Initial Settings For PID Controllers

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Let's say you're the lead configuration engineer on the automation portion of a green-field plant installation project, and you need to give your start-up guys a head start with a set of default PID tuning constants. You want to hand it over in a way that the board operators can place some of their basic controls in auto mode with the expectation that the loops will control fairly close to their setpoints without significant oscillation.

The following table offers some time-tested default values for gain, integral time, and derivative time that will work in most common situations as a starting point during initial unit start-up. If your control system uses other tuning constant units (e.g., reset for the integral action, then you'll have to do the conversion – I'm sure you can handle it).

A Variety of PID Controllers

PID Default Startup Values

Process Variable	K (Gain)	Ti (Integral Time, min.)	K (Gain)
Flow	0.8	0.2	0.0
Level	1.0	10.0	0.0
Pressure	2.0	0.5	0.0
Temperature	1.0	3.0	0.2

The values for flow control loops and level control loops will almost always work. In a few cases, a gain of 0.8 for a flow control loop may be too aggressive and should be reduced for nervous valves or loops that tend to oscillate.

Process temperatures are often measured indirectly by devices in thermowells, thereby introducing measurement lag due to the inherent thermal lag.

The gains for pressure and temperature loops may need to be increased, depending upon the engineering units range of the controller. If the controller has a wide range (e.g., a pressure controller with a 0-500 psig range) and tight control is required around the setpoint (let's say in this case, SP = 400 psig), then a larger gain may be required to keep the PV close to setpoint. This is because gain works on error as a percent of the engineering units range. So, a 1.0 psig deviation from setpoint is only 0.2% of range – a gain of 2.0 would result in a valve movement of only 0.4% - not much action. In this case, a gain of 5.0 or even 10.0 might be more appropriate.

Temperature is the only variable where derivative action should be applied with confidence in the default case. In general, derivative is reserved for loops with measurement lag. Flows, levels, and pressures do not normally suffer from this destabilizing characteristic. On the other hand, process temperatures are often measured indirectly by devices in thermowells, thereby introducing measurement lag due to the inherent thermal lag. Derivative action in this case can help, since its purpose is to "reverse" the control action as the PV "reverses" its trajectory and starts heading back toward setpoint after a deviation away from setpoint. A small amount of derivative in this case is recommended.

Derivative action is totally inappropriate for "noisy" process variables, as can often be the case for flow and level (and sometimes, pressure) measurements. Derivative action acting on a noisy deviation can produce wild valve swings, depending upon the values of the gain and derivative. In the case of a noisy measurement, a solution that is often suggested is to heavily filter the PV. However, this can often introduce artificial measurement lag, further degrading control loop performance.

The recommended integral time for temperature may need to be increased (less aggressive integral action) for loops with significant process dead time and lag – for example, for controlling a distillation column temperature with reflux flow or reboiler heat.

As is always the case, you'll need to use your experience and good engineering judgment on these types of projects, but this should give you a good starting point for configuration of these very important PID control algorithm parameters.

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