

General Operating and Maintenance Instructions for Temperature Measurement with Thermocouples and Resistance Thermometers

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1. Glossary

| | |
|----------|--|
| ECC | extension or compensating cable |
| Ø | diameter |
| FL | fitting length |
| TEMF | thermoelectric electromotive force (EMF) / thermoelectric voltage of thermocouples |
| GS | gauge slide |
| MTC | mantle thermocouple |
| MTC line | mantle thermocouple line |
| MR | measuring resistance |
| MRT | mantle resistance thermometer |
| r | radius |
| PS | protective sleeve |
| TC | thermocouple |
| TC GS | thermocouple gauge slide |
| TW | thermoelectric wire |
| RT | resistance thermometer |
| RT GS | resistance thermometer gauge slide |
| MML | mantle measuring line |

2. Mode of Operation

2.1. Preface

Temperature registration is evident in various processes e.g. melting, chemical reactions, food processing etc. As wide as the scope are the tasks to be solved by temperature sensors, their physical operating principles and technical construction.

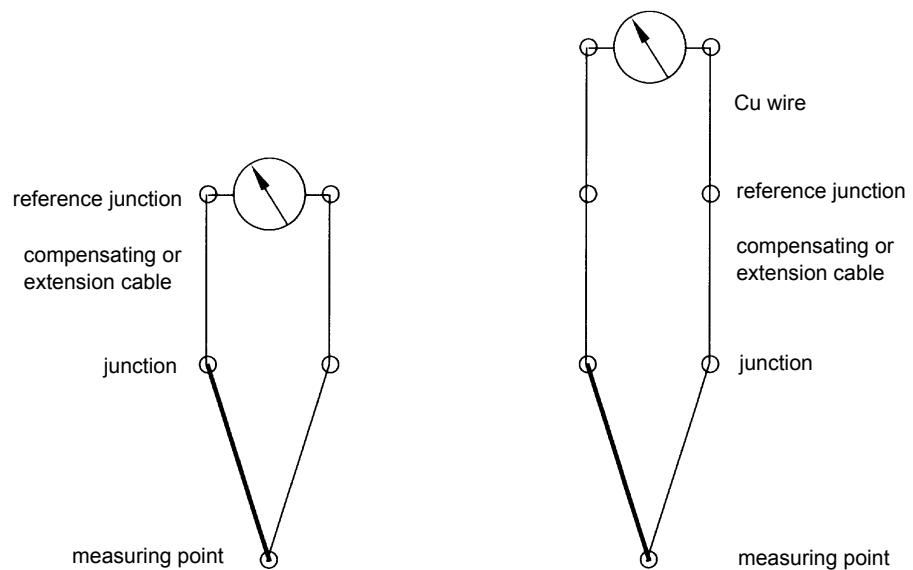
This brochure informs mainly about thermocouples and platinum resistance thermometers. Both are widely accepted, e.g. for temperature measurement in gases, liquids, molten bath, or solid state bodies and surfaces. Which sensor (and eventually protective sleeve) is used for a given application depends on the needed accuracy, response behaviour, temperature range and chemical properties.

2.2. Temperature Measurement using Thermocouples

A thermocouple consists of 2 different metal or metal alloy wires which are punctually welded. If the junction of the thermocouple is heated a voltage will be generated at the open end. The thermocouple is attached to a reference junction with constant temperature by a special wire known as the compensating cable or extension cable. The thermocouple measures the temperature difference between the reference junction and the thermocouple junction. If there is no reference junction with constant temperature available the reference junction is treated as a thermostat. This thermostat regulates the temperature into a fixed value of e.g. 0, 20, 50, 70 °C. The temperature can be compensated too by a voltage regulator. This voltage regulator consists of a wheatstone bridge with constant supply voltage. One or two temperature dependent resistances clear the influence of the changing reference temperature by an additional voltage. The bridge connexion is designed that way it does not add voltage on the reference temperature.

The thermocouple needs to be extended to the reference junction by a compensating cable or extension cable. These cables share the thermoelectric characteristics of the thermocouple if used with temperatures up to 200°C. They do not supply voltage and have the same admissible tolerance as the thermocouple wires.

From the wide range specific thermocouples have been chosen. These standardized thermocouples meet high demands regarding constitution, pureness, and workmanship. They are characterized by good repeatability and reliability during usage. Thermoelectric voltage and admissible tolerance of standardized thermocouples are defined in core value tables per DIN EN 60584-1.



To protect the thermocouple from mechanical or chemical wear it is built into protective sleeves or casing pipes. The protective sleeves are standardized acc. to DIN regulations and need to comply to the respective operating conditions.

2.3. Resistance Thermometers

Resistance thermometers use the continuous resistance change of metals during changing temperatures. Because of the high steadiness and the good repeatability nowadays the main resistance substance is of platinum as well as of nickel. Both metals have a positive temperature coefficient, that is their resistance rises with increasing temperature.

3. Commissioning of Electrical Thermometers

3.1. Mounting of Electrical Thermometers

Usually the mounting methods are as follows:

- Screw-in thread (cylindrical or conical)
- Flange and counterflange, movable; tight only with little gas pressure
- Welded flange; as well with sealing lens
- Movable clamped joints; tight against liquids and high gas pressure
- Movable clamped joints, flexible; tight up to approx. 8 bar / 100°C
- Welding into pipes / pipe sockets, walls
- Bayonet nipples; neither airtight nor tight against liquids
- Screwing on, welding to, sticking on surfaces
- Position of protective sleeve: for small temperatures optional, for higher temperatures preferably vertical
- Ceramic protective sleeves need to be protected against mechanical effects (as impacts) and thermal shocks. Avoid direct contact with flames. When mounting into hot processes insert slowly (1-2 cm/min. for 1600°C; 10-20 cm/min for 1200°C) or preheat adequate. Avoid horizontal self-supporting lengths > approx. 500 mm for temperatures > 1200°C.

Furthermore keep in mind:

- Use only matching ECC with TC
- Always connect the RT to a copper wire with maximum possible diameter. The ambient temperature at the terminal head shall be < 200°C, with inbuilt transmitter < 90°C.

3.2. Mounting and Operation Instructions

Make sure for all aforementioned mounting methods that the process connections are tightly fixed and safe according to the generally recognised codes of practice and the local regulations. Ensure furthermore that the thermometers do have an adequate heat exchange surface with the measured medium and errors by heat conduction of the protective sleeve are kept small. For technical applications the following fitting lengths are therefore recommended:

| | |
|-------------------|--|
| Water / liquid | temperature sensitive length + approx. 5x PS diameter |
| Air / gas / steam | temperature sensitive length + approx. 10x PS diameter |

For thermocouples the temperature sensitive length may be disregarded in general, follow manufacturer's data for RT. In pipes with small diameters the desired fitting length may only be achieved if the PS is mounted into an elbow that way it is directed towards the flow. For a FL of e.g. temperature sensitive length + 1x PS diameter face errors are relatively high compared to standard tolerance values.

It is important to know that the temperature sensitive part (the peak) of the RT and RT GS may not be bent. The instruments may not be bent on a length of approx. 50 mm with 6 and 3 mm Ø. On the other hand the MTC line may be bent without harming the technical characteristics. This applies to MTC, resp. MTC GS also.

3.3. Measuring Lines

Connecting cables between thermometer and other instruments of the measuring circuit normally are isolated with synthetic material or fibre glass resp. mineral fibre. The connecting cables have to meet the following demands:

- they must be suitable for the area, i.e. they must be durable against thermal, mechanical, chemical effects
- the measuring signal may not / only as little as possible be altered by lead resistances (diameter, length) or damaged isolation
- the ECC must match the TC and needs to be connected with correct polarity
- keep away disturbances from the wanted signal by electrostatic shielding, twin stranded cable, square cross of supply lines, spacing of > 0.5 m to supply lines when run in parallel
- at junctions all lines must be metallic bright and free of change-over contacts to ensure the resistance is negligible small
- ECC wires of replacement materials are not to be exposed to temperatures > 200°C at junctions

Measuring lines as well as the TC and RT are to be checked for mechanical and electrical integrity at regular intervals.

