

## 1. Application

Depending on requirement and operating conditions, various device versions are available. The following information serves for the evaluation and commissioning of our devices.

## 2. Selection criteria

The user must ensure that the correct temperature-measuring device has been selected in terms of indicating range and version (e.g. resistance of the materials to the measurement medium, measuring range, etc.). Observe the regulations applicable to the application.

### 2.1 Measuring principles

Mechanical temperature measuring devices are simple in construction, sturdy and reliable. These require no external energy to function. Mainly bimetal systems or gas pressure or liquid measuring systems are employed for pointer thermometers.

#### ➤ Bimetal thermometer

The bimetal thermometer mainly consists of the immersion tube with fixed bimetal coil and a display unit with dial and pointer permanently connected to the former. The rotary movement of 270° of the bimetal coil acts directly on the pointer by way of a shaft. Through different material combinations of the bimetal it is possible to select indicating ranges between -100°C and +600°C. Designs and dimensions are established in DIN 16204.

The following bimetal versions are available:

- Bimetal thermometer with axial immersion tube (bimetal helix coil is directly connected to the pointer by way of a drive shaft)
- Bimetal thermometer with vertical immersion tube (bimetal helix coil and pointer are interconnected by way of a 90° deflection spring or, for industrial versions, with an angular mechanism)
- Bimetal thermometers with adjustable joint stem (bimetal helix coil and pointer are interconnected by way of a deflection spring and are adjustable up to 90° by way of a joint)

#### Function of the bimetal

The bimetal helix coil consists of two permanently joined strips of metal having different temperature expansion. These strips are spirally coiled. By suitably selecting winding length, diameter and material pairing the system is matched so that a rotary movement of 270° is achieved with the rated temperature range. Bimetal helix coils are available for continuous operation temperatures up to 500°C. Intermittent loads up to 600°C are permissible on devices with corresponding indicating ranges.

#### ➤ Bulb thermometers

Bulb thermometers mainly consist of the immersion tube with a pressure vessel (bulb) and the indicating unit. Both parts are interconnected by way of a capillary. The bulb is considered the active part of the immersion tube and is filled with a gas, mercury or a fluid as expansion medium. A change in pressure in the bulb results in a deflection of the coil spring measuring mechanism, which in turn produces the indication. Different measuring ranges can be accomplished by selecting the suitable bulb:

- Gas filled systems: -200°C to +400°C
- Mercury filled systems: -50°C to +600°C
- Alcohol filled systems (toluene): -50°C to +600°C

Designs and dimensions are based on DIN 16 205 and DIN 16 206.

The following bulb thermometer design versions are possible:

- Bulb thermometer with vertical immersion tube
- Bulb thermometer with axial immersion tube
- Bulb thermometer with adjustable joint stem (immersion tube and pointer can be adjusted relative to each other up to an angle of 90°)
- Bulb thermometer with long-distance line (immersion tube and indicator are interconnected by way of a long-distance line)

### Function of the bulb thermometers

The measuring system consists of the immersion tube with a bulb located at the lower end and a coil spring measuring mechanism located in the indicating unit. Both parts are interconnected by way of a capillary.

### Spiral coil spring measuring mechanism

This consists of the spiral coil spring, a spirally wound flat tube made of special steel and the pointer mechanism. A change in pressure or volume of the expansion material in the bulb deforms the spiral coil spring, which is translated into a rotary display movement of 270° by way of the pointer mechanism. The volumetric capacity of the spiral coil spring is extremely small to keep any influence on the indication by the ambient temperature low.

### Immersion tube

The immersion tube consists of a closed steel or stainless steel tube body. The connection fitting of the immersion tube is located in the upper area and is available in various thread versions. The bulb area is considered the active part of the immersion tube, which must reach the process temperature entirely.

### Long-distance line

The long-distance line made of steel, copper or stainless steel joins the immersion tube with the display unit. To achieve minimum indicating error through fluctuating long-distance line temperatures, the largest possible bulb volumes should be selected for gas thermometers. In liquid thermometers it is possible to offset the display error through external temperature influence by a long-distance line with double capillary and a special compensation mechanism. This method is called full compensation.

