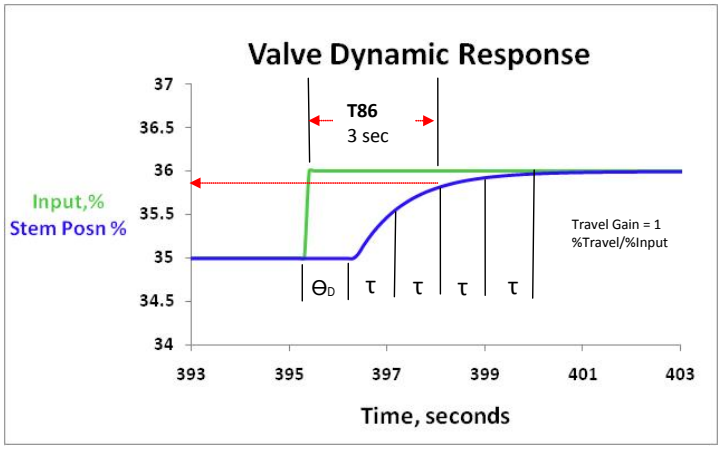
ProNamics Control Inc.

Check Out your control valves

The open loop step test is near and dear to those of us who spend time diagnosing control loop performance problems. It's a simple test. You put the loop of interest into manual mode and ask the operator to step the output signal to the valve. You measure the process response to the output step - and the valve position response if it's available.

Why is this test so important? One key reason is that it provides a good estimate of how well the control valve is following orders. In an ideal world we would like to valve to move with infinite speed and perfectly track to the control output signal. The actual world is not the ideal world though. Sometimes the valve response is too slow or has excessive deadtime. Sometimes 'valve tracking' nonlinearities like backlash and stiction compromise the positioning resolution of the valve. Sometimes the valve position controller (positioner) is flawed and causes the valve to overshoot the steady state target. These factors all degrade control loop performance by forcing us into slower tuning and/or causing continuous cycling when the loop in placed in automatic mode.



Performance Criterion	Spec.	Unit
Stroke Time	< 10	sec
Dead Time	< 0.5	sec
Time Constant	< 1.0	sec
T86	< 2.0	sec
Max Overshoot	20	% of Step Change
Stiction,%	< 0.15	%
Backlash,%	< 0.5	%

At the end of the day the control valve dynamic response and positioning resolution needs to be good enough to support the *overall* loop performance objectives. We can't live with slow valve response on a control loop that needs to respond quickly to upsets. We can't live with a control valve stiction cycle if low process variability is required. How do we make sure that valve performance is meeting the demands of the loop? A good first step is to define a valve performance specification necessary to support the loop objectives. This performance specification is used by the control valve vendors to quote the correct valve. It's used by the maintenance team to adequately repair the valve. Before a new valve is installed in the pipeline it should be step tested to ensure that it is meeting the performance specification. The valve should also be tested after the valve has been placed into operation to verify the in-situ performance.

Remember that control valve wear out degrading performance over time. A regular valve testing program should be established to ensure that the valve is up to the job.

