How to Measure the Temperature of Flowing Liquids in a Closed Process Using a Temperature Probe

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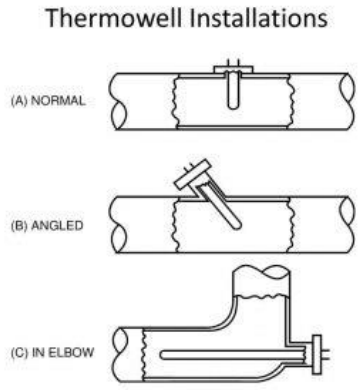
Accurately measuring the temperature of a viscous liquid can present its own set of unique challenges, but what if the liquid is flowing?

Thermowells

A thermowell is a device that allows you to measure the temperature of moving fluid **without having to shut down the entire process to insert or remove the temperature probe.** Basically, it is a metal tube closed at one end, mounted in the process stream and open at the other end, and made just larger than the temperature probe but still making contact with it for thermal conductivity. The fluid heats the thermowell which in turn transfers the temperature to the probe.

Orientation

There are 4 ways to insert a thermowell into a flowing liquid:



- Perpendicular to flow
- Diagonal to flow
- In elbow facing downstream
- In elbow facing upstream

At first glance, *perpendicular to flow* may seem like an obvious choice. However, when inserting a temperature probe or sensor into a liquid, it is vital to immerse the temperature probe to a depth equal to four times (or more) the probe (or thermowell) diameter. Depending on the diameter of your pipe, this may not be feasible. This method is also most susceptible to oscillatory turbulence as the fluid passes by the thermowell. **This process is called vortex shedding and can result in mechanical fatigue and eventually failure of the thermowell.**

Inserting diagonally to flow will allow for additional insertion length but it is prone to many of the same shortcomings as being installed perpendicularly. If you must use either method, make sure that the probe tip is just past the center of the pipe.

Using an elbow for the installation point allows you to get the maximum immersion depth from your probe. But, if the thermowell is installed facing downstream, the temperature probe end will be measuring the temperature of the fluid during or after vortex shedding has occurred, which may affect the accuracy of the measurement.

Whenever possible, a temperature probe should be installed in an elbow facing upstream. In this orientation, the fluid will be flowing mostly parallel to the temperature sensor, resulting in less vortex shedding. This configuration will also have the best time response, as the tip of the thermocouple junction is one of the first things the fluid will come into contact with.

Placement of the Temperature Probe

If you wish to measure the temperature of a fluid from a source or outlet to the process, **a good rule of thumb is to install your temperature probe 25 pipe diameters away**. This allows for adequate mixing of the fluid being measured.

Conclusion

While there are 4 main methods, the best way to measure the temperature of a flowing liquid is with a thermowell installed in an elbow facing upstream. Placement of thermowell should be at least 25 pipe diameters from the source or outlet of the process being measured, using the proper temperature probe for the job.

TEGAM offers a full variety of temperature probes and sensors for various measurement applications within industrial and research scenarios, including RTD probes, thermistor probes and thermocouple probes. Our Temperature Probe Selection Guide is a handy resource for helping you to select the style and type of temp sensor that will be just right for your application. You can also reach-out and contact TEGAM for more individual assistance as needed via phone or form – we look forward to being of assistance. Thanks for reading!