## 2.2 Indicating and measuring ranges

Temperature measuring devices differ in indicating range and measuring range. The error limits within the measuring range are adhered to. The temperature-measuring device must therefore be selected so that the measuring range is not exceeded during normal operation. The appropriate indicating and measuring ranges are shown in the table Chapter 9.

## 2.3 Error limits

The error limits for thermometers are divided in 2 classes (1 and 2) and are established in the standard DIN EN 13 190 (Table in Chapter 9)

## 2.4. Ambient temperatures

### ➤ Vibrations

If temperature measuring device vibrations cannot be avoided through suitable installation devices, pointer mechanism damping or fluid charge must be employed.

### ➤ Corrosive atmosphere

Appropriate housings and components made of resistant materials must be provided for corrosive atmosphere. Special surface treatments are also employed for external protection.

### 3. Protective tubes

A special problem with the installation of temperature measuring points is the heat transport to the process or from the process by way of the measuring device. As a result the active part of the immersion tube fails to reach full process temperature resulting in incorrect indications.

If the minimum immersion depth is not marked on the immersion tube, full process temperature must be available up to the screw connection of the device. On devices with long-distance line it is necessary to consider the effect of the temperature on the capillaries. Insofar as these are entirely or partly exposed to the process temperature, calibration at the factory is possible. The effect of the temperature on the long-distance line can be calculated if required.

Various types of protective tubes can be found in Chapter 8.

### 4. Installation

The load capacity of the thermometer depends on the following parameters: measurement medium, measurement medium pressure, measurement medium temperature, flow velocity, installation length, material.

Prior to installation it must be ensured that the device is suitable in terms of process connection, media compatibility, temperature resistance and measuring range. Seals must be suitable for the process connection and resistant to the measurement medium. In order to keep the measuring error through heat dissipation low, the sensor should be immersed in the medium to be measured as deep as possible.

Vibrations and pulsating measurement media can considerably influence the service life of measuring mechanisms. It is recommended to use housings with fluid damping.

Operation with long-distance line:

Securely install long-distance line with low vibration. Consider the effect of the temperature on the long-distance line. Insofar as the long-distance line is exposed to the process temperature, calibrating in the factory is possible.

Upon installation with protective tubes, the thermal conductivity resistance values of medium-protective sleeve-immersion tube must be considered for the heat flow and related measuring errors. The thermal resistance between protective tube and immersion tube can be considerably improved with thermal conductivity pastes or oils.

The devices do not generally require maintenance.

### 5. Maintenance and repair

Temperature measuring devices are generally maintenance-free.

Repairs must only be performed by the manufacturer. Before submitting a device for repair, carefully clean the parts in contact with the measurement medium, especially dangerous measurement media. A description of the measurement medium or a contamination declaration should be enclosed with the repair order.

### 6. Electrical auxiliary installations

Only trained technical personnel should be entrusted with the installation and electrical connection. Devices with electrical auxiliary installations are marked with a nameplate explaining the electrical connection.

It is imperative to take into account the load limits. Exceeding them could result in damages. It is absolutely essential to observe the national and international safety regulations (e.g. VDE 0100) during installation, commissioning and operation of the devices. Ensure that the cable diameters correspond to the nominal widths of the sealing inserts.

Securely tighten screw connections. This is required to achieve the confirmed protective systems. With versions including angular connectors, plug connectors or cable connection socket, the centrally arranged mounting screws must be tightened hand tight.

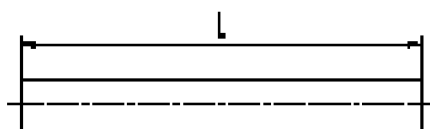
On devices with magnet snap-action contact it must be observed that the CE mark according to EMC guideline is valid only insofar as the switching frequency does not exceed 5 switching cycles per minute.

If specified, suitable disconnection amplifiers or multifunction relays must be used (e.g. for devices with inductive contact). The applicable operating regulations must be observed.

