do not interchange the positive and negative poles, particularly if the compensation line has been added.
To ensure correct connections according to DIN EN60584 defined the colour for the negative conductor as white and the positive conductor has the respective code colour of the element.
According to DIN 43713 and the 14 the color code is reversed Here, the *positive conductor* has the colour *red* and the *negative conductor* has the *code colour of the element*.
Problems might arise if items are installed both according to DIN 43710 and according to DIN EN60584, e.g. sensor NiCr-Ni Type K pursuant to EN and the line NiCr-Ni according to DIN.
The code colour for NiCr-Ni is, actually, in both cases *green*. Unfortunately, the green conductor is, pursuant to *DIN EN60584, the POSITIVE POLE* and, according to DIN *43714, the NEGATIVE POLE*.

General
Compensating cables deliver up to 200 ° C the same voltage as the corresponding thermocouples.
As a result of the requirement to use lines and elements which are made of the same material, these lines are marked with particular colour codes.
This colour code is pursuant to DIN EN60584.
Additionally, there are other code colours for *older* elements according to DIN 43710.
These colours are pursuant to DIN 43 713 and 43714.

One disadvantage of the compensation line is its relatively high electrical resistance, which, with low-impedance measuring units, would negatively distort the measuring results. Using an additional resistance the feed line is to be aligned to a predefined value to which the measuring unit is to be calibrated. Usually, this value amounts to 10 Ohm.

Protection tubes
Usually, the thermocouple is, for practical reasons, provided with a protection tube. This tube varies according to the intended use and the temperature requirements, pressure and chemical influences.
The appropriate material for the protection tube is vital for the lifecycle of the thermal element.
Protection tubes used for temperature measurements of DIESEL EXHAUSTS are particularly effected by vibrations, shocks and gas eruptions, in addition, the temperature range of the material is reduced due to the combustion gases. Due to these reasons, it is necessary to keep the installation length as short as possible. The reference value for an effective installation length in the medium is 10 times the diameter of the protection tube (with the heat dissipation error negligible).
With regard to extreme loads and larger installation lengths, we provide special protection tubes. These tubes are lathed and drilled out of the solid and taken on the basis of their special form, are particularly suitable for rough applications.