A Case For
Mechanical Temperature Control

Instrument, mechanical or project engineers may see a multitude of temperature applications cross their desks. Their immediate reaction might be to employ a temperature control loop. **But could a mechanical, self-operated temperature regulator be a better solution for the valve application?**

When approaching a temperature control application, the engineer usually considers:

- The degree of accuracy needed
- Whether the application requires feedback (are limit switches/output signals used)
- Whether the application needs to be controlled through a DCS, PLC or other type of controller
- The budget for the application

The answer to whether a mechanical temperature regulator might be a cost effective and reliable solution for the application depends on those considerations.

In almost any process facility, a variety of temperature control applications can be found. As with any controlled variable, both the accuracy and criticality of those applications can vary widely. Often, non-critical temperature applications become instrumented control loops even when a mechanical, self-operated regulator could provide the desired accuracy along with a substantial cost savings.

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What's Considered?

A typical temperature control loop requires:

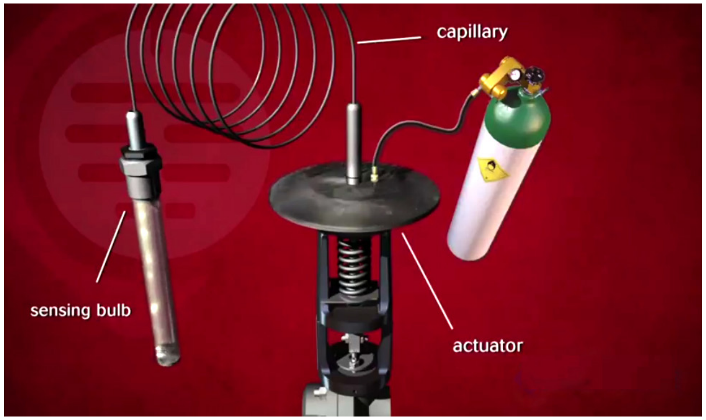
a temperature sensor
wiring and conduit
connection to a controlling device
a control valve (and sometimes a positioner and/or I/P converter, and an air filter regulator)
plant air

A self-contained temperature regulator (Figure 1) requires no power, no air or other expensive components to operate. Representative costs based on a 1" line size would be:

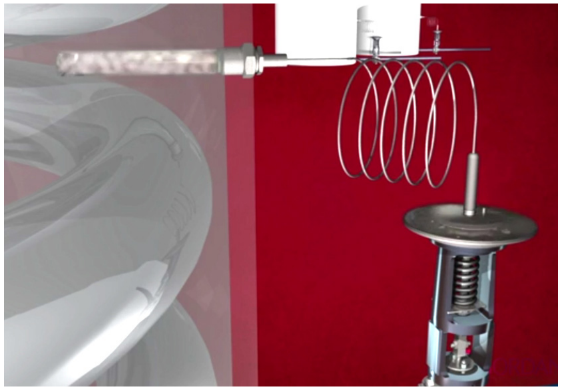
Temperature transmitter	$500 - $1,300
Temperature controller	$200 - $850
Control valve and actuator	$1,500 - $3,000
I/P converter	$200 - $600
Air set regulator	$80 - $150
Positioner	$600 - $3,000
Control loop total	**$3,800 - $8,900**
Temperature regulator	**$500 - $3,500**

Figure 1

Although designs may vary from manufacturer to manufacturer, most temperature regulators operate on the same principle. A pre-measured amount of "fill" is drawn into the thermal system filling the upper diaphragm chamber, the capillary tube and most of the bulb.



As the controlled temperature increase, the fill in the sensing bulb begins to vaporize and creates pressure on the sealed system. This pressure drives the valve stem, closing direct-acting valves or opening reverse-acting valves.



By using different fill fluids, many different temperature control ranges can be offered for both cooling and heating applications - temperature ranges are readily available from -20°F (-29°C) to 450°F (232°C).

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As could be expected, temperature regulators do not react as quickly as control loops, and these regulators will have a broader temperature band versus setpoint. To accomplish full travel, a span of 8 to 20 degrees is typical. However, when applied correctly, accuracy of 3 to 4 degrees can be expected at plus or minus the desired setpoint. It is up to specifiers to decide if such a temperature band is acceptable.