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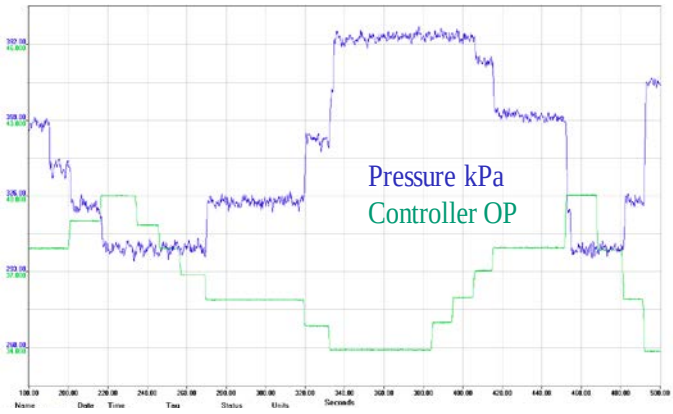
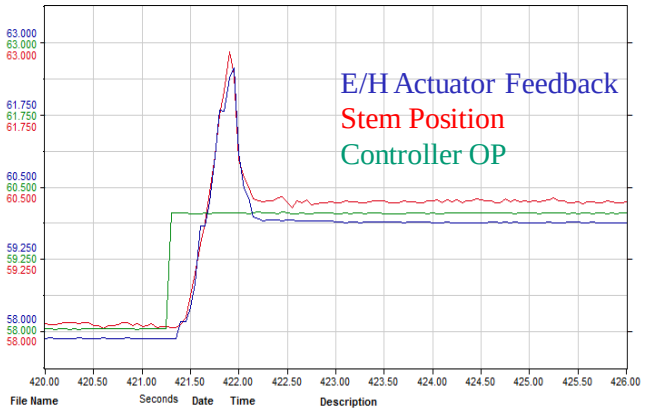
Consider the examples from some of our recent surveys where very significant valve problems were revealed by the open loop bump test. Example 1 shows a pipeline holding pressure control valve with 3% backlash. The pressure controller output needs to move by 3% on a reversal before the valve actually moves. This results in a significant delay before there is an effective response to a line disturbance.

In Example 2 the meter backpressure valve position overshoots the steady state target by approximately 100% revealing a problem with the valve position controller. Repairing the positioner eliminated the continuous cycling in Auto mode.

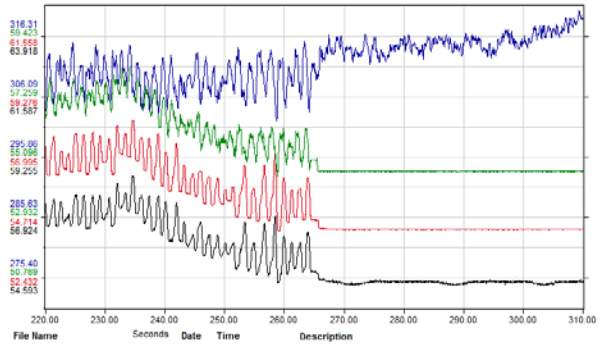


Example 1 – There is almost 3% backlash in this valve. A good backlash target is 0.5%

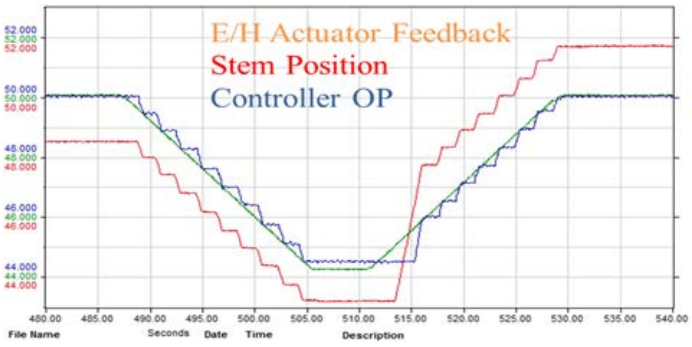


Example 2 shows a valve with almost 100% overshoot of the steady state position.

In example 3 cycling in the mainline pumping station discharge pressure loop is stopped when the pressure controller is placed into manual mode. The subsequent open loop bump tests revealed that the steady state valve movement was much higher than target change after an output reversal. The cycling was stopped after the actuator and positioner were repaired.



Example 3 – Pressure, controller output and valve position are all cycling in Auto mode. The cycling stops in manual mode



Example 3b – Open loop step tests shows excessive valve step on output reversal

It's fair to say that while control valve dynamic performance has improved substantially over the past 2 decades, valves are still a major source of poor loop performance. We need to test our key valves periodically to ensure that the good valve performance is being maintained. The open loop step test is still the best tool for evaluating valve performance.

Please give us a call or email if you'd like to discuss valve performance specifications and valve testing in more detail.

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