

We began our temperature school in the first issue of *Pentronic News* 2017. So far we have done a historical review and looked at thermodynamics and heat transfer as well as quality assurance in calibration. The most recent lesson was on various types of temperature sensors. In this issue we begin our look at thermocouples and Pt100s, which will continue in future issues.

## LESSON 5 THERMOCOUPLES AND PT100S

### VARIOUS DESIGNS

Contact temperature sensors come in many different types. The ones most commonly used in industry are thermocouples and platinum resistance thermometers (Pt100s). These can have a similar external appearance and can therefore be difficult to distinguish from each other.

### THERMOCOUPLES

#### Thermocouple wire

In its simplest form, a thermocouple consists of a pair of wires: two insulated thermocouple wires made of differing materials with one end of each wire short-circuited together to create what is called the measuring junction. The measuring junction can be joined together by means of welding, squeezing or twisting.

What limits the thermocouple wires' use is often the insulation material. Common insulating materials are various grades of plastic or fibrous material. The temperature resistance of insulation material can range from 100 °C up to 1200 °C.



*Thermocouple wire with a plug connector. The measuring junction at the far left is unprotected.*

#### Springloaded thermocouples in armouring

Springloaded thermocouples are often used where you want to measure the temperature inside an enclosed space, such as plastic syringes, or to measure inside tools by measuring inside a hole made in the material.

The stainless steel armouring provides good protection against e.g. damage from crushing. An adapter is threaded into the hole and the springloaded sensor's bayonet cap is screwed firmly into it. The bayonet cap is adjustable by using the armouring's spiral-shaped grooves where the springloading can run. This enables the thermocouple to be continuously adapted to the depth of the measuring hole. The force of the spring-loading ensures that the sensor tip touches the bottom of the hole.



*A continuously adjustable springloaded thermocouple with a bayonet cap.*

#### Sheathed thermocouples

For industrial use, there are thermocouples with wires that are insulated with e.g. magnesium oxide, which in its turn is encased in a steel sheath. These thermocouples are usually called sheathed thermocouples.



*A sheathed thermocouple with a direct-mounted connector.*



*A sheathed thermocouple with a fixed-mounted extension cable.*

### PT100S

#### VARIOUS SENSOR DESIGNS

##### Common basic models

The most common types of platinum resistance thermometers are called the Pt100 or the Pt1000 depending on which resistor is used.

In terms of their external appearance, there are a number of basic types of resistance thermometers. Below we show various methods of encapsulation. At the top is a universal type with a fixed connection to an extension cable inside a connection housing. Alternatively, the connection housing can be replaced by a plug that fits the corresponding socket on a connection cable.

##### DIN standards

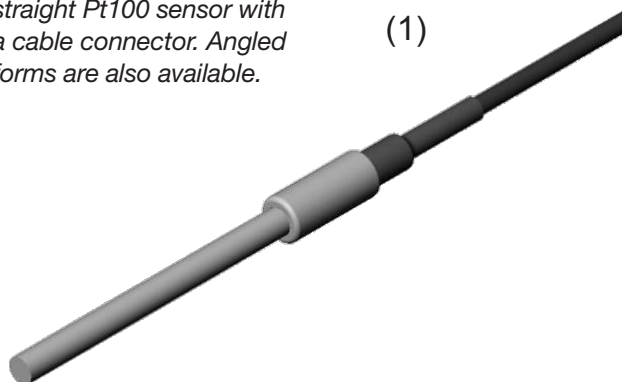
Both the following designs are standardised forms in accordance with the norms DIN 43763 form B and DIN 43772 form 4 (D) respectively for measuring through the walls of pipes, tanks and similar objects.

The outer protection, the armouring, seals completely against the process, while the measurement insert can be handled totally separately from the process medium for such purposes as replacement or calibration.

For the best results, protection tubes should normally be customised to the relevant measuring circumstances. Standardised solutions are more appropriate for classical, known applications.

(1) An example of a straight Pt100 sensor with a cable connector. Angled forms are also available.

