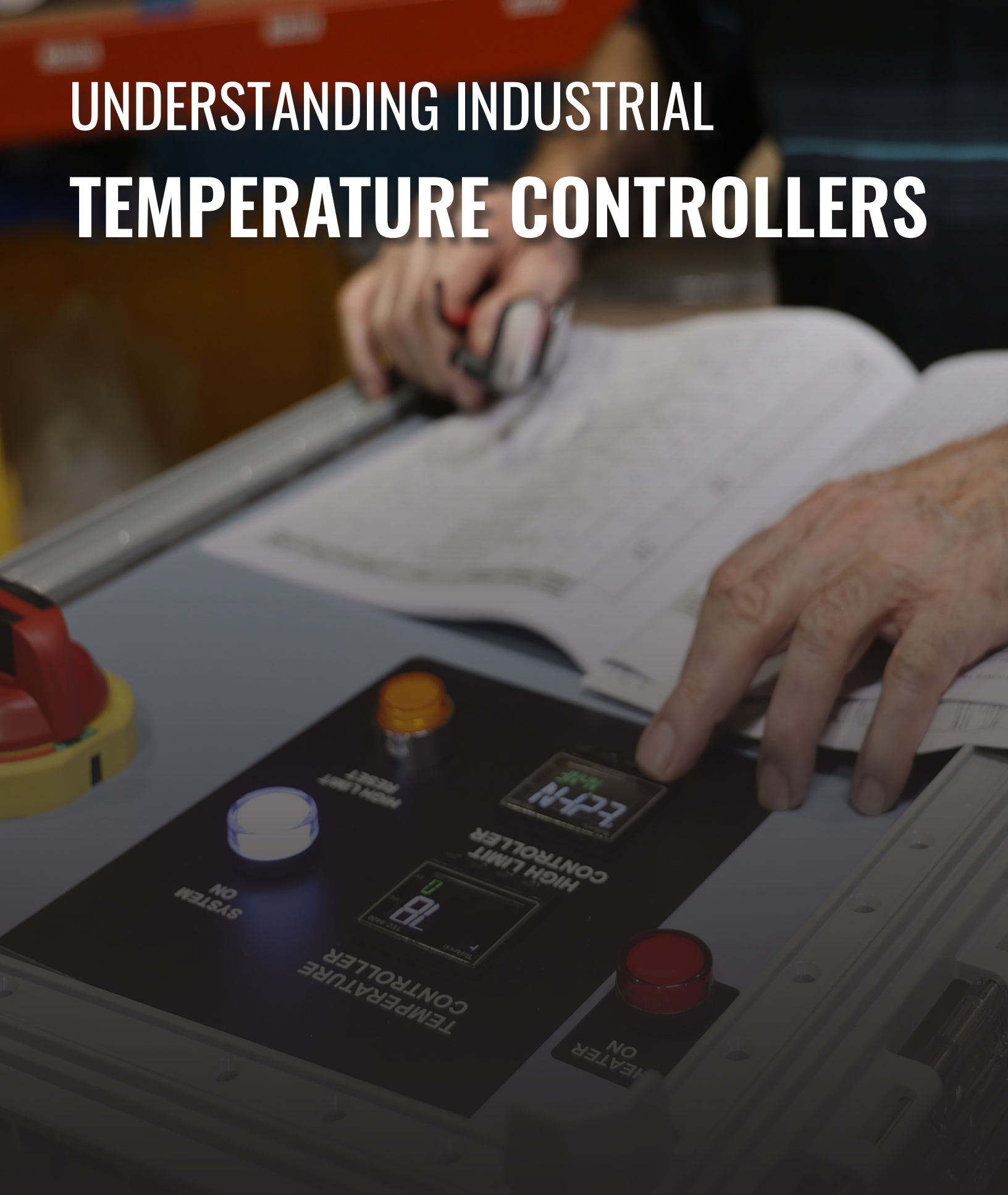
UNDERSTANDING INDUSTRIAL
TEMPERATURE CONTROLLERS



TEMPCO

Temperature controllers play an important role in modern industrial systems by automatically maintaining a desired process value. While most people associate controllers with temperature regulation, many modern controllers can also monitor and control other process variables such as flow, pressure, speed, volume, and mass.

