

Sensor placement and response time

QUESTION: We are planning to rebuild the control equipment in our process facility and review all our sensor installations at the same time. To measure the temperature in an existing district heating pipe, a temperature sensor has been installed in a thermowell as shown in the diagram. Is this the best place to put the temperature sensor or do we need to move it?

Kim Å

ANSWER: Unfortunately it is impossible to answer your question with a simple yes or no. The answer depends on what you want to achieve by measuring the temperature – generally in this case 90 – 110 °C. If you want to achieve a short response time when the temperature changes, you should avoid using your existing installation of the temperature sensor.

Downstream from where the pipe's diameter increases, a wake occurs that is characterised by low velocity and recirculating flow – “back-flow”. Due to the low velocity, the water in this zone slowly adapts its temperature to that of the main flow. A low velocity around the thermowell also makes the sensor react slowly. [Ref 1]. One advantage of the present installation is that it creates a minimal extra pressure drop.

If you want to achieve as short a response time as possible, you should install the sensor in section A, where the velocity is greatest. The thermowell should also have as small an outer diameter as possible. However, the pressure drop will be slightly larger than with the existing installation. The flow velocity in section B is lower than that in section A. The sensor installation

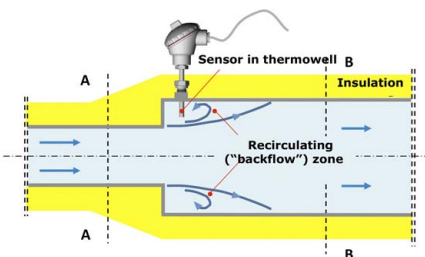
Questions should be of general interest and be about temperature measurement techniques and/or heat transfer.

QUESTIONS?
ANSWERS!

in section B therefore causes a slightly smaller pressure drop but also a slightly longer response time than the sensor installation in section A.

In many cases the pressure drop caused by the thermowell is of limited significance to the flow. How pressure drop and other disruptions caused by the thermowell affect the flow must be assessed from case to case. To determine the response time and pressure drop requires doing a measurement or a calculation. Influencing factors include the properties of the sensor, thermowell, pipe and flow. If you want to minimise the pressure drop in the pipes you must also replace the straight transition fitting between the pipes with a conical transition fitting.

The water used in the pipes that supply district heating in Sweden is very clean and normally it is not necessary to worry about the thermowell getting dirty. This is more of a problem when you work with dirty fluids. You must then be



careful when installing thermowells and other components that disrupt the flow. One example is discussed in [Ref 2].

In cases when you want to avoid using thermowells that disrupt the flow, you can consider using a sensor that lies on the outside of the pipe. The sensor should then be installed in section A where the flow velocity is greatest. The response time will be longer than for a sensor in a thermowell and the measurement error can increase. You must decide from case to case if this type of installation is an acceptable solution to the measuring problem. See [Ref 3].

References, see www.pentronic.se > News > Pentronic News > PN Archive

[Ref 1] PentronicNews 2001-1 p 4 & 2008-5 p 3

[Ref 2] PentronicNews 2008 - 1, p 4

[Ref 3] PentronicNews 2009 - 5, p 3

If you have questions or comments, contact
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