3.4. Mantle Thermocouple Line (MTC line)

MTC lines are designed for especially difficult environmental conditions like enduring temperatures of 500 °C, nuclear radiation, high mechanical stress where ordinary wires fail. The outer sheath of the MTC line is of metal with ceramic fibre isolation. The inner wire is a thermoelectric wire (MTC) and the mantle measuring line has an inner wire of copper. Both are flexible (with $r > 3x \varnothing$ once, with $r > 5x \varnothing$ several times). If spiral winded they may serve as „elastic“ lines.

Insulating resistance reference values of MTC lines 1.5 mm Ø and higher:

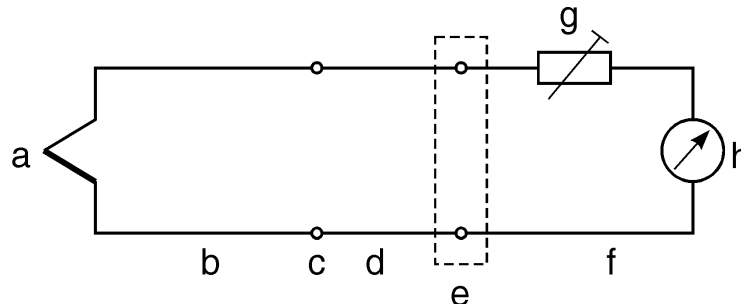
- up to +200°C approx. 1000 MΩ x m
- up to +600°C approx. 1 MΩ x m
- up to +1000°C approx. 10 KΩ x m

The indicated dimension value (Ohm x m) implies that a part of 1 m holds the isolation resistance named above. If the part has a length of 10 m the total isolation resistance is 1/10 fold high, if the part is only 0.1 m, it is 10 fold that high. The MTC line's ceramic isolation (usually MgO) is hygroscopic so the required seal may not be damaged. Epoxy resin (glue) as well as hot melted plastics are suitable for sealing.

4. Appendix

4.1. Wiring Diagram Thermocouple (principle)

This temperature measurement is based on voltage measurement. The resulting force (EMF) is a function of the temperature difference between the measuring point (a) and the reference point (e) resp. instrument (h). Depending on the input resistance of the instrument a line compensation is necessary for low impedance input resp. not necessary for high impedance input.

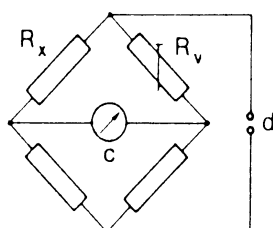


- a: measuring point: TC junction
- b: thermoelectric wire (TW)
- c: junction TW - ECC
- d: extension or compensating cable (ECC): up to 200°C same thermoelectric characteristics as TC
- e: reference point:
 - e¹ with constant temperature (e.g. 0°C, 50°C)
 - e² with simulation of a temperature-sensitive auxiliary supply which scales the TC signal
- f: copper wire
- g: balancing resistor (only for low impedance instruments like moving coil indicator without amplifier)
- h: Measuring instrument:
 - h¹ mV meter
 - h² mV meter with temperature scale
 - h³ indicator with booster
 - h⁴ controller or recorder
 - h⁵ transmitter mV / 4-20 mA and instrument downstream (indicator, controller, recorder)

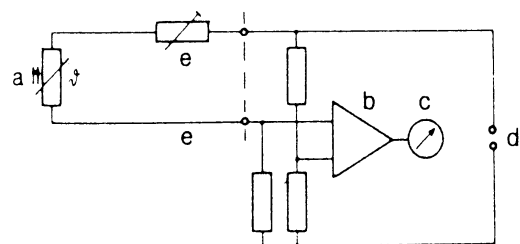
4.2. Wiring Diagram Resistance Thermometer (principle)

This temperature measurement is based either on resistance measurement using a resistance bridge (2 or 3 wire circuit) or on voltage drop measurement using a sensing resistor with constant current stream (4 wire circuit, current - voltage measurement).

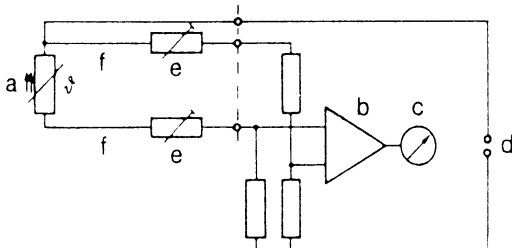
Wheatstone bridge (principle)



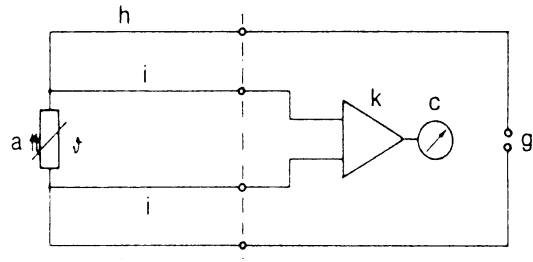
2 wire circuit



3 wire circuit



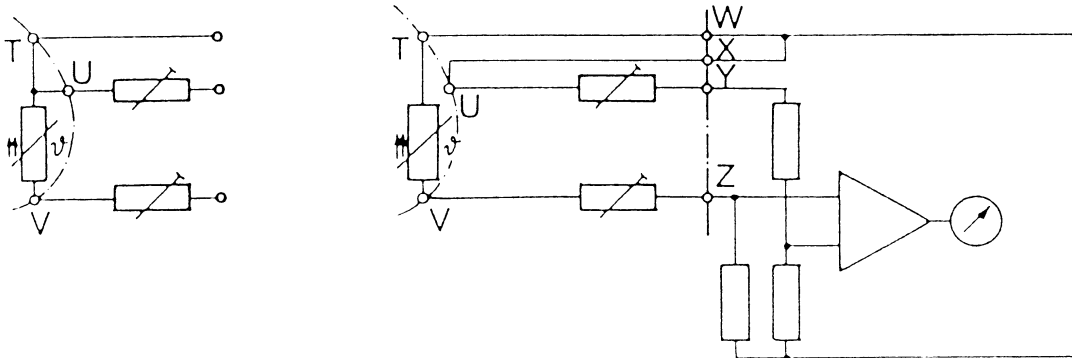
4 wire circuit



- a: sensing resistor
- b: differential amplifier
- c: indicator, recorder
- d: voltage supply (U_{const})
- e: resistivity R_L and modification T_{amb} are taken completely into account of measurement (balancing)
- f: because R_L in bridge is symmetric it is changed by T_{amb}
- g: constant current source (i_{const})
- h: current path; $i = \text{const}$ independent of circuit resistance
- i: voltage path, because of k: effectively independent of R_L
- k: high-impedance amplifier

4.3. Wiring Diagram Resistance Thermometer 2 wire circuit with Loop (principle)

As a variant to the nowadays usual 3 wire circuit occasionally a 2 wire circuit with loop was used. This circuit too ensures that temperature caused modifications of lead resistance do not have an effect on the measurement. Instruments designed for 2 wire circuit with loop can connect to 3 wire RTs if the method indicated below is followed.



The clamps of the instrument are named W, X, Y, Z. The clamps of the RT are named T, U, V. Proceed as follows:

Connect a 3 wire cable to instrument and RT that way: connect W or X to T, Y to U, Z to V (names of clamps are chosen freely). For a 4 wire cable disconnect loop X-Y, one wire remains unused after connecting (release free wire from W or X). If a line compensation is necessary proceed as for 3 wire circuit but insert a balancing resistor into wire Y-U and Z-V in advance.

