POSITION-VÄSTERVIK

The parts of a process sensor

For the uninitiated it can be hard to understand what components are required in a temperature sensor. Suppliers describe them in various ways. In this article we present the basic building blocks of a process sensor.

The introduction already mentions a difficult term – process sensor. In general this terms refers to a temperature sensor that measures within a process. A narrower definition, as depicted in Figure 1, is a sensor with a terminal head that is designed to measure temperatures in e.g. pipes and tanks.

The external part of a temperature sensor is called the housing. The housing can consist of a terminal head, a neck (tube), and a flange or a threaded plug for mounting onto a pipe or tank wall. Below the plug the housing's protection tube that comes in contact with the process provides sufficient protection against the process medium.

The sensor as a staircase

The threaded nipple can be placed at any distance between the housing's terminal head and the probe tip that is in contact with the process. The dimensions of the protection tube above and below the nipple can also be selected to suit the insertion depth into the process and the insulation's thickness. Some customers want to protect the insulating mat outside their process furnace's wall or roof by using large and robust necks that can be walked or climbed on.

Of course a temperature sensor must contain a sensor, which in the case of Pt100s must be sheathed in a measurement insert. See Figure 2. Thanks to the outer protection tube, the measurement insert can be replaced as necessary without leakage occurring in the enclosing wall of the process. No additional thermowell in the wall is required. Figure 3B shows most clearly that the measurement insert is screwed into the base of the terminal head with two springloaded screws. When these and possibly also the signal cable are disconnected from the terminal block or transmitter the measurement insert can easily be pulled out via the terminal head.

For temperatures up to max. approx. 600 °C wire-wound Pt100 sensors can be used [Ref 1].

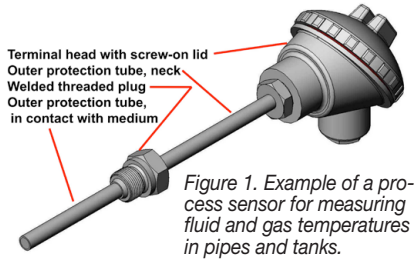


Figure 1. Example of a process sensor for measuring fluid and gas temperatures in pipes and tanks.

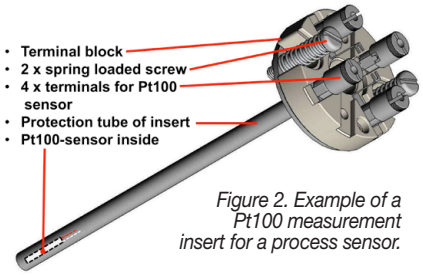


Figure 2. Example of a Pt100 measurement insert for a process sensor.

Above that, thermocouples must be used [Ref 2]. The Pt100 sensor in the measurement insert is linked by two, three or preferably four conductors to the terminal block. See Figure 3. The maximum temperature of the conductors' insulation limits the measuring range. The material PTFE can normally be used up to approx. 250 °C and metal-sheathed probes up to approx. 600 °C.

A four-wire connection is also preferable from the terminal head's terminal block to the peripheral instrumentation in order to reduce measurement error due to the cabling. See [Ref 3].

To facilitate customers' own inventory management, Pentronic supplies three options for the process sensor's signal termination, which apply to both Pt100s and thermocouples. See Figure 3. The most common termination is a terminal block (3B) or a transmitter (3C) on the measurement insert in the terminal head. There are various types of transmitters, so customers purchasing this equipment must remember to specify the measuring range and any signal bus. For customers wanting to be able to mount a transmitter or terminal block later there is the option (3A) with stripped wires.

Four-wire connection most reliable

Pentronic supplies as a standard four-wire-connected Pt100s up to the terminal block. If you do not have subsequent signal processing intended for four wires, just avoid connecting any one of the four terminals and you get a three-wire connection. To adapt to a two-wire connection, you connect in parallel the white and red wires respectively, each pair to its own terminal. The double wire area then halves the measurement error resulting from the wire resistance [Ref 3].

The process sensor's construction can worsen the heat transfer to the resistor due to the existence of an air gap (typically 0.5 – 1 mm) between the outer protection tube and the measurement insert. The powder filling around the Pt100 resistor inside the measurement insert can also cause interference. Pentronic has always equipped such sensors with metal casings with a good fit between the outer protection tube and the insert, and inside the insert to the resistor to facilitate the heat transfer. This gives a rapid response time and also more accurate readings when using short insertion lengths. See Figure 4 and [Ref 4].

The process sensor with replaceable measurement insert originally had standardised dimensions according to the German DIN standard. Many other versions have been developed to meet various needs. For example, there are sensors with no outer protection tube in contact with the process. Instead, a conical thermowell is welded onto the vessel wall that seals against processes with high pressure and high flow velocity. The measurement insert is then mounted in the thermowell with the sensor's threaded plug. See Figure 5. For examples of process sensors, see [Ref 5].

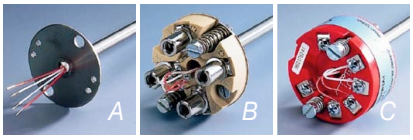


Figure 3.
A) Measurement insert with stripped wires for later mounting of a terminal block or transmitter.
B) Measurement insert with mounted terminal block.
C) Measurement insert with mounted transmitter

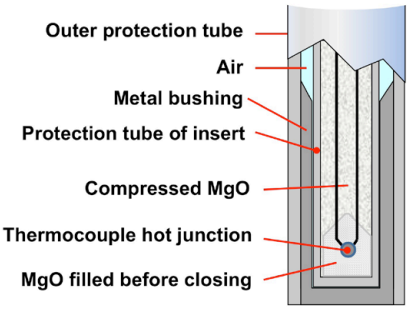
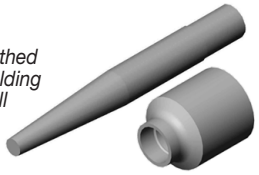


Figure 4. Probe tip on Pentronic's process sensor with a thermocouple

Figure 5. A fully lathed thermowell for welding into the vessel wall using a mounting boss



References, see www.pentronic.se > News > Pentronic News > PN Archive
[Ref 1] See PentronicNews 2013-1 p. 4.
[Ref 2] See PentronicNews 2011-3 p. 4.
[Ref 3] Link: http://goo.gl/ZyqhUK
[Ref 4] See PentronicNews 2009-5 p. 4.
[Ref 5] Link 1: http://goo.gl/ZkpqzT
Link 2: http://goo.gl/OcGwxV
Links: Use the address bar for the Short URLs.

If you have questions or comments, contact Hans Wenegård: hans.wenegard@pentronic.se