They will also need to consider whether there is a need for stem position or temperature feedback. A mechanical device typically has no output signal or position switch to give the operator field visibility.

Certain steps can be taken to maximize the accuracy of the temperature application. Considerations in regards to that issue include the temperature range of the actuator, the stroke length of the valve (a shorter stroke requires less fill fluid phase change to stroke the valve, thus improving performance), and the installed flow capacity (Cv) in the valve body.

Additionally, many manufacturers offer piloted temperature regulators that provide reduced temperature spans and, in many cases, larger line sizes for higher flow rates.

Sensing Elements

Numerous sensing bulbs are also available and can be tailored specifically to the application to increase accuracy. Finned bulbs (Figure 2), for example, offer greater surface area (and thus sensitivity to temperature changes) and typically are applied on duct applications to control heating, cooling or humidity within a structure.

"Dead zones" toward the capillary end of a bulb often are used to ensure temperature reading is in the desired area of a tank or vessel (Figure 2).

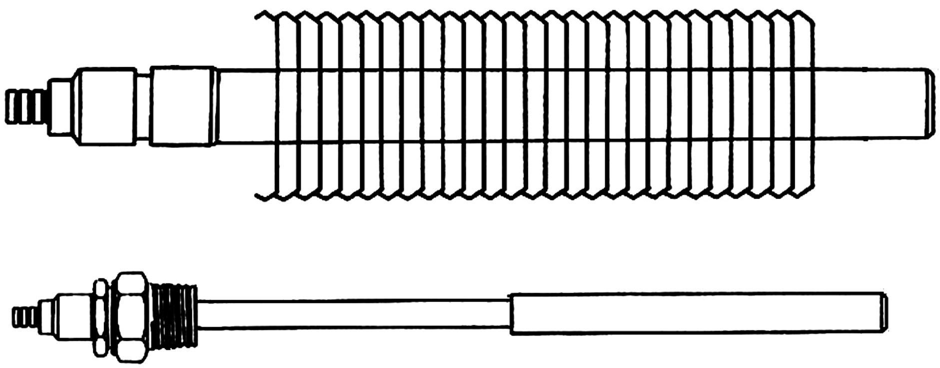

Figure 2 - Finned bulb (top) and dead zone (bottom)

Many end users will use a thermowell to facilitate installation and maintenance tasks.

Steam Tracing

Stories abound of burst water lines that occur when plants experience an early freeze. This often results from steam tracing lines not used because an operator either fails to open the necessary steam tracing valves or is not aware of a weather forecast. Fortunately, products are available that can eliminate this issue.

With steam tracing water lines, both the bulb and capillary often can be eliminated and the actuator allowed to simply measure and react to the ambient temperature. Using the example of the burst water line, an operator could set the temperature regulator for 40°F (4.5°C) will then close as the ambient temperature rises above that level so costly steam will not be allowed to flow into tracing lines when not needed.

As with any industrial product, quality and accuracy of temperature regulators varies from manufacturer to manufacturer. When selecting a valve for this purpose, considerations should be:

Is the thermal system fully sealed and replaceable
What is the manufacturer's stated accuracy
What "real world" accuracy can be expected
Is the application suitable for a commercial or industrial valve

When a temperature control failure in a control loop occurs, multiple devices may be responsible and troubleshooting involves seeking out the component causing the error.

Installation and Maintenance

Understanding the cost advantages of a self-contained temperature valve is easy - both at the component level and with installation labor costs. What's a little more complicated is troubleshooting issues. When a temperature control failure in a control loop occurs, multiple devices may be responsible and troubleshooting involves seeking out the component causing the error. If a mechanical valve is used, an operator simply checks the setpoint on the valve for accuracy. If that setpoint is correct, the thermal system is tested. Components not working correctly can be replaced. If testing proves the valve is functioning, the heating/cooling fluid supply is checked.

Conclusion

Mechanical temperature regulators can provide a cost-effective and reliable means to control temperature. When they are appropriate for an application, they also can simplify maintenance and reduce both installation and operating costs.

About the Author

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