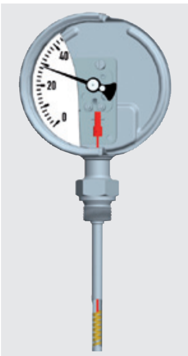
Mechanical temperature measuring instruments

Temperature is an indicator of the thermal condition of a homogenous material or body. It expresses the energy of motion that is contained in the molecules of the material. Transmission of temperature from one body to another, e.g. process medium and thermometric sensor, requires close physical contact between both bodies to achieve thermal equilibrium. Conventional temperature measurement is based on the property of certain materials to alter their physical shape or volume proportional to the temperature applied. The most commonly used principles in the WIKA production are highlighted below.

Bimetal thermometers

Operating principle
The temperature is measured by means of a bimetal system inside the temperature sensor. The bimetal is made from two metal strips, permanently joined together, each metal having a different thermal expansion coefficient. This causes the strip to deflect in proportion to the temperature variation. The actual bimetal system consists of a bimetal strip that is either

- helically or
- spirally



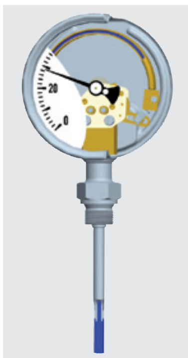
wound, depending on the size of the sensor and the temperature range to be measured. Any temperature variation causes the bimetal to rotate an attached spindle.
This rotation is indicated by a pointer on a dial scale.
WIKA bimetal thermometers are available for temperature ranges from -70 to +600 °C with accuracies complying with Class 1 and 2 of EN 13190.

Expansion thermometers

Operating principle
The temperature is measured by a liquid-filled measuring system consisting of a temperature probe, a capillary and a bourdon tube. These three components form a sealed system. Any temperature variation causes a change in the internal pressure of this system. As a result of this pressure change the shaft and pointer connected to the tube rotate and the temperature value is indicated on the scale. With capillary lengths available between 500 and 10,000 mm, it is also possible to measure temperatures at remote measuring points.
WIKA expansion thermometers are available for temperature ranges from -40 to +400 °C with accuracies complying with Class 1 and 2 of EN 13190.

Gas actuated thermometer with or without capillary

Operating principle
Gas actuated thermometers consist of a stem, a capillary and a case containing the bourdon tube element. These components are connected to form a single system. The complete measuring system is filled with an inert gas under pressure. Any temperature variation causes a change in the internal pressure of the stem, leading to a deflection of the bourdon tube. A mechanical linkage (movement) transmits this deflection to the pointer.



Variations in the ambient temperature acting on the case are compensated for by a bimetal element mounted between the movement and the bourdon tube.
WIKA gas actuated thermometers are available for temperature ranges from -200 to +700 °C with an accuracy complying with Class 1 of EN 13190.

Conversion reference

How to calculate	From K	°C	°F	°R	°Ré
K	x	K= °C + 273.15	K= 5/9 (°F + 459.67)	K= 5/9 °R	K= 5/4 °Ré + 273.15
°C	°C= K - 273.15	x	°C= 5/9 (°F - 32)	°C= 5/9 °R - 273.15	°C= 5/4 °Ré
°F	°F= 9/5 K - 459.67	°F= 9/5 °C + 32	x	°F= °R - 459.67	°F= 9/4 °Ré + 32
°R	°R= 9/5 K	°R= 9/5 °C + 491.68	°R= °F + 459.67	x	°R= 9/4 °Ré + 491.68
°Ré	°Ré= 4/5 K - 218.52	°Ré= 4/5 °C	°Ré= 4/9 (°F - 32)	°Ré= 4/9 °R - 218.52	x

Limit of error in °C

per DIN EN 13190

Applicable for expansion and bimetal dial thermometers

Scale range in °C	Measuring range in °C	Limit of error in ± °C Class 1	Class 2
-20 ... +40	-10 ... +30	1	2
-20 ... +60	-10 ... +50	1	2
-20 ... +120	-10 ... +110	2	4
-30 ... +30	-20 ... +20	1	2
-30 ... +50	-20 ... +40	1	2
-30 ... +70	-20 ... +60	1	2
-40 ... +40	-30 ... +30	1	2
-40 ... +60	-30 ... +50	1	2
-100 ... +60	-80 ... +40	2	4
0 ... 60	10 ... 50	1	2
0 ... 80	10 ... 70	1	2
0 ... 100	10 ... 90	1	2
0 ... 120	10 ... 110	2	4
0 ... 160	20 ... 140	2	4
0 ... 200	20 ... 180	2	4
0 ... 250	30 ... 220	2.5	5
0 ... 300	30 ... 270	5	10
0 ... 400	50 ... 350	5	10
0 ... 500	50 ... 450	5	10
0 ... 600	100 ... 500	10	15
0 ... 700	100 ... 600	10	15
50 ... 650	150 ... 550	10	15
100 ... 700	200 ... 600	10	15

Basic points of thermo-dynamic temperature scales

Unit	Symbol	Reference value absolute zero	triple point of water
Kelvin	K	0	273.16
Grad Celcius	°C	-273.15	0.01
Grad Fahrenheit	°F	-459.67	32.01
Grad Rankine	°R	0	491.68
Grad Réaumur	°Ré	-218.52	0

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