TECHNICAL NOTE TNPC01

Manual Tune Procedures

Product(s): PID Controllers

The following defines two manual tune procedures. The first, being the less complicated of the two, offers a smaller chance of oscillation during the tune procedure. The second procedure induces system oscillation to determine optimum PI settings.

Manual tuning of fairly quick responding systems is often more acceptable than the results achieved from an auto tune of the same system.

Transducers utilized in flow rate applications, line pressure measurements, or the like, will normally detect system changes reasonably soon after the controller has made an output power adjustment to a pump's drive or a valve's motor.

Since the derivative contribution (D of the PID) to the controller's output power is based on the feedback signal's rate of change, and this rate of change can be fairly quick, often the system is driven into an unacceptable oscillation as the output power is increased and decreased quickly trying to maintain the setpoint programmed.

Lowering the derivative value to zero will remove the derivative contribution to the output power and leave only the proportional and integral power contributions for control. The manual provided with the control units describes a manual tune procedure utilizing a chart recorder if the unit has an analog output. However, the following procedures do not require the chart recorder.

PROCEDURE 1: SIMPLE MANUAL TUNE PROCEDURE WITH VERY LITTLE OR NO SYSTEM OSCILLATION DURING THE TUNE PROCEDURE.

- Lower the derivative value to 0, we will not change this value from zero after this first step.
- Lower the integral value to 0, easy second step.
- Raise the proportional value 100.0
- Increase the integral value to 100
- Slowly lower the integral value and observe the system's response.
- Since the system will be maintained around setpoint, change setpoint and verify if system corrects in an acceptable amount of time. If not acceptable or you would like a quick response, continue lowering the integral value.
- If the system begins to oscillate again, record the integral value and raise value to 100. Just like me, you got a little greedy trying to get the quickest response.

- After raising the integral value to 100, return to the proportional value and raise this value until oscillation ceases.
- Lower the proportional value back to 100.0 and then lower the integral value slowly to a value that is 10% to 20% higher than the recorded value when oscillation started. (recorded value times 1.1 or 1.2)

Change the setpoint and watch as the system tracks quickly and efficiently. If you experience an overshoot that is not desirable, consider using the setpoint ramp parameter. It is most useful at system start-up or when a large setpoint change is introduced during system operation.

PROCEDURE 2: UTILIZING THE SYSTEM OSCILLATION TO DETERMINE OPTIMUM PROPORTIONAL AND INTEGRAL VALUES. MORE COMPLEX THAN PROCEDURE 1.

During this procedure, you are going to locate the ultimate gain value utilizing the proportional value only. Then you will introduce error correction with the integral value. As you can see above, the rate of change, or derivative value, may be more of a nuisance. You will have to move back and forth between the parameters, mostly proportional and integral, with an occasional setpoint change as we manually tune the unit.

This may seem as a tedious process to complete a manual tune of a quick responding system, but surprisingly you will complete the process in a reasonably short time period with acceptably tight control results.

- Lower the derivative value to 0, we will not change this value from zero after this first step.
- Lower the integral value to 0, easy second step.
- Raise the proportional value to a high value, I often use 150.0
- Change the setpoint value to develop a difference between actual process value and setpoint value.
- Lower the proportional value slowly. You may see some correction but there will always be a difference between the process value and the setpoint value you programmed (steady state error).
- As you lower the proportional band slowly, you increase the risk of initiating a system oscillation. If oscillation becomes large and is not acceptable, record the proportional band value and then raise the band value until oscillation ceases.
- Since the proportional band has been raised to stop the system oscillation, this is a good time to raise the integral value to 100. Eventually we will use the integral value for error correction.
- Return to the proportional band and lower the value slowly until a value that is double of the earlier recorded value is reached.
- Now lower the integral value slowly and the error between setpoint value and process value will decrease.
- Since the system will be maintained around setpoint, change setpoint and verify if system corrects in an acceptable amount of time. If not acceptable or you would like a quick response, continue lowering the integral value.
- If the system begins to oscillate again, record the integral value and raise value to 100. Just like me, you got a little greedy trying to get the quickest response.
- After raising the integral value to 100, return to the proportional value and raise this value until oscillation ceases.
- Lower the proportional value to the double value used earlier in the set-up and then lower the integral value slowly to a value that is 10% to 20% higher than the recorded value when oscillation started. (recorded value times 1.1 or 1.2)

Change the setpoint and watch as the system tracks quickly and efficiently. If you experience an overshoot that is not desirable, consider using the setpoint ramp parameter. It is most useful at system start-up or when a large setpoint change is introduced during system operation.