5. Colour Coding Schemes for Thermocouples

| TC | code letter | International DIN EN 60584 colour code | | DIN 43713/ 43714 * colour code | |
|--------------|-------------|---|----------------------|-----------------------------------|----------------------------|
| | | mantle colour | wire colour | mantle colour | wire colour |
| Cu-CuNi | T | brown | + brown - white | brown | Type U + red - brown |
| Fe-CuNi | J | black | + black - white | blue | Type L + red - blue |
| NiCr-CuNi | E | magenta | + magenta - white | --- | --- |
| NiCr-Ni | K | green | + green - white | green | + red - green |
| NiCrSi-NiSi | N | pink | + pink - white | -- | -- |
| Pt13Rh-Pt | R | orange | + orange - white | -- | -- |
| Pt10Rh-Pt | S | orange | + orange - white | white | + red - white |
| Pt30Rh-Pt6Rh | B | grey | + grey - white | grey | + red - grey |

*This column is indicated only for completion. DIN 43713 and 43714 are ceased to be valid.

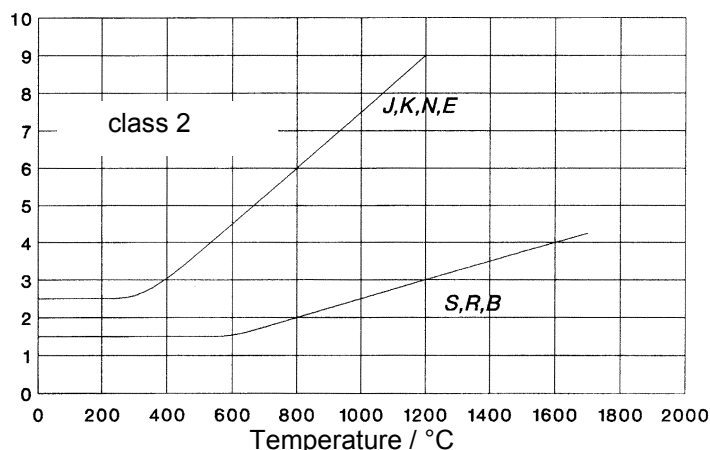
6. Core Values acc. to DIN EN 60584 for Thermocouples

The core value charts for thermocouples is documented in DIN EN 60584. This international guidance is a base for all thereby induced standards.

Thermocouples acc. to DIN EN 60584 are divided into 3 tolerance classes. These tolerance classes apply to thermo wires 0.25 to 3 mm Ø and refer to their delivery status. They do not indicate possible aging of the instrument because this depends strongly on the operation conditions. The defined tolerance class values are not necessarily the recommended limits of the application temperature. The core value tables define thermoelectric voltage values for considerable further temperature ranges. Beyond these temperature limits no tolerances are defined (see colour code for thermocouples and extension resp. compensating cables).

Tolerance class 2 acc. to DIN EN 60584

Tolerances (+/-) / Kelvin



6.1. Tolerances acc. to DIN EN 60584-2 (DIN 43710) (reference temperature 0°C)

| Class | 1 | 2 | 3 *2) |
|---|---|--|--|
| Limit deviation *1) (±) application range type T | 0.5°C or 0.004*t -40°C ... +350°C | 1.0°C or 0.0075*t -40°C ... +350°C | 1.0°C or 0.015*t -200°C ... +40°C |
| Limit deviation *1) (±) application range type E type J type K | 1.5°C or 0.004*t -40°C ... +800°C -40°C ... +750°C -40°C ... +1000°C | 2.5°C or 0.0075*t -40°C ... +900°C -40°C ... +750°C -40°C ... +1200°C | 2.5°C or 0.015*t -200°C ... +40°C -200°C ... +40°C |
| Limit deviation *1) (±) application range type R and S type B | 1°C or 1+0.003*(t-1100°C) 0°C ... +1600°C | 1.5°C or 0.0025*t 0°C ... +1600°C +600°C ... +1700°C | 4°C or 0.005*t +600°C ... +1700°C |
| Limit deviation *1) (±) application range type U *3) | 0..600°C ±0.0075 * t or ±3.0°C | | |
| Limit deviation *1) (±) application range type L *3) | 0..900°C ±0.0075 * t or ±3.0°C | | |

*1) The limit deviation values are given as a fixed value in °C or in percentage relating to the effective temperature in °C. The higher given value is effective.

*2) Thermocouples and thermo wires usually are delivered according to the upper chart for temperature ranges higher -40°C. A thermocouple of the same material may have a higher deviation than indicated for class 3 during temperatures below -40°C. If thermocouples are needed which maintain the limit values for class 1, 2 and / or 3 this must be indicated during ordering process whereas the material must be selected carefully.

*3) Thermocouples type U and L are described only in DIN 43710. The tolerances of these instruments are not divided into classes.

6.2. Thermoelectric Voltage acc. to DIN EN 60584-1

in mV for temperatures in 10°C steps

Cu-CuNi (type T)

| Measuring temp. ° | 0 | -10 | -20 | -30 | -40 | -50 | -60 | -70 | -80 | -90 | -100 |
|-------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| -100 | -3.379 | -3.657 | -3.923 | -4.177 | -4.419 | -4.648 | -4.865 | -5.070 | -5.261 | -5.439 | -5.603 |
| 0 | 0.000 | -0.383 | -0.757 | -1.121 | -1.475 | -1.819 | -2.153 | -2.476 | -2.788 | -3.089 | -3.379 |
| Measuring temp. ° | 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
| 0 | 0.000 | 0.432 | 0.833 | 1.238 | 1.647 | 2.058 | 2.472 | 2.886 | 3.302 | 3.717 | 4.131 |
| 100 | 4.131 | 4.544 | 5.228 | 5.714 | 6.206 | 6.704 | 7.209 | 7.720 | 8.237 | 8.759 | 9.288 |
| 200 | 9.288 | 9.822 | 10.362 | 10.907 | 11.458 | 12.013 | 12.574 | 13.139 | 13.709 | 14.283 | 14.862 |
| 300 | 14.862 | 15.445 | 16.032 | 16.624 | 17.219 | 17.819 | 18.422 | 19.030 | 19.641 | 20.255 | 20.872 |
| 400 | 20.872 | | | | | | | | | | |

Fe-CuNi (type J)

| Measuring temp. ° | 0 | -10 | -20 | -30 | -40 | -50 | -60 | -70 | -80 | -90 | -100 |
|-------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| -100 | -4.633 | -5.037 | -5.426 | -5.801 | -6.159 | -6.500 | -6.821 | -7.123 | -7.403 | 7.659 | -7.890 |
| 0 | 0.000 | -0.501 | -0.995 | -1.482 | -1.961 | -2.431 | -2.893 | -3.344 | -3.786 | -4.215 | -4.633 |
| Measuring temp. ° | 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
| 0 | 0.000 | 0.507 | 1.019 | 1.537 | 2.059 | 2.585 | 3.116 | 3.650 | 4.187 | 4.726 | 5.269 |
| 100 | 5.269 | 5.814 | 6.360 | 6.909 | 7.459 | 8.010 | 8.562 | 9.115 | 9.669 | 10.224 | 10.779 |
| 200 | 10.779 | 11.334 | 11.889 | 12.445 | 13.000 | 13.555 | 14.110 | 14.665 | 15.219 | 15.773 | 16.327 |
| 300 | 16.327 | 16.881 | 17.434 | 17.986 | 18.538 | 19.090 | 19.642 | 20.194 | 20.745 | 21.297 | 21.848 |
| 400 | 21.848 | 22.400 | 22.952 | 23.504 | 24.057 | 24.610 | 25.164 | 25.720 | 26.276 | 26.834 | 27.393 |
| 500 | 27.393 | 27.953 | 28.516 | 29.080 | 29.647 | 30.216 | 30.788 | 31.362 | 31.939 | 32.519 | 33.102 |
| 600 | 33.102 | 33.689 | 34.279 | 34.873 | 35.470 | 36.071 | 36.675 | 37.284 | 37.896 | 38.512 | 39.132 |
| 700 | 39.132 | 39.755 | 40.382 | 41.012 | 41.645 | 42.281 | 42.919 | 43.559 | 44.203 | 44.848 | 45.494 |
| 800 | 45.494 | 46.141 | 46.786 | 47.431 | 48.074 | 48.715 | 49.353 | 49.989 | 50.622 | 51.251 | 51.877 |
| 900 | 51.877 | 52.500 | 53.119 | 53.735 | 54.347 | 54.956 | 55.561 | 56.164 | 56.763 | 57.360 | 57.953 |
| 1000 | 57.953 | 58.545 | 59.134 | 59.721 | 60.307 | 60.890 | 61.473 | 62.054 | 62.634 | 63.214 | 63.792 |
| 1100 | 63.792 | 64.370 | 64.948 | 65.525 | 66.102 | 66.679 | 67.255 | 67.831 | 68.406 | 68.980 | 69.553 |