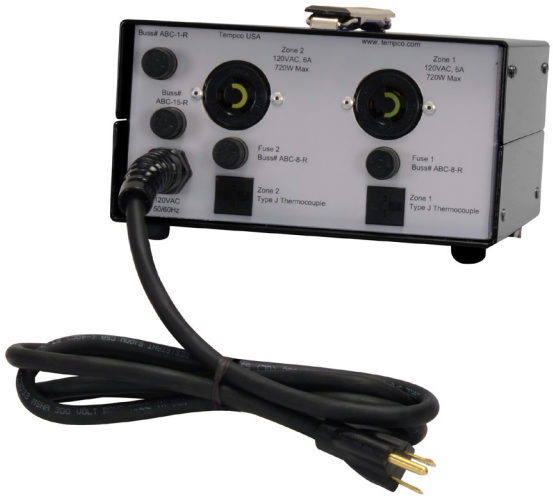
In industrial applications, a controller continuously compares a measured process value to a desired setpoint. Based on that comparison, it sends an output signal to a heating device, cooling system, motor drive, or other control component to maintain stable operating conditions. This automatic adjustment improves process consistency, product quality, and overall system efficiency.

Today, temperature and process controllers are used throughout plastics processing, packaging equipment, food service equipment, laboratory equipment, thermoformers, batch and continuous ovens, and medical equipment. Tempco's line of temperature controllers is designed to support these applications with flexible input and output configurations that can be matched to specific system requirements.

HOW TEMPERATURE CONTROLLERS WORK

Every controller requires an input signal and an output signal.

The input signal typically comes from a temperature sensor such as a thermocouple or RTD (Resistance Temperature Detector). These sensors continuously monitor process temperature and transmit that information to the controller. The controller compares the measured value to the setpoint and determines how much output is required to maintain the desired process variable.



The above image shows the back of Tempco Controle console. The inputs for temperature sensors are shown at the bottom of the console.

Although temperature is the most common application, Tempco controllers can also accept process signals from devices such as flow meters, pressure transmitters, load cells, and speed sensors. In these applications, the controller monitors a process value instead of temperature and adjusts the output accordingly.

For example, a flow control system may use a 4-20mA signal where 4mA represents 0 CFM and 20mA represents 100 CFM. Once those values are scaled into the controller, the operator can select a desired flow rate and the controller automatically adjusts the connected equipment to maintain that target value.

UNDERSTANDING CONTROLLER OUTPUTS

The type of output used depends on the equipment being controlled. Different applications require different methods of switching or regulating power.

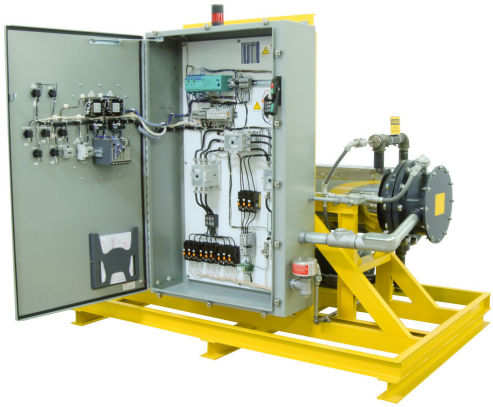
Mechanical relays and magnetic contactors are commonly used to switch power to heating and cooling devices. While often associated with simple ON/OFF control, they can also be used effectively in PID-controlled systems. These devices physically open and close electrical contacts to energize the load. Because they rely on moving components, their switching speed is slower than solid-state devices. However, in applications with significant thermal mass, such as heating steel platens or tanks of liquid, mechanical contactors can provide excellent temperature stability and long service life.