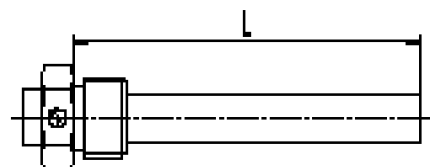
### 7. Storage

Store and transport the thermometers in dry and clean conditions preferably in the original packaging. Permissible storage temperature: -20°C.....+60°C. Avoid shocks and vibrations. Please contact the manufacturer if in doubt.

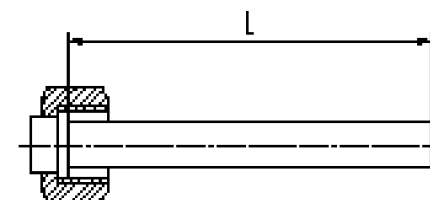
### 8. Types of protective tubes



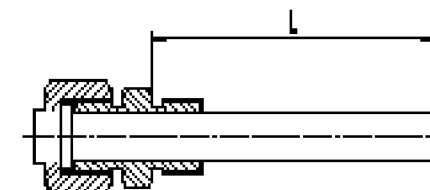
**00**  
Without thread (smooth)  
Pressure: max. 6 bar  
Ø 7mm brass, Ø 8mm steel/stainless steel  
(Ø 6, 9, 10, 13, 15mm possible)



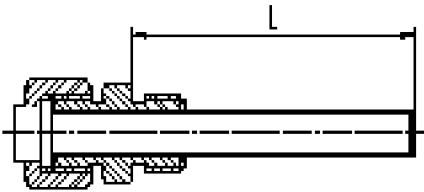
**01**  
With protective sleeve according to JAKO standard  
Pressure: brass: 16 bar; steel: 40 bar;  
stainless steel: 60 bar  
Ø 9mm: brass, 45, 63mm long  
Ø 8mm: brass, from 80 up to 400mm length,  
Lateral screw from 200mm  
Ø 10mm: steel, from 300°C / 500mm length  
Ø 10mm: stainless steel (Ø 12, 13mm possible)



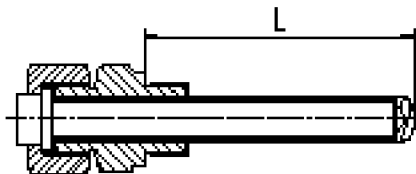
**02**  
With union nut  
Pressure: max 10 bar (steel, stainless steel)  
Ø (6), 8mm (steel, stainless steel)



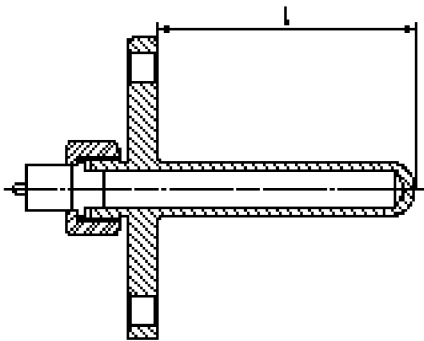
**03**  
With union nut and loose screw connection  
Pressure: max. 10 bar  
Ø (6), 8mm (steel, stainless steel)



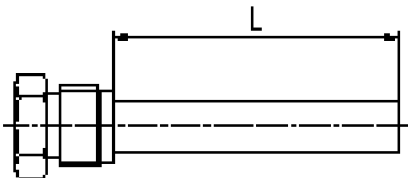
04  
With union nut and loose protective sleeve  
Pressure: max. 25 bar  
Ø 10mm (steel, stainless steel)



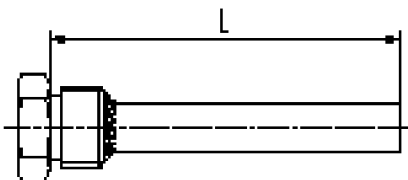
05  
With union nut and loose protective sleeve  
of solid material  
Pressure: max. 100 bar  
Ø 16mm (steel, stainless steel)



