



**Q: What are some techniques I can use to reduce overshoot at start-up in temperature control systems?**

**Answer:** Heating systems have several reasons for overshoot. Three of the most common are:

- 1) Incorrectly tuned controller
- 2) Heater too big, particularly when the process reaches setpoint.
- 3) Cycle Time too long

### **1) Incorrectly tuned controller...**

While it is difficult to totally eliminate start-up overshoot, an incorrectly tuned controller will really aggravate the problem. For many applications the controller will work out of the box. If the process is slow enough, almost anything will work. Autotuning controllers will usually tame all but the most difficult processes. CAL controllers (and some others) have an option to auto-tune at set-point. If your process temperature is near room temperature, this is often necessary. It also works well when the process has a large start-up excursion. DAC (Derivative Approach Control) reduces overshoot by watching the acceleration of the error and reducing output.

If your controller oscillates, try reducing the Integral (Reset) period by 30% and increasing the proportional band by 30%. These two items will often tame the controller. You can also try resetting the controller to a set of parameters that work for many processes.

Try these:

- Proportional Band: 5% of process temperature or 20° - whichever is greater
- Integral (Reset) Time: 5 minutes
- Derivative (Rate) Time: 30 seconds

### **2) Heater too big...**

We see this issue a lot. If a little heater works, a big heater will work better. Actually, it won't. In processes where there is a big start-up excursion, it is often necessary to use a heater that is "too big" in order to get the process to set-point, however in most processes a properly sized heater is important. It is sometimes possible to change the "Maximum Power" setting to effectively "reduce" the size of the heater.

Other than buying a new heater, you can also use the low alarm to trigger a relay to switch the heater power.

- Change the heater voltage when you get near setpoint. Going from 240 VAC to 120 VAC reduces heater wattage 75%. From 208 to 120 reduces it by 66%. The 10% transformer tap reduces heater power 19%.
- Use two heaters, and drop out one when you get near setpoint.

### **3) Cycle Time too long...**

In the olden days of contactors, it was tough to shorten the cycle time. It just ate your contactor. With solid state relays you can shorten the cycle time to below 1 second. In a low mass process, a cycle time of 1 minute is almost forever. If your process gets too cold, and then the heater kicks on and it gets too hot, your cycle time could be too long. Try making it 30% faster and see if it helps the problem. If it does, see what you can do to shorten the cycle time.

For a complete list of Applications Notes, Conversion Factors, Applications Data and Sample Configurations see [www.AdvIndSys.com/ApplicationsNotes.htm](http://www.AdvIndSys.com/ApplicationsNotes.htm)