Choosing Process Controllers and Temperature Control Power Panels for Heaters

Heater life can be extended by providing close control even in those applications that may not require it. However, the proper controls and control systems are necessary.

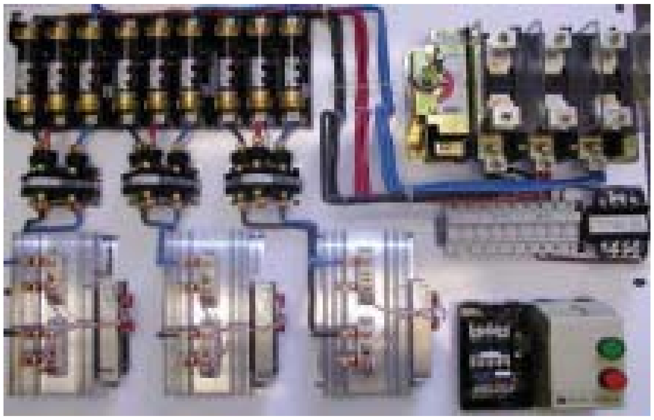
In today's sophisticated processes, tight control can be critical. Even in thoseapplications not requiring it, close control can help your process and greatly extend heater life. However, applications that do require it must have the proper type of controls. What constitutes a control system? Each control type and power-switching device has advantages and disadvantages, including accuracy, useful life, heat generation, derating, and electrical noise and heater life.

An electric heater consists of a coiled nichrome wire surrounded by compressed magnesium oxide. Long cycle times on power switching devices produce temperature changes in the nichrome wire. If the wire is constantly expanding and contracting, it eventually will break due to thermal stress. Also, most power-switching devices must be derated. As ambient temperature rises, the current carrying capabilities of power-switching devices decrease. Every process requires controls. Among those used on your line are temperature and power controls. Here's a look at a few commonly used.

Six Zone Fuzzy Logic Power Panel

NPH Temperature Control/Power Panels

Bulb and Capillary Thermostat



Inside an MDR Switched Power Panel

Temperature Control Types:

Bulb-and-Capillary Thermostats: Relatively easy to operate, a bulb-and-capillary thermostat simply requires the user to set the dial to the required temperature. As the temperature increases, fluid in the capillary expands. The fluid pushes against the bellows and turns the switch off near the desired temperature. As the fluid cools, the pressure on the bellows reduces and the switch turns on, providing a control voltage to the coil of either an electromechanical contactor or mercury-displacement relay (MDR). This is a slow process, which reduces system accuracy.

Electronic PID Temperature Controls: A PID control accepts a thermocouple or RTD input from the process and provides a control voltage to an electromechanical contactor or MDR. Some what complicated to program, most modern temperature controls have an autotune feature that enables the control to program itself to match process specifications. It also can be purchased with an AC or DC output, which provides the gate signal to turn on and off solid-state relays, or a 4 to 20 mA signal to control burstfired SCR's.

Power-Switching Devices:

Electromechanical Contactors: With this device, control voltage from the temperature control pulls in a spring-loaded coil that brings the contacts together, allowing voltage to flow to the heater. These contactors should not be cycled faster than once every 30 sec. Due to carbon build-up on the contacts and wear on the coils, they have a limited life. Accuracy is poor due to the cycle time. Electrical noise is generated on the line and heater life is short.

Mercury-Displacement Relays: MDR's operate much like an electromechanical contactor. The devices use encapsulated mercury as the contact media. They have a 5 sec cycle time for fast response and slightly better control. The enclosed coil generates heat up to approximately 23 W per three-pole contactor. Use the manufacturer's derating curves for higher than- normal ambient temperatures. Many plants do not allow mercury in their facilities, which limits MDR usage. Electrical noise is generated, but heater and relay life are longer than an electromechanical contactor.

Solid-State Relays: Competitive with MDR's, solid-state relays have a cycle time of 1 sec and provide good control accuracy. They generate heat at 1.5 W per A switched per leg. Remember to take this into consideration when usingthem in non-vented electrical enclosures. Use the manufacturer's derating curves for higher than normal ambient temperatures. Little or no electrical noise is generated and heater and relay life are long.

Burst-Fired SCR's: The cycle time for a burst-fired SCR can be as fast as 16 ms. SCR's provide tight temperature control but also generate heat. Therefore, higher current units must be fan cooled. This must be taken into account whendesigning and sizing an electrical enclosure. Little or no electrical noise is generated and heater and SCR life are long. As a general rule of thumb, if you have a non-circulating application and tight control is not required, you can use thermostats and contactors or MDR's. If, however, you have a flowing media, a PID control with solid-state relays or SCR's will be required to provide the type of control necessary for your application.

SCR-Power Theory Technical Manual.pdf

View Temperature Control Sigle Zone Power Panels

Practical Applications:

Do you know which type of control system is best under a number of different circumstances? The following examples provide practical applications and explain why certain systems are more suited for some processes than others.