NiCr-Ni (type K)

| Measuring temp. ° | 0 | -10 | -20 | -30 | -40 | -50 | -60 | -70 | -80 | -90 | -100 |
|-------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| -100 | -3.554 | -3.852 | -4.138 | -4.411 | -4.669 | -4.913 | -5.141 | -5.354 | -5.550 | -5.730 | -5.891 |
| 0 | 0.000 | -0.392 | -0.778 | -1.156 | -1.527 | -1.889 | -2.243 | -2.587 | -2.920 | -3.243 | -3.554 |
| Measuring temp. ° | 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
| 0 | 0.000 | 0.397 | 0.798 | 1.203 | 1.612 | 2.023 | 2.436 | 2.851 | 3.267 | 3.682 | 4.096 |
| 100 | 4.096 | 4.509 | 4.920 | 5.328 | 5.735 | 6.138 | 6.540 | 6.941 | 7.340 | 7.739 | 8.138 |
| 200 | 8.138 | 8.539 | 8.940 | 9.343 | 9.747 | 10.153 | 10.561 | 10.971 | 11.382 | 11.795 | 12.209 |
| 300 | 12.209 | 12.624 | 13.040 | 13.457 | 13.874 | 14.293 | 14.713 | 15.133 | 15.554 | 15.975 | 16.397 |
| 400 | 16.397 | 16.820 | 17.243 | 17.667 | 18.091 | 18.516 | 18.941 | 19.366 | 19.792 | 20.218 | 20.644 |
| 500 | 20.644 | 21.071 | 21.497 | 21.924 | 22.350 | 22.776 | 23.203 | 23.629 | 24.055 | 24.480 | 24.905 |
| 600 | 24.905 | 25.330 | 25.755 | 26.179 | 26.602 | 27.025 | 27.447 | 27.869 | 28.289 | 28.710 | 29.129 |
| 700 | 29.129 | 29.548 | 29.965 | 30.382 | 30.798 | 31.213 | 31.628 | 32.041 | 32.453 | 32.865 | 33.275 |
| 800 | 33.275 | 33.685 | 34.093 | 34.501 | 34.908 | 35.313 | 35.718 | 36.121 | 36.524 | 36.925 | 37.326 |
| 900 | 37.326 | 37.725 | 38.124 | 38.522 | 38.918 | 39.314 | 39.708 | 40.101 | 40.494 | 40.885 | 41.276 |
| 1000 | 41.276 | 41.665 | 42.053 | 42.440 | 42.826 | 43.211 | 43.595 | 43.978 | 44.359 | 44.740 | 45.119 |
| 1100 | 45.119 | 45.497 | 45.873 | 46.249 | 46.623 | 46.995 | 47.367 | 47.737 | 48.105 | 48.473 | 48.838 |
| 1200 | 48.838 | 49.202 | 49.565 | 49.926 | 50.286 | 50.644 | 51.000 | 51.355 | 51.708 | 52.060 | 52.410 |
| 1300 | 52.410 | 52.759 | 53.106 | 53.451 | 53.795 | 54.138 | 54.479 | 54.819 | | | |

Pt13Rh-Pt (type R)

| Measuring temp. ° | 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
|-------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 0 | 0.000 | 0.054 | 0.111 | 0.171 | 0.232 | 0.296 | 0.363 | 0.431 | 0.501 | 0.573 | 0.647 |
| 100 | 0.647 | 0.723 | 0.800 | 0.879 | 0.959 | 1.041 | 1.124 | 1.208 | 1.294 | 1.381 | 1.469 |
| 200 | 1.469 | 1.558 | 1.648 | 1.739 | 1.831 | 1.923 | 2.017 | 2.112 | 2.207 | 2.304 | 2.401 |
| 300 | 2.401 | 2.498 | 2.597 | 2.696 | 2.796 | 2.896 | 2.997 | 3.099 | 3.201 | 3.304 | 3.408 |
| 400 | 3.408 | 3.512 | 3.616 | 3.721 | 3.827 | 3.933 | 4.040 | 4.147 | 4.255 | 4.363 | 4.471 |
| 500 | 4.471 | 4.580 | 4.690 | 4.800 | 4.910 | 5.021 | 5.133 | 5.245 | 5.357 | 5.470 | 5.583 |
| 600 | 5.583 | 5.697 | 5.812 | 5.926 | 6.041 | 6.157 | 6.273 | 6.390 | 6.507 | 6.625 | 6.743 |
| 700 | 6.743 | 6.861 | 6.980 | 7.100 | 7.220 | 7.340 | 7.461 | 7.583 | 7.705 | 7.827 | 7.950 |
| 800 | 7.950 | 8.073 | 8.197 | 8.321 | 8.446 | 8.571 | 8.697 | 8.823 | 8.950 | 9.077 | 9.205 |
| 900 | 9.205 | 9.333 | 9.461 | 9.590 | 9.720 | 9.850 | 9.980 | 10.111 | 10.242 | 10.374 | 10.506 |
| 1000 | 10.506 | 10.638 | 10.771 | 10.905 | 11.039 | 11.173 | 11.307 | 11.442 | 11.578 | 11.714 | 11.850 |
| 1100 | 11.850 | 11.986 | 12.123 | 12.260 | 12.397 | 12.535 | 12.673 | 12.812 | 12.950 | 13.089 | 13.228 |
| 1200 | 13.228 | 13.367 | 13.507 | 13.646 | 13.786 | 13.926 | 14.066 | 14.207 | 14.347 | 14.488 | 14.629 |
| 1300 | 14.629 | 14.770 | 14.911 | 15.052 | 15.193 | 15.334 | 15.475 | 15.616 | 15.758 | 15.899 | 16.040 |
| 1400 | 16.040 | 16.181 | 16.323 | 16.464 | 16.605 | 16.746 | 16.887 | 17.028 | 17.169 | 17.310 | 17.451 |
| 1500 | 17.451 | 17.591 | 17.732 | 17.872 | 18.012 | 18.152 | 18.292 | 18.431 | 18.571 | 18.710 | 18.849 |
| 1600 | 18.849 | 18.988 | 19.126 | 19.264 | 19.402 | 19.540 | 19.677 | 19.814 | 19.951 | 20.087 | 20.222 |
| 1700 | 20.222 | 20.356 | 20.488 | 20.620 | 20.749 | 20.877 | 21.003 | | | | |

