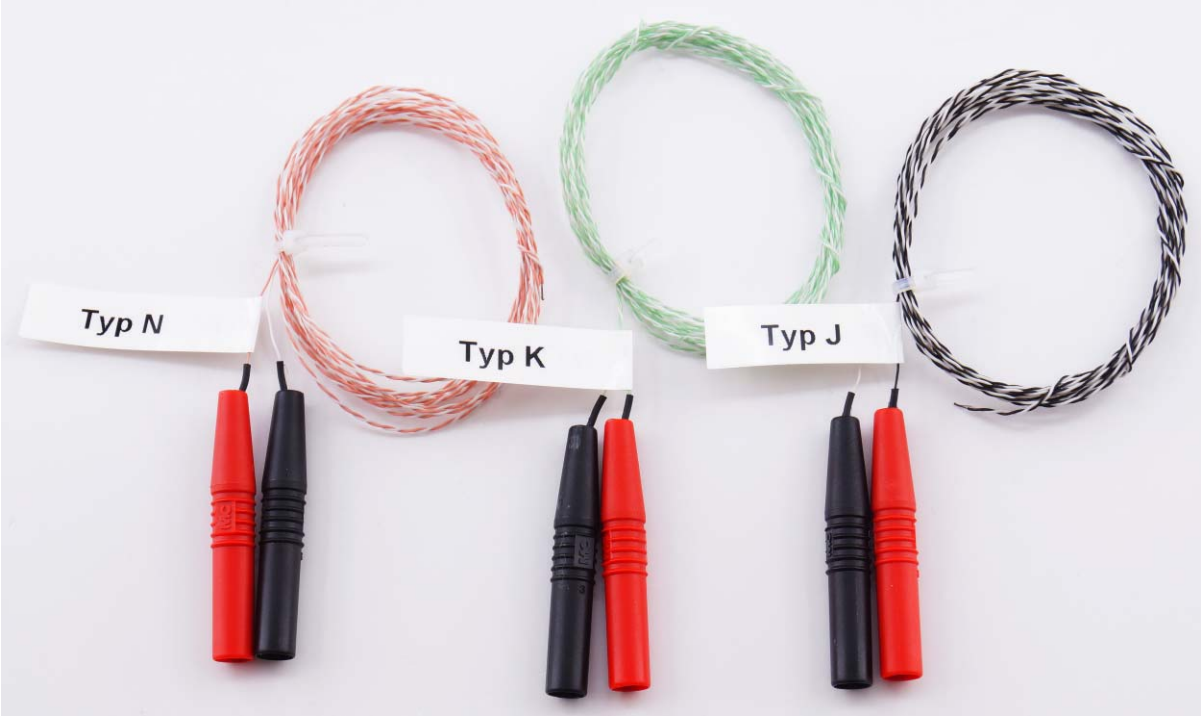
Set of 3 Thermocouples 1017904

Instruction manual

11/14 SD/UD



1. Safety instructions

All three thermocouples are exclusively to be used with microvoltmeter 1001016 (230 V) or 1001015 (115 V) or another such suitable device.

- Do not apply any external voltage to the 4mm safety plugs.

2. Contents

1 Thermocouple type N, NiCrSi–NiSi (red-white)

1 Thermocouple type K, NiCr–NiAl (green-white)

1 Thermocouple type J, Fe–CuNi (black-white)

3. Additionally required equipment

1 Microvoltmeter (230 V)	1001016
or	
1 Microvoltmeter (115 V)	1001015

4. Technical data

Length of wires:	2 m
Operating temperature:	-75°C to +250°C
Connectors:	1 pair of 4-mm safety plugs
Sensitivity of thermocouples:	
Type N, NiCrSi–NiSi:	30 µV/K
Type K, NiCr–NiAl:	42 µV/K
Type J, Fe–CuNi:	54 µV/K

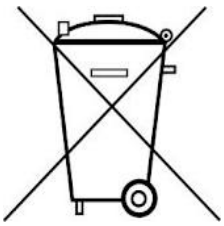
5. Description

All three thermocouples consist of two different insulated metal wires, which are connected together at one end, while the other ends may be connected via safety plugs. The metal wires of the type-N thermocouple (NiCrSi–NiSi) are colour-coded with red and white insulation, those of the type-K thermocouple (NiCr–NiAl) are green and white and those of the type-J thermocouple (Fe–CuNi) are black and white.