Scenario 1:

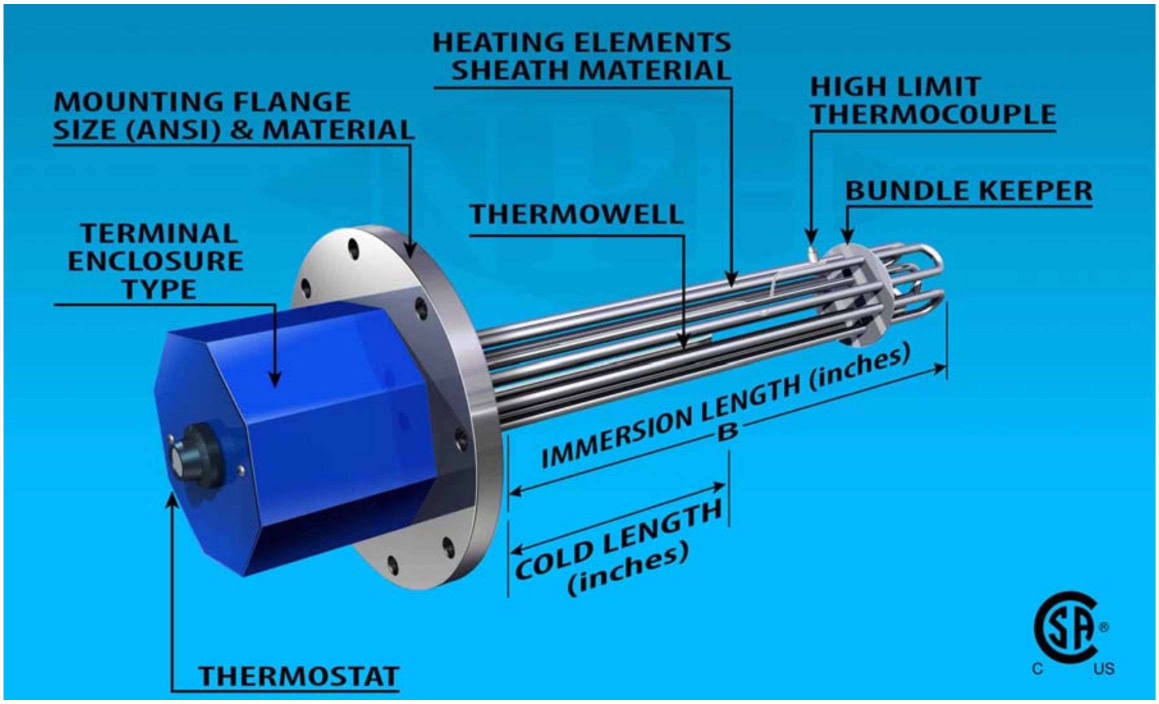
Assume you want to heat and maintain a tank of water at 180°F (82°c), ±15°F. Parts are dipped into the tank for degreasing. You think you want to use an immersion heater with controls, but should you? For this application, you can use a bulb-and-capillary thermostat with an electromechanical contactor. Tight control is not necessary, so this combination is suitable. If you want to increase the life of the power switching device, use a thermostat with an MDR. Be sure that heater is sized properly so the MDR will cycle on a regular basis. If it remains in the closed mode for an extended period of time, the enclosed coil will build up a lot of heat and raise the temperature inside your control cabinet.

Scenario 2:

Again, assume you have a tank of water you want to heat and maintain at 180°F (82°c) ± 5°F. You are cleaning filter membranes and do not want any possible contact between the heater and the membrane. Water is passing through a circulation heater at 50 gal/min. What type of control should you use? A PID control with solid-state relays will work, and this combination will provide the required accuracy. Why don't you see a PID control with an electromechanical contactor or MDR? With the contactor, 208.5 lb of water will flow through the heater between control cycles. The control system cannot possible keep up and maintain the desired accuracy. The same holds true for a MDR with almost 35 lb of water flowing through the system between cycles.

Scenario 3:

Again, you have a tank of water you want to heat and maintain at180°F (82°c) ± 2°F. You want to circulate the water at 50 gal/min through theheater, then pull water off the tank and mix it with an acid. If the water is too warm, the acid will change color and be useless. What should you use? A PID/SCR combination is the only control system fast enough to keep up with the process and maintain the required accuracy. As with any electric heater application an approved high temperature control limit is required.

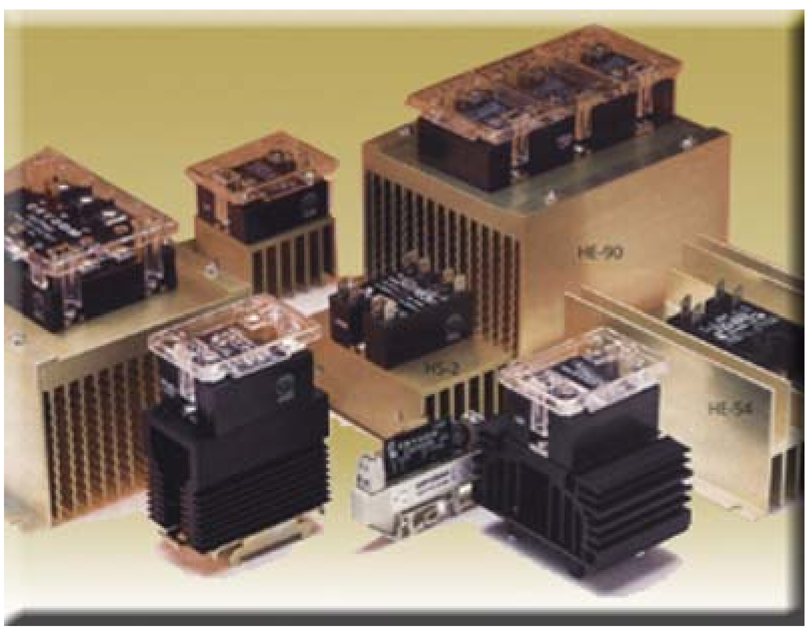


Flanged Immersion Heaters

[View Industrial Process Heaters-NPH Sensor & Control Inc]

Fuzzy Logic and PID Digital Temperature Controllers

[Guide-Fuzzy Logic & PID Temperature Controllers]



Solid State Relays (SSRs) and SCRs

[Review & Buy Solid State Relays (SSR's)]

Mercury Displacement Relays (MDRs)

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