Pt10Rh-Pt (type S)

| Measuring temp. ° | 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
|-------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 0 | 0.000 | 0.055 | 0.113 | 0.173 | 0.235 | 0.299 | 0.365 | 0.433 | 0.502 | 0.573 | 0.646 |
| 100 | 0.646 | 0.720 | 0.795 | 0.872 | 0.950 | 1.029 | 1.110 | 1.191 | 1.273 | 1.357 | 1.441 |
| 200 | 1.441 | 1.526 | 1.612 | 1.698 | 1.786 | 1.874 | 1.962 | 2.052 | 2.141 | 2.232 | 2.323 |
| 300 | 2.323 | 2.415 | 2.507 | 2.599 | 2.692 | 2.786 | 2.880 | 2.974 | 3.069 | 3.164 | 3.259 |
| 400 | 3.259 | 3.355 | 3.451 | 3.548 | 3.645 | 3.742 | 3.840 | 3.938 | 4.036 | 4.134 | 4.233 |
| 500 | 4.233 | 4.332 | 4.432 | 4.532 | 4.632 | 4.732 | 4.833 | 4.934 | 5.035 | 5.137 | 5.239 |
| 600 | 5.239 | 5.341 | 5.443 | 5.546 | 5.649 | 5.753 | 5.857 | 5.961 | 6.065 | 6.170 | 6.275 |
| 700 | 6.275 | 6.381 | 6.486 | 6.593 | 6.699 | 6.806 | 6.913 | 7.020 | 7.128 | 7.236 | 7.345 |
| 800 | 7.345 | 7.454 | 7.563 | 7.673 | 7.783 | 7.893 | 8.003 | 8.114 | 8.226 | 8.337 | 8.449 |
| 900 | 8.449 | 8.562 | 8.674 | 8.787 | 8.900 | 9.014 | 9.128 | 9.242 | 9.357 | 9.472 | 9.587 |
| 1000 | 9.587 | 9.703 | 9.819 | 9.935 | 10.051 | 10.168 | 10.285 | 10.403 | 10.520 | 10.638 | 10.757 |
| 1100 | 10.757 | 10.875 | 10.994 | 11.113 | 11.232 | 11.351 | 11.471 | 11.590 | 11.710 | 11.830 | 11.951 |
| 1200 | 11.951 | 12.071 | 12.191 | 12.312 | 12.433 | 12.554 | 12.675 | 12.796 | 12.917 | 13.038 | 13.159 |
| 1300 | 13.159 | 13.280 | 13.402 | 13.523 | 13.644 | 13.766 | 13.887 | 14.009 | 14.130 | 14.251 | 14.373 |
| 1400 | 14.373 | 14.494 | 14.615 | 14.736 | 14.857 | 14.978 | 15.099 | 15.220 | 15.341 | 15.461 | 15.582 |
| 1500 | 15.582 | 15.702 | 15.822 | 15.942 | 16.062 | 16.182 | 16.301 | 16.420 | 16.539 | 16.658 | 16.777 |
| 1600 | 16.777 | 16.895 | 17.013 | 17.131 | 17.249 | 17.336 | 17.483 | 17.600 | 17.717 | 17.823 | 17.947 |
| 1700 | 17.947 | 18.061 | 18.174 | 18.285 | 18.395 | 18.503 | 18.609 | | | | |

Pt30Rh-Pt6Rh (type B)

| Measuring temp. ° | 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
|-------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 0 | 0.000 | 0.002 | 0.003 | 0.002 | 0.000 | 0.002 | 0.006 | 0.011 | 0.017 | 0.025 | 0.033 |
| 100 | 0.033 | 0.043 | 0.053 | 0.065 | 0.078 | 0.092 | 0.107 | 0.123 | 0.141 | 0.159 | 0.178 |
| 200 | 0.178 | 0.199 | 0.220 | 0.243 | 0.267 | 0.291 | 0.317 | 0.344 | 0.372 | 0.401 | 0.431 |
| 300 | 0.431 | 0.462 | 0.494 | 0.527 | 0.561 | 0.596 | 0.632 | 0.669 | 0.707 | 0.746 | 0.787 |
| 400 | 0.787 | 0.828 | 0.870 | 0.913 | 0.957 | 1.002 | 1.048 | 1.095 | 1.143 | 1.192 | 1.242 |
| 500 | 1.242 | 1.293 | 1.344 | 1.397 | 1.451 | 1.505 | 1.561 | 1.617 | 1.674 | 1.732 | 1.792 |
| 600 | 1.792 | 1.852 | 1.912 | 1.974 | 2.037 | 2.101 | 2.165 | 2.230 | 2.296 | 2.363 | 2.431 |
| 700 | 2.431 | 2.499 | 2.569 | 2.639 | 2.710 | 2.782 | 2.854 | 2.928 | 3.002 | 3.078 | 3.154 |
| 800 | 3.154 | 3.230 | 3.308 | 3.386 | 3.466 | 3.546 | 3.626 | 3.708 | 3.790 | 3.873 | 3.957 |
| 900 | 3.957 | 4.041 | 4.127 | 4.213 | 4.299 | 4.387 | 4.475 | 4.564 | 4.653 | 4.743 | 4.834 |
| 1000 | 4.834 | 4.926 | 5.018 | 5.111 | 5.205 | 5.299 | 5.394 | 5.489 | 5.585 | 5.682 | 5.780 |
| 1100 | 5.780 | 5.878 | 5.976 | 6.075 | 6.175 | 6.276 | 6.377 | 6.478 | 6.580 | 6.683 | 6.786 |
| 1200 | 6.786 | 6.890 | 6.995 | 7.100 | 7.205 | 7.311 | 7.417 | 7.524 | 7.632 | 7.740 | 7.848 |
| 1300 | 7.848 | 7.957 | 8.066 | 8.176 | 8.286 | 8.397 | 8.508 | 8.620 | 8.731 | 8.844 | 8.956 |
| 1400 | 8.956 | 9.069 | 9.182 | 9.296 | 9.410 | 9.524 | 9.639 | 9.753 | 9.868 | 9.984 | 10.099 |
| 1500 | 10.099 | 10.215 | 10.331 | 10.447 | 10.583 | 10.679 | 10.796 | 10.913 | 11.029 | 11.146 | 11.263 |
| 1600 | 11.263 | 11.380 | 11.497 | 11.614 | 11.731 | 11.848 | 11.965 | 12.082 | 12.199 | 12.316 | 12.433 |
| 1700 | 12.433 | 12.549 | 12.666 | 12.782 | 12.898 | 13.014 | 13.130 | 12.246 | 13.361 | 13.476 | 13.591 |
| 1800 | 13.591 | 13.706 | 13.820 | | | | | | | | |

Cu-CuNi (type U) acc. to DIN 43710*

| Measuring temp. ° | 0 | -10 | -20 | -30 | -40 | -50 | -60 | -70 | -80 | -90 | -100 |
|-------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| -100 | -3.40 | -3.68 | -3.95 | -4.21 | -4.46 | -4.69 | -4.91 | -5.12 | -5.32 | -5.51 | -5.70 |
| 0 | 0.00 | -0.39 | -0.77 | -1.14 | -1.50 | -1.85 | -2.18 | -2.50 | -2.81 | -3.11 | -3.40 |
| Measuring temp. ° | 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
| 0 | 0.00 | 0.40 | 0.80 | 1.21 | 1.63 | 2.05 | 2.48 | 2.91 | 3.35 | 3.80 | 4.25 |
| 100 | 4.25 | 4.71 | 5.18 | 5.65 | 6.13 | 6.62 | 7.12 | 7.63 | 8.15 | 8.67 | 9.20 |
| 200 | 9.20 | 9.74 | 10.29 | 10.85 | 11.41 | 11.98 | 12.55 | 13.13 | 13.71 | 14.30 | 14.90 |
| 300 | 14.90 | 15.50 | 16.10 | 16.70 | 17.31 | 17.92 | 18.53 | 19.14 | 19.76 | 20.38 | 21.00 |
| 400 | 21.00 | 21.62 | 22.25 | 22.88 | 23.51 | 24.15 | 24.79 | 25.44 | 26.09 | 26.75 | 27.41 |
| 500 | 27.41 | 28.08 | 28.75 | 29.43 | 30.11 | 30.80 | 31.49 | 32.19 | 32.89 | 33.60 | |

*This standard is ceased to be valid.