(1)

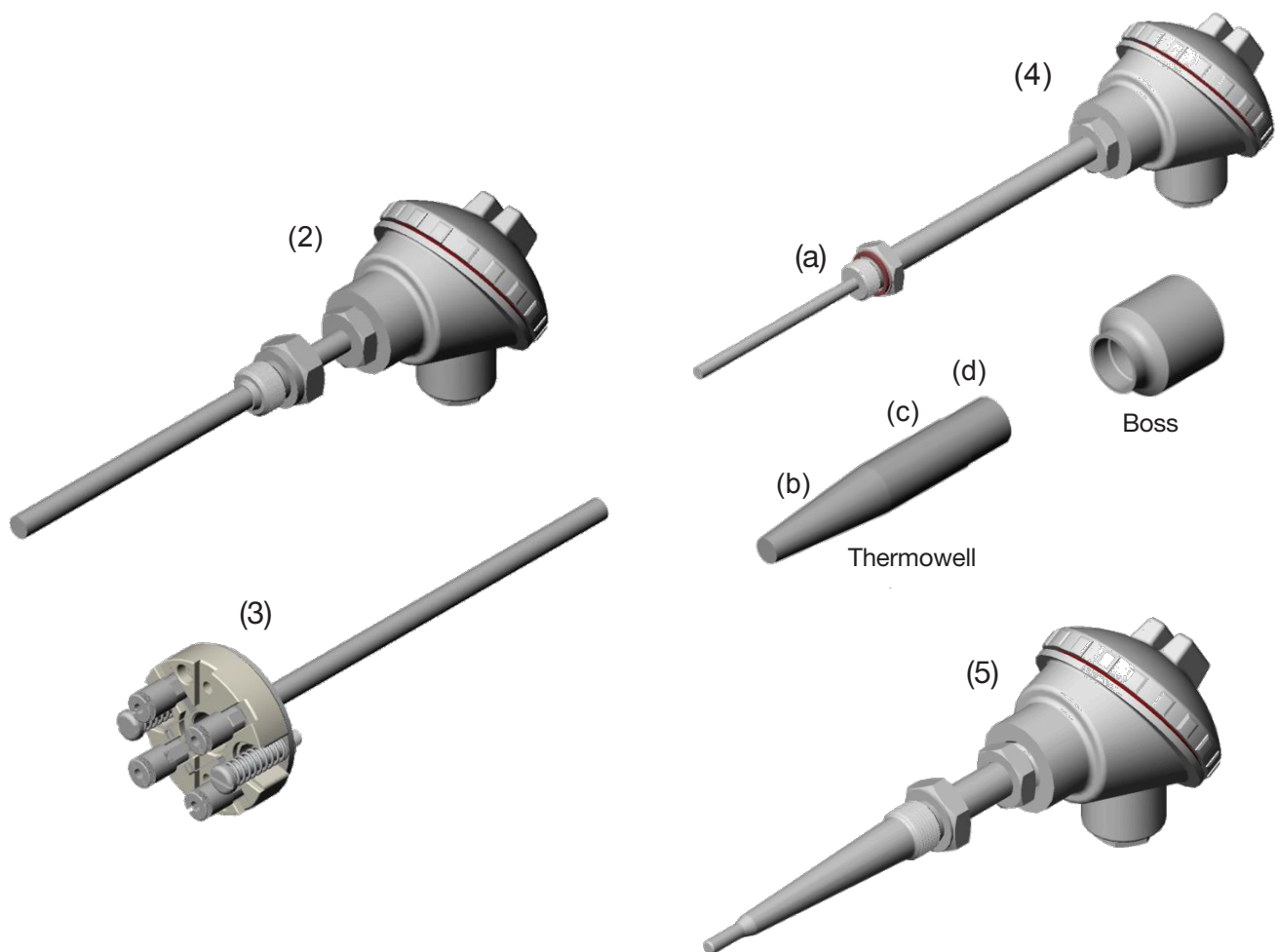


The armouring (2) and measurement insert (3) together comprise one process sensor in accordance with the old DIN 43763 form B. The armouring is threaded into the wall of a pipe or tank, and the measurement insert, the Pt100 sensor, can be handled without causing leakage. This type is usually sold in insertion depths from 100 mm upwards and is designed for low pressure and low flow velocities. The threading and neck length can also be varied.

A temperature sensor (4) in accordance with DIN 43772 form 4 (D) with an interchangeable measurement insert (a) and a fully lathed thermowell with a weld-in boss. This thermowell is primarily designed to resist high pressure and high flow velocities. Only the thermowell's conical section (b) is passed by the process flow. The

cylindrical section (c) functions as the contact surface for the weld-in boss and the narrow cylindrical section (d) has internal threading for the measurement insert while the outside is often marked with information about the material.

This temperature sensor (5) with its specially lathed thermowell can be used for taking critical readings, inter alia shorter response times. If the measuring environment allows, it is easy to construct the thermowell so that the resistor comes into closer thermal contact with the desired medium. The example shown here has a reduced amount of material at the tip combined with a thinner measurement insert.



If you would like to discover even more about temperature measurement, Pentronic offers courses in traceable temperature measurement in Västervik or at your own premises if required. For more information visit [www.pentronic.se](http://www.pentronic.se)

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