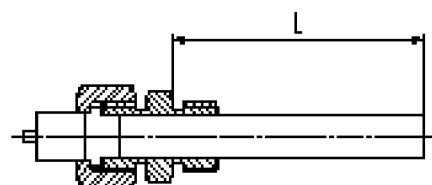
06  
With union nut and flange protective sleeve  
Pressure: max. 60 (160) bar  
Flanges: according to DIN  
Ø 13mm (steel, stainless steel)



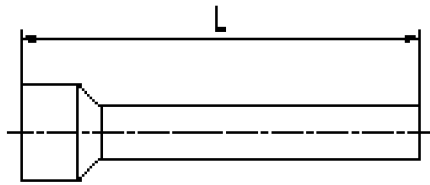
07  
With collar and loose nipple  
Pressure: max. 10 bar  
Ø (6), 8mm (steel, stainless steel)



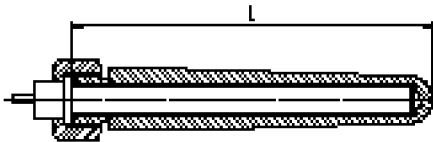
08  
With fixed thread  
Pressure: max. 10 bar  
Ø (6), 8mm (steel, stainless steel)



09  
Sliding-type clamp screw connection  
Pressure: max. 10 (16) bar  
Ø (6), 8mm (steel, stainless steel)



10  
Weld-in sleeve according to JAKO standard  
Pressure: max. 60 bar  
45mm: Ø 18mm (steel, stainless steel)  
63, 80, 100, 150, 200, 250, 300mm:  
Ø 13mm (steel, stainless steel)



11  
Weld-in sleeve according to DIN 16 179



12  
Weld-in-sleeve with neck tube  
according to DIN 43 763

## 9. Technical addition

Mercury and gas pressure thermometers generally have a different outer diameter.  
Special diameters are available on request.

Standard immersion tube lengths: 45, 63, 80, 100, 150, 200, 300, 350, 400, 450, 500, 600, 700, 800, 900, 1000mm. Special lengths are available on request.

#### 10. Error limits according to DIN EN 13 190

| Display Range<br>EN 13 190<br>°C | Measuring range<br>EN 13 190<br>°C | Deviation Class 1<br>°C | Deviation Class 2<br>°C |
|----------------------------------|------------------------------------|-------------------------|-------------------------|
| -20 to +40                       | -10 to +30                         | 1,0                     | 2,0                     |
| -20 to +60                       | -10 to +50                         | 1,0                     | 2,0                     |
| -30 to +50                       | -20 to +40                         | 1,0                     | 2,0                     |
| -40 to +40                       | -30 to +30                         | 1,0                     | 2,0                     |
| -40 to +60                       | -30 to +50                         | 1,0                     | 2,0                     |
| 0 to 60                          | 10 to 50                           | 1,0                     | 2,0                     |
| 0 to 80                          | 10 to 70                           | 1,0                     | 2,0                     |
| 0 to 100                         | 10 to 90                           | 1,0                     | 2,0                     |
| 0 to 120                         | 20 to 100                          | 2,0                     | 4,0                     |
| 0 to 160                         | 20 to 140                          | 2,0                     | 4,0                     |
| 0 to 200                         | 20 to 180                          | 2,0                     | 4,0                     |
| 0 to 250                         | 30 to 220                          | 2,5                     | 5,0                     |
| 0 to 300                         | 30 to 270                          | 5,0                     | 10,0                    |
| 0 to 350                         | 50 to 300                          | 5,0                     | 10,0                    |
| 0 to 400                         | 50 to 350                          | 5,0                     | 10,0                    |
| 0 to 500                         | 50 to 450                          | 5,0                     | 10,0                    |
| 0 to 600                         | 100 to 500                         | 10,0                    | 15,0                    |
| 0 to 700                         | 100 to 600                         | 10,0                    | 15,0                    |
| 50 to 650                        | 150 to 550                         | 10,0                    | 15,0                    |
| 100 to 700                       | 200 to 600                         | 10,0                    | 15,0                    |