FE-CuNi (type L) acc. to DIN 43710*

| Measuring temp. ° | 0 | -10 | -20 | -30 | -40 | -50 | -60 | -70 | -80 | -90 | -100 |
|-------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| -100 | -4.75 | -5.15 | -5.53 | -5.90 | -6.26 | -6.60 | -6.93 | -7.25 | -7.56 | -7.86 | -8.15 |
| 0 | 0.00 | -0.51 | -1.02 | -1.53 | -2.03 | -2.51 | -2.98 | -3.44 | -3.89 | -4.33 | -4.75 |
| Measuring temp. ° | 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
| 0 | 0.00 | 0.52 | 1.05 | 1.58 | 2.11 | 2.65 | 3.19 | 3.73 | 4.27 | 4.82 | 5.37 |
| 100 | 5.37 | 5.92 | 6.47 | 7.03 | 7.59 | 8.15 | 8.71 | 9.27 | 9.83 | 10.39 | 10.95 |
| 200 | 10.95 | 11.51 | 12.07 | 12.63 | 13.19 | 13.75 | 14.31 | 14.88 | 15.44 | 16.00 | 16.56 |
| 300 | 16.56 | 17.12 | 17.68 | 18.24 | 18.80 | 19.36 | 19.92 | 20.48 | 21.04 | 21.60 | 22.16 |
| 400 | 22.16 | 22.72 | 23.29 | 23.86 | 24.43 | 25.00 | 25.57 | 26.14 | 26.71 | 27.28 | 27.85 |
| 500 | 27.85 | 28.43 | 29.01 | 29.59 | 30.17 | 30.75 | 31.33 | 31.91 | 32.49 | 33.08 | 33.67 |
| 600 | 33.67 | 34.26 | 34.85 | 35.44 | 36.04 | 36.64 | 37.25 | 37.85 | 38.47 | 39.09 | 39.72 |
| 700 | 39.72 | 40.35 | 40.98 | 41.62 | 42.27 | 42.92 | 43.57 | 44.23 | 44.89 | 45.55 | 46.22 |
| 800 | 46.22 | 46.89 | 47.57 | 48.25 | 48.94 | 49.63 | 50.32 | 51.02 | 51.72 | 52.43 | |

*This standard is ceased to be valid.

7. Core Values acc. to DIN EN 60751 for Resistance Thermometers

in ohm for measuring resistances in 1°C steps

Pt100

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| -200 | 18,520 | 18,952 | 19,384 | 19,815 | 20,247 | 20,677 | 21,108 | 21,538 | 21,967 | 22,397 | 22,825 |
| -190 | 22,825 | 23,254 | 23,682 | 24,110 | 24,538 | 24,965 | 25,392 | 25,819 | 26,245 | 26,671 | 27,096 |
| -180 | 27,096 | 27,522 | 27,947 | 28,371 | 28,796 | 29,220 | 29,643 | 30,067 | 30,490 | 30,913 | 31,335 |
| -170 | 31,335 | 31,757 | 32,179 | 32,601 | 33,022 | 33,443 | 33,864 | 34,284 | 34,704 | 35,124 | 35,543 |
| -160 | 35,543 | 35,963 | 36,382 | 36,800 | 37,219 | 37,637 | 38,055 | 38,472 | 38,889 | 39,306 | 39,723 |
| -150 | 39,723 | 40,140 | 40,556 | 40,972 | 41,388 | 41,803 | 42,218 | 42,633 | 43,048 | 43,462 | 43,876 |
| -140 | 43,876 | 44,290 | 44,704 | 45,117 | 45,531 | 45,944 | 46,356 | 46,769 | 47,181 | 47,593 | 48,005 |
| -130 | 48,005 | 48,416 | 48,828 | 49,239 | 49,649 | 50,060 | 50,470 | 50,881 | 51,291 | 51,700 | 52,110 |
| -120 | 52,110 | 52,519 | 52,928 | 53,337 | 53,746 | 54,154 | 54,562 | 54,970 | 55,378 | 55,786 | 56,193 |
| -110 | 56,193 | 56,600 | 57,007 | 57,414 | 57,821 | 58,227 | 58,633 | 59,039 | 59,445 | 59,850 | 60,256 |
| -100 | 60,256 | 60,661 | 61,066 | 61,471 | 61,876 | 62,280 | 62,684 | 63,088 | 63,492 | 63,896 | 64,300 |
| -90 | 64,300 | 64,703 | 65,106 | 65,509 | 65,912 | 66,315 | 66,717 | 67,120 | 67,522 | 67,924 | 68,325 |
| -80 | 68,325 | 68,727 | 69,129 | 69,530 | 69,931 | 70,332 | 70,733 | 71,134 | 71,534 | 71,934 | 72,335 |
| -70 | 72,335 | 72,735 | 73,134 | 73,534 | 73,934 | 74,333 | 74,732 | 75,131 | 75,530 | 75,929 | 76,328 |
| -60 | 76,328 | 76,726 | 77,125 | 77,523 | 77,921 | 78,319 | 78,717 | 79,114 | 79,512 | 79,909 | 80,306 |
| -50 | 80,306 | 80,703 | 81,100 | 81,497 | 81,894 | 82,290 | 82,687 | 83,083 | 83,479 | 83,875 | 84,271 |
| -40 | 84,271 | 84,666 | 85,062 | 85,457 | 85,853 | 86,248 | 86,643 | 87,038 | 87,432 | 87,827 | 88,222 |
| -30 | 88,222 | 88,616 | 89,010 | 89,404 | 89,798 | 90,192 | 90,586 | 90,980 | 91,373 | 91,767 | 92,160 |
| -20 | 92,160 | 92,553 | 92,946 | 93,339 | 93,732 | 94,124 | 94,517 | 94,909 | 95,302 | 95,694 | 96,086 |
| -10 | 96,086 | 96,478 | 96,870 | 97,261 | 97,653 | 98,044 | 98,436 | 98,827 | 99,218 | 99,609 | 100,000 |
| 0 | 100,000 | 100,391 | 100,781 | 101,172 | 101,562 | 101,953 | 102,343 | 102,733 | 103,123 | 103,513 | 103,903 |
| 10 | 103,903 | 104,292 | 104,682 | 105,071 | 105,460 | 105,849 | 106,238 | 106,627 | 107,016 | 107,405 | 107,794 |
| 20 | 107,794 | 108,182 | 108,570 | 108,959 | 109,347 | 109,735 | 110,123 | 110,510 | 110,898 | 111,286 | 111,673 |
| 30 | 111,673 | 112,060 | 112,447 | 112,835 | 113,221 | 113,608 | 113,995 | 114,382 | 114,768 | 115,155 | 115,541 |
| 40 | 115,541 | 115,927 | 116,313 | 116,699 | 117,085 | 117,470 | 117,856 | 118,241 | 118,627 | 119,012 | 119,397 |
| 50 | 119,397 | 119,782 | 120,167 | 120,552 | 120,936 | 121,321 | 121,705 | 122,090 | 122,474 | 122,858 | 123,242 |
| 60 | 123,242 | 123,626 | 124,009 | 124,393 | 124,777 | 125,160 | 125,543 | 125,926 | 126,309 | 126,692 | 127,075 |
| 70 | 127,075 | 127,458 | 127,840 | 128,223 | 128,605 | 128,987 | 129,370 | 129,752 | 130,133 | 130,515 | 130,897 |
| 80 | 130,897 | 131,278 | 131,660 | 132,041 | 132,422 | 132,803 | 133,184 | 133,565 | 133,946 | 134,326 | 134,707 |
| 90 | 134,707 | 135,087 | 135,468 | 135,848 | 136,228 | 136,608 | 136,987 | 137,367 | 137,747 | 138,126 | 138,506 |
| 100 | 138,506 | 138,885 | 139,264 | 139,643 | 140,022 | 140,400 | 140,779 | 141,158 | 141,536 | 141,914 | 142,293 |
| 110 | 142,293 | 142,671 | 143,049 | 143,426 | 143,804 | 144,182 | 144,559 | 144,937 | 145,314 | 145,691 | 146,068 |
| 120 | 146,068 | 146,445 | 146,822 | 147,198 | 147,575 | 147,951 | 148,328 | 148,704 | 149,080 | 149,456 | 149,832 |
| 130 | 149,832 | 150,208 | 150,583 | 150,959 | 151,334 | 151,710 | 152,085 | 152,460 | 152,835 | 153,210 | 153,584 |
| 140 | 153,584 | 153,959 | 154,333 | 154,708 | 155,082 | 155,456 | 155,830 | 156,204 | 156,578 | 156,952 | 157,325 |
| 150 | 157,325 | 157,699 | 158,072 | 158,445 | 158,818 | 159,191 | 159,564 | 159,937 | 160,309 | 160,682 | 161,054 |
| 160 | 161,054 | 161,427 | 161,799 | 162,171 | 162,543 | 162,915 | 163,286 | 163,658 | 164,030 | 164,401 | 164,772 |
| 170 | 164,772 | 165,143 | 165,514 | 165,885 | 166,256 | 166,627 | 166,997 | 167,368 | 167,738 | 168,108 | 168,478 |
| 180 | 168,478 | 168,848 | 169,218 | 169,588 | 169,958 | 170,327 | 170,696 | 171,066 | 171,435 | 171,804 | 172,173 |