In a metal wire, the ends of which are at different temperatures, the differing propagation speeds of electrons at the warm and the cold end result in thermal diffusion taking place. The current resulting from this diffusion causes the cooler end to become negatively charged with respect to the warmer end. A thermal diffusion voltage arises between the two ends, which is proportional to the difference in temperature between the two ends, with the Seebeck coefficient being the constant of proportionality. If wires of two different metals are connected at the ends, with these ends being at different temperatures T_1 and T_2, and a voltmeter is connected between the wires at one of the points of contact, the apparatus which results is called a thermocouple. The voltmeter then displays a thermal voltage which is directly proportional to the temperature difference between the points of contact. The constant of proportionality in this case is the difference between the Seebeck coefficients of the two metals. This corresponds to the sensitivity of the thermocouple.

6. Cleaning, disposal

- In order to clean the equipment, use a soft, damp cloth.
- After taking measurements in water, dry off the thermocouples with a soft cloth.
- The packaging should be disposed at local recycling centres.
- If the thermocouples themselves are to be disposed of, they must not be included with normal household waste. Local regulations are to be obeyed.



7. Sample experiment

Determining the sensitivity of the thermocouple pairs

Required equipment:

1 Set of 3 thermocouples	1017904
1 Thermometer, -20–110°C	1003384
1 Thermometer clip	1003528
1 Set of 10 glass beakers, tall	1002873
1 Magnetic stirrer und heater (@230 V)	1002807
or	
1 Magnetic stirrer und heater (@115 V)	1002806
1 Microvoltmeter (@230 V)	1001016
or	
1 Microvoltmeter (@115 V)	1001015

- Set up the experiment as in Fig. 1.
- Connect one of the three thermocouples to the inputs of the microvoltmeter via the safety plugs. The input sockets of the microvoltmeter represent the reference point which is at temperature T_1.
- Set a measuring range of -2…2 mV and turn off the filter for the upper cut-off limit.
- Fill the glass beaker with a few centimetres of water and dip the thermocouple pair into it before turning on the heating.
- Record the thermocouple voltage as a function of temperature T_2, e.g. in steps of 5°C up to 80°C.
- Repeat the experiment with the other two thermocouples.
- Plot the measurements for all three thermocouples on a single graph and fit a straight line to each set of measurements (Fig. 2).
- The sensitivity of the thermocouple pairs is given by the gradient of the line in each case. They each correspond to the difference between the Seebeck coefficients of the two metals from which the thermocouples are made.

Fig. 1: Experiment set-up.

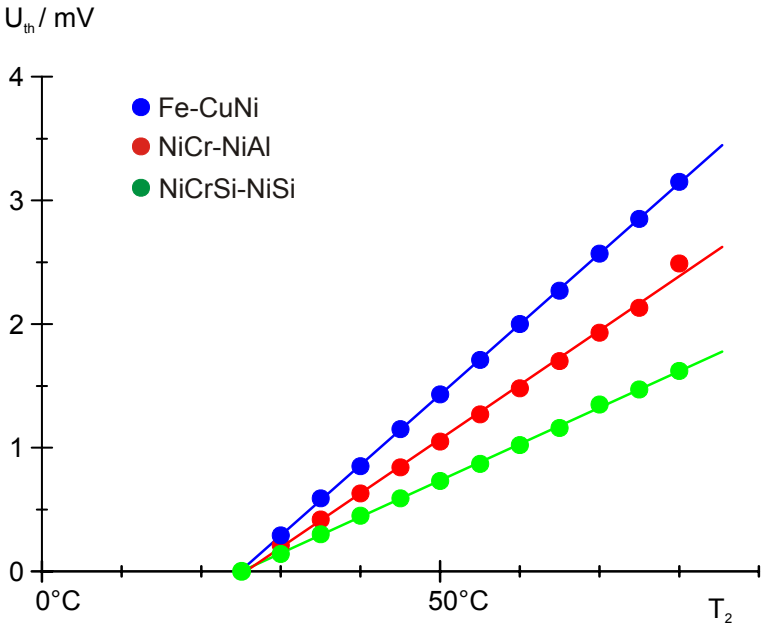


Fig. 2: Thermocouple voltages as a function of temperature for thermocouples of type N (green), K (red) and J (blue). The curves intersect with the T_2 axis of the graph at temperature T_1 = 23°C, the reference point (input sockets of microvoltmeter).