Solid state relays (SSRs) use electronic switching rather than mechanical contacts. They typically require a low-voltage DC signal from the controller and can switch much faster than mechanical devices. This makes them well suited for applications that require faster response times and more frequent cycling.

Most industrial temperature control systems operate using PID (Proportional-Integral-Derivative) control, an example being Tempco's TBC-41. In a PID system, the controller continuously evaluates the difference between the measured value and the desired setpoint, then adjusts its output accordingly. The power transfer device used depends on the application requirements.

Variable frequency drives (VFDs) are commonly used to regulate motor-driven equipment such as pumps and fans. SCR (silicon-controlled rectifier) power controllers are frequently used in electric heating applications. These devices typically accept a 4-20mA or 0-10VDC control signal and adjust output based on process demand. Unlike devices that switch fully on and off, SCRs can continuously vary power output, much like a light dimmer, allowing smooth and infinitely adjustable control.

For larger industrial heating systems, Tempco's Turnkey Process Heating Systems integrate controllers, power switching devices, alarms, and operator interfaces into a single package, simplifying installation and system operation.



An example of an all-in-one turnkey system from Tempco, integrating a temperature control panel with the larger heating system.

USING CONTROLLERS FOR PROCESS APPLICATIONS

Modern controllers are capable of much more than temperature regulation. In many industrial systems, controllers are used to regulate airflow, liquid flow, pressure, line speed, and material feed rates.

By scaling analog input signals such as 4-20mA or 0-10VDC, controllers can display process values in engineering units that are meaningful to operators. This allows a single controller platform to support a wide range of applications.

In a flow control application, for example, the controller may receive a signal from a flow transmitter and send an output signal to a VFD controlling a blower or pump. As process demand changes, the controller continuously adjusts output to maintain the desired flow rate. This same control strategy can be applied to many other industrial processes where stable, repeatable control is required.

ADDITIONAL CONTROLLER FUNCTIONS

Many controllers provide multiple outputs that support functions beyond primary process control.

One output may control heating while another controls cooling. In multi-stage systems, separate outputs can control primary and secondary heating circuits. Controllers can also activate alarms, warning lights, annunciators, conveyors, or other equipment once a process reaches the desired operating condition.

Communication features provide additional functionality. Many Tempco controllers support retransmission outputs and RS-485 communications, allowing process values to be monitored by PLCs, SCADA systems, industrial PCs, or other controllers. Tempco control consoles and engineered control panels are often configured with these capabilities to provide centralized monitoring and control.

SELECTING THE RIGHT CONTROLLER

Different applications require different controller capabilities.

For applications requiring temperature changes over time, Tempco's TEC-4500 and TEC-9500 ramp-and-soak controllers can automatically execute programmed temperature profiles. Wash-down and outdoor applications can utilize the TEC-9300 controller, which carries a NEMA 4X (IP65) rating.

Applications requiring compliance with NFPA 79 or IEC/EN 60204-1 can utilize Tempco's LCD display controller series. Systems requiring FM-approved high-limit protection can utilize models such as the TEC-460, TEC-960 and TEC-6600.

For larger systems, Tempco also offers complete power and temperature control panels that combine controllers, power components, disconnects, alarms, and operator interfaces into a centralized control package.

CONCLUSION

Industrial temperature controllers are designed to do much more than maintain an accurate temperature. With the ability to monitor and regulate a wide range of process variables, modern controllers provide the flexibility required for today's automated manufacturing and process systems.

Understanding the relationship between sensors, controllers, outputs, and power devices is essential when designing reliable process control systems. Proper controller selection improves process stability, product consistency, system efficiency, and long-term reliability.

With a broad selection of temperature controllers, process control products, engineered panels, and control consoles, Tempco Electric Heater Corporation provides solutions for a wide variety of industrial heating and automation applications.