Pt100 (continued)

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|-----|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| 190 | 172,173 | 172,542 | 172,910 | 173,279 | 173,648 | 174,016 | 174,384 | 174,752 | 175,120 | 175,488 | 175,856 |
| 200 | 175,856 | 176,224 | 176,591 | 176,959 | 177,326 | 177,693 | 178,060 | 178,427 | 178,794 | 179,161 | 179,528 |
| 210 | 179,528 | 179,894 | 180,260 | 180,627 | 180,993 | 181,359 | 181,725 | 182,091 | 182,456 | 182,822 | 183,188 |
| 220 | 183,188 | 183,553 | 183,918 | 184,283 | 184,648 | 185,013 | 185,378 | 185,743 | 186,107 | 186,472 | 186,836 |
| 230 | 186,836 | 187,200 | 187,564 | 187,928 | 188,292 | 188,656 | 189,019 | 189,383 | 189,746 | 190,110 | 190,473 |
| 240 | 190,473 | 190,836 | 191,199 | 191,562 | 191,924 | 192,287 | 192,649 | 193,012 | 193,374 | 193,736 | 194,098 |
| 250 | 194,098 | 194,460 | 194,822 | 195,183 | 195,545 | 195,906 | 196,268 | 196,629 | 196,990 | 197,351 | 197,712 |
| 260 | 197,712 | 198,073 | 198,433 | 198,794 | 199,154 | 199,514 | 199,875 | 200,235 | 200,595 | 200,954 | 201,314 |
| 270 | 201,314 | 201,674 | 202,033 | 202,393 | 202,752 | 203,111 | 203,470 | 203,829 | 204,188 | 204,546 | 204,905 |
| 280 | 204,905 | 205,263 | 205,622 | 205,980 | 206,338 | 206,696 | 207,054 | 207,411 | 207,769 | 208,127 | 208,484 |
| 290 | 208,484 | 208,841 | 209,198 | 209,555 | 209,912 | 210,269 | 210,626 | 210,982 | 211,339 | 211,695 | 212,052 |
| 300 | 212,052 | 212,408 | 212,764 | 213,120 | 213,475 | 213,831 | 214,187 | 214,542 | 214,897 | 215,252 | 215,608 |
| 310 | 215,608 | 215,962 | 216,317 | 216,672 | 217,027 | 217,381 | 217,736 | 218,090 | 218,444 | 218,798 | 219,152 |
| 320 | 219,152 | 219,506 | 219,860 | 220,213 | 220,567 | 220,920 | 221,273 | 221,626 | 221,979 | 222,332 | 222,685 |
| 330 | 222,685 | 223,038 | 223,390 | 223,743 | 224,095 | 224,447 | 224,799 | 225,151 | 225,503 | 225,855 | 226,206 |
| 340 | 226,206 | 226,558 | 226,909 | 227,260 | 227,612 | 227,963 | 228,314 | 228,664 | 229,015 | 229,366 | 229,716 |
| 350 | 229,716 | 230,066 | 230,417 | 230,767 | 231,117 | 231,467 | 231,816 | 232,166 | 232,516 | 232,865 | 233,214 |
| 360 | 233,214 | 233,564 | 233,913 | 234,262 | 234,610 | 234,959 | 235,308 | 235,656 | 236,005 | 236,353 | 236,701 |
| 370 | 236,701 | 237,049 | 237,397 | 237,745 | 238,093 | 238,440 | 238,788 | 239,135 | 239,482 | 239,829 | 240,176 |
| 380 | 240,176 | 240,523 | 240,870 | 241,217 | 241,563 | 241,910 | 242,256 | 242,602 | 242,948 | 243,294 | 243,640 |
| 390 | 243,640 | 243,986 | 244,331 | 244,677 | 245,022 | 245,367 | 245,713 | 246,058 | 246,403 | 246,747 | 247,092 |
| 400 | 247,092 | 247,437 | 247,781 | 248,125 | 248,470 | 248,814 | 249,158 | 249,502 | 249,845 | 250,189 | 250,533 |
| 410 | 250,533 | 250,876 | 251,219 | 251,562 | 251,906 | 252,248 | 252,591 | 252,934 | 253,277 | 253,619 | 253,962 |
| 420 | 253,962 | 254,304 | 254,646 | 254,988 | 255,330 | 255,672 | 256,013 | 256,355 | 256,696 | 257,038 | 257,379 |
| 430 | 257,379 | 257,720 | 258,061 | 258,402 | 258,743 | 259,083 | 259,424 | 259,764 | 260,105 | 260,445 | 260,785 |
| 440 | 260,785 | 261,125 | 261,465 | 261,804 | 262,144 | 262,483 | 262,823 | 263,162 | 263,501 | 263,840 | 264,179 |
| 450 | 264,179 | 264,518 | 264,857 | 265,195 | 265,534 | 265,872 | 266,210 | 266,548 | 266,886 | 267,224 | 267,562 |
| 460 | 267,562 | 267,900 | 268,237 | 268,574 | 268,912 | 269,249 | 269,586 | 269,923 | 270,260 | 270,597 | 270,933 |
| 470 | 270,933 | 271,270 | 271,606 | 271,942 | 272,278 | 272,614 | 272,950 | 273,286 | 273,622 | 273,957 | 274,293 |
| 480 | 274,293 | 274,628 | 274,963 | 275,298 | 275,633 | 275,968 | 276,303 | 276,638 | 276,972 | 277,307 | 277,641 |
| 490 | 277,641 | 277,975 | 278,309 | 278,643 | 278,977 | 279,311 | 279,644 | 279,978 | 280,311 | 280,644 | 280,978 |
| 500 | 280,978 | 281,311 | 281,643 | 281,976 | 282,309 | 282,641 | 282,974 | 283,306 | 283,638 | 283,971 | 284,303 |
| 510 | 284,303 | 284,634 | 284,966 | 285,298 | 285,629 | 285,961 | 286,292 | 286,623 | 286,954 | 287,285 | 287,616 |
| 520 | 287,616 | 287,947 | 288,277 | 288,608 | 288,938 | 289,268 | 289,599 | 289,929 | 290,258 | 290,588 | 290,918 |
| 530 | 290,918 | 291,247 | 291,577 | 291,906 | 292,235 | 292,565 | 292,894 | 293,222 | 293,551 | 293,880 | 294,208 |
| 540 | 294,208 | 294,537 | 294,865 | 295,193 | 295,521 | 295,849 | 296,177 | 296,505 | 296,832 | 297,160 | 297,487 |
| 550 | 297,487 | 297,814 | 298,142 | 298,469 | 298,795 | 299,122 | 299,449 | 299,775 | 300,102 | 300,428 | 300,754 |
| 560 | 300,754 | 301,080 | 301,406 | 301,732 | 302,058 | 302,384 | 302,709 | 303,035 | 303,360 | 303,685 | 304,010 |
| 570 | 304,010 | 304,335 | 304,660 | 304,985 | 305,309 | 305,634 | 305,958 | 306,282 | 306,606 | 306,930 | 307,254 |

Pt100 (continued)

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|-----|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| 580 | 307,254 | 307,578 | 307,902 | 308,225 | 308,549 | 308,872 | 309,195 | 309,518 | 309,841 | 310,164 | 310,487 |
| 590 | 310,487 | 310,810 | 311,132 | 311,454 | 311,777 | 312,099 | 312,421 | 312,743 | 313,065 | 313,386 | 313,708 |
| 600 | 313,708 | 314,029 | 314,351 | 314,672 | 314,993 | 315,314 | 315,635 | 315,956 | 316,277 | 316,597 | 316,918 |
| 610 | 316,918 | 317,238 | 317,558 | 317,878 | 318,198 | 318,518 | 318,838 | 319,157 | 319,477 | 319,796 | 320,116 |
| 620 | 320,116 | 320,435 | 320,754 | 321,073 | 321,391 | 321,710 | 322,029 | 322,347 | 322,666 | 322,984 | 323,302 |
| 630 | 323,302 | 323,620 | 323,938 | 324,256 | 324,573 | 324,891 | 325,208 | 325,526 | 325,843 | 326,160 | 326,477 |
| 640 | 326,477 | 326,794 | 327,110 | 327,427 | 327,744 | 328,060 | 328,376 | 328,692 | 329,008 | 329,324 | 329,640 |
| 650 | 329,640 | 329,956 | 330,271 | 330,587 | 330,902 | 331,217 | 331,533 | 331,848 | 332,162 | 332,477 | 332,792 |
| 660 | 332,792 | 333,106 | 333,421 | 333,735 | 334,049 | 334,363 | 334,677 | 334,991 | 335,305 | 335,619 | 335,932 |
| 670 | 335,932 | 336,246 | 336,559 | 336,872 | 337,185 | 337,498 | 337,811 | 338,123 | 338,436 | 338,748 | 339,061 |
| 680 | 339,061 | 339,373 | 339,685 | 339,997 | 340,309 | 340,621 | 340,932 | 341,244 | 341,555 | 341,867 | 342,178 |
| 690 | 342,178 | 342,489 | 342,800 | 343,111 | 343,422 | 343,732 | 344,043 | 344,353 | 344,663 | 344,973 | 345,284 |
| 700 | 345,284 | 345,593 | 345,903 | 346,213 | 346,522 | 346,832 | 347,141 | 347,451 | 347,760 | 348,069 | 348,378 |
| 710 | 348,378 | 348,686 | 348,995 | 349,303 | 349,612 | 349,920 | 350,228 | 350,536 | 350,844 | 351,152 | 351,460 |
| 720 | 351,460 | 351,768 | 352,075 | 352,382 | 352,690 | 352,997 | 353,304 | 353,611 | 353,918 | 354,224 | 354,531 |
| 730 | 354,531 | 354,837 | 355,144 | 355,450 | 355,756 | 356,062 | 356,368 | 356,674 | 356,979 | 357,285 | 357,590 |
| 740 | 357,590 | 357,896 | 358,201 | 358,506 | 358,811 | 359,116 | 359,420 | 359,725 | 360,029 | 360,334 | 360,638 |
| 750 | 360,638 | 360,942 | 361,246 | 361,550 | 361,854 | 362,158 | 362,461 | 362,765 | 363,068 | 363,371 | 363,674 |
| 760 | 363,674 | 363,977 | 364,280 | 364,583 | 364,886 | 365,188 | 365,491 | 365,793 | 366,095 | 366,397 | 366,699 |
| 770 | 366,699 | 367,001 | 367,303 | 367,604 | 367,906 | 368,207 | 368,508 | 368,810 | 369,111 | 369,412 | 369,712 |
| 780 | 369,712 | 370,013 | 370,314 | 370,614 | 370,914 | 371,215 | 371,515 | 371,815 | 372,115 | 372,414 | 372,714 |
| 790 | 372,714 | 373,013 | 373,313 | 373,612 | 373,911 | 374,210 | 374,509 | 374,808 | 375,107 | 375,406 | 375,704 |
| 800 | 375,704 | 376,002 | 376,301 | 376,599 | 376,897 | 377,195 | 377,493 | 377,790 | 378,088 | 378,385 | 378,683 |
| 810 | 378,683 | 378,980 | 379,277 | 379,574 | 379,871 | 380,167 | 380,464 | 380,761 | 381,057 | 381,353 | 381,650 |
| 820 | 381,650 | 381,946 | 382,242 | 382,537 | 382,833 | 383,129 | 383,424 | 383,720 | 384,015 | 384,310 | 384,605 |
| 830 | 384,605 | 384,900 | 385,195 | 385,489 | 385,784 | 386,078 | 386,373 | 386,667 | 386,961 | 387,255 | 387,549 |
| 840 | 387,549 | 387,843 | 388,136 | 388,430 | 388,723 | 389,016 | 389,310 | 389,603 | 389,896 | 390,188 | 390,481 |
| 850 | 390,481 | 390,774 | 391,066 | 391,359 | 391,651 | 391,943 | 392,235 | 392,527 | 392,819 | 393,110 | 393,402 |

7.1. Limit Value Deviation for Resistance Thermometers Pt100 acc. to DIN EN 60751

| Temp. [°C] | KI. B DIN | | KI. B½ DIN | | KI. B1/3 DIN | | KI. B1/10 DIN | | KI. A DIN | | KI. A½ DIN | |
|---------------|-----------|------|------------|------|--------------|------|---------------|------|-----------|------|------------|------|
| | [°C] | [Ω] | [°C] | [Ω] | [°C] | [Ω] | [°C] | [Ω] | [°C] | [Ω] | [°C] | [Ω] |
| 0 | 0.30 | 0.12 | 0.15 | 0.06 | 0.10 | 0.04 | 0.03 | 0.01 | 0.15 | 0.06 | 0.08 | 0.03 |
| 50 | 0.55 | 0.21 | 0.40 | 0.15 | 0.35 | 0.13 | 0.28 | 0.10 | 0.25 | 0.10 | 0.18 | 0.07 |
| 100 | 0.80 | 0.30 | 0.65 | 0.24 | 0.60 | 0.22 | 0.53 | 0.19 | 0.35 | 0.13 | 0.28 | 0.10 |
| 150 | 1.05 | 0.39 | 0.90 | 0.33 | 0.85 | 0.31 | 0.78 | 0.28 | 0.45 | 0.17 | 0.38 | 0.14 |
| 200 | 1.30 | 0.48 | 1.15 | 0.42 | 1.10 | 0.40 | 1.03 | 0.37 | 0.55 | 0.20 | 0.48 | 0.17 |
| 300 | 1.80 | 0.64 | 1.65 | 0.58 | 1.60 | 0.56 | 1.53 | 0.53 | 0.75 | 0.27 | 0.68 | 0.24 |
| 400 | 2.75 | 2.30 | 2.15 | 0.73 | 2.10 | 0.71 | 2.03 | 0.68 | 0.95 | 0.33 | 0.88 | 0.30 |

Technische Änderungen vorbehalten • Subject to change without notice • Changements techniques sous réserve

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