

# What are the main types of issues that cause control valve issues?

Control valve issues and understanding the root causes can be a very challenging task. Before we go further on control valve issues,

Troubleshooting control valve issues is essential otherwise they can severely affect control loop performance. Some control valve issues are obvious to experienced control valve technicians and can easily be detected by loop performance assessment software. Others can be more difficult to detect without running specific tests.

Five common issues associated with control valves are found at a high frequency in poorly performing control loops. They are:

1. Dead band
2. Stiction
3. Positioner Overshoot
4. Incorrect valve sizing
5. Nonlinear flow characteristics

Let's take a closer look at each of these problems.

## What is Dead band in a control valve?

A valve with dead band acts like there is some backlash between the controller output and the actual valve position. Every time the controller output changes direction, the dead band must be traversed before the valve physically starts moving. Although dead band may be caused by mechanical backlash (looseness or play in mechanical linkages), it can also be caused by excessive friction in the valve, an undersized actuator, or a defective positioner.

A control valve with dead band will cause oscillations in a level loop under PI or PID control if the controller directly drives the control valve (non-cascade). A control valve with dead band can also cause oscillations after a set point change in control loops on self-regulating processes – especially if the integral action of the controller is a little excessive.

## Symptoms & Indication of Dead Band

When the controller signals fail to detect or trigger any valve activity, these are the signs of a Dead band. In the case of a Dead band, the control valve reacts to backlash between the controller output and valve position.

Indicators of high dead band:

- Increase in errors from load disturbance
- Rise in system dead time
- Frequent fluctuating control loop
- Uneven control

## How to Fix Dead Band in a Control Valve

As the controller output changes direction, the dead band needs to be stretched across before the valve physically starts moving. In some cases, a Dead band is useful, but in most applications, the effects of a Dead band are disastrous.

For the control valve, the ideal solution is to get rid of the Dead band extensively. When you are stuck with the Dead band principal in a big valve source, an increase in PID (proportional integral derivative) gain can decrease the Integrated Absolute Error by raising the rate of change of PID, thus decreasing the decrease deadtime due to Dead band.

The practical issue faced is Dead band sometimes varies with valve position, operating conditions, and time of positioner tuning; the impact of output upon a change in direction removes the deadtime and loss of motion from the backlash.

## How to Avoid Dead Band in Control Valves

Although mechanical backlashes cause Dead band to occur due to loosening or mechanical linkage, excessive friction in the valve, a defective positioner, or a reduction in the size of the actuator can also cause Dead band to arrive.

Having isolation or on-off valve gives a great advantage when used in series along with the throttle valve. The throttle valve is placed at a more accessible position for better maintenance for some upstream and downstream runs, which require a minimum but can offer a more consistent flow relationship between the valve position.

The increased deadtime of the Dead band is not visible in open-loop step tests, but the procedure of reversing the direction of step change is reduced.

A basic algorithm can be configured to upfill the change in PID output with a slightly adjusting less amount than the Dead band where the output changes direction with a greater noise band seen in the PID output.

## Stiction

Another very common problem found in control loops is stiction. This is short for Static Friction and means that the valve internals are sticky. If a valve with stiction stops moving, it tends to stick in that position. Then additional force is required to overcome the stiction. The controller continues to change its output while the valve continues to stick in position. Additional pressure mounts in the actuator. If enough pressure builds up to overcome the static friction, the valve breaks free. The valve movement quickly absorbs the excess in pressure, and often the valve overshoots its target position.

## Symptoms & Indication of Stiction in Control Valves

If the Control valve is noticed to move more than 0.5% in each cycle, then there is a stiction problem

- There may be sticky valve internals
- Undersized actuators

- Media Viscosity
- Tight Shutoff
- The control valve will never meet the desired set point in stiction
- The valve keeps on sticking to a new position
- The controller output reverses the direction, and the whole process functions in opposite directions
- A loop cycle is caused due to stiction; the control valve output movement will be like a saw-tooth wave, while the process may look like a square wave or irregular sine wave.

## How to Fix Stiction in Control Valves

To fix the problems related to Stiction in the valve, it has to be assured that the valve actuator and positioner are sized properly to adjust the force required to move the valve.

Identifying the air pressure of the valve meets the recommended air supply by the control valve manufacturer.

Having a check of the torque on the valve packing gland.

It is also recommended to have a visual inspection of the valve's internals for signs of scaling, scarring, or wear and tear, having to replace the valve as needed. Using viscous or sticky process fluid enhances the problem of stiction, locating the valve, checking for its orientation, and evaluating whether the valve is less exposed to stickiness as high-performance butterfly valves can be a replacement option.

## How to Avoid Stiction in a Control Valve

The stiction or binding problem in valves is caused due to a few things that need to be fixed to avoid these frequent sticking of valves.

The main cause of stiction is the packing either tight or damaged; this packing needs to be replaced with a new set and tighten the flange of packing until hand tight and just a single turn with the spanner.

Inspect regularly if it is straight; any marks or rough surfaces by running your hand over the entire surface will be a good examination process. If there are areas suspected of uneven changes in the valve, clean it and smooth it with fine grinding paste and install it thoroughly.

## What is Positioner Overshoot in Control Valves?

Some positioners are tuned too aggressively for the valve they are controlling. This causes the valve to overshoot its target position after a change in controller output. Sometimes the positioner is simply defective in a way that causes overshoot. If the process controller is also tuned aggressively, the combination with positioner overshoot can cause severe oscillations in the control loop.

## Symptoms & Indication of Positioner Overshoot in Control Valves

The control valve positioners may have been stroked several times throughout usage; there may be screw repositions and weakened components such as springs and mechanical linkage. These valve positioners undergo repeated seating of the valve and liquid or gas passing through it.

Usually, valve positioners allow tighter control over the process, but a damaged positioner will overshoot without maintaining the accurate speed and not meeting the valve's setpoint. Additionally, these positioners will show reduced friction and affect the smooth performance; components experience calibration drift causing the valves and positioners to function with obligations prematurely and operate with improper regulations from gasses and liquids.

## **How to Fix Positioner Overshoot in Control Valves**

The integral time in the control valve acts as an error later, and the offset can be removed by setting a low integration period. Adjusting the integral, proportion, and derivative parameters can control the positioner overshooting. Practice increasing the integral time value in small increments until the fluctuation is noticed to eliminate the offset.

The derivative time works as decelerate in controlling the loop in some of the applications, while in other control valve applications, a slight overshoot is tolerated. In some cases, the derivative control can reduce the overshoots. Still, it can result in a lack of desired responsiveness so that the derivative time can be utilized as per the response to changes are optimized.

## **How to Avoid Positioner Overshoot in Control Valves**

Working on only one adjustment at a time is recommended; acting on all the controls may cause disorientation, and valve setting may move the positioner.

Proportional gain controls the speed of the process racing towards the setpoint; setting high gain can reach your setpoint quickly but will result in a drastic overshoot and fluctuations of the positioner. A low gain may prevent an overshoot but may take longer to achieve the setpoint.

As a safety measure to avoid any overshoot, initially set the integral time, derivative time, and proportional time at zero and then increase the proportional gain value gradually in small portions till the occurrence of oscillation, and then reduce the setting.

## **Valve Sizing**

The fourth common problem with control valves is oversized valves. Valves should be sized so that full flow is obtained at about 70%-90% of travel, depending on the valve characteristic curve and the service conditions.

In most cases, however, control valves are sized too large for the flow rates they need to control. This leads to the valve operating at small openings even at full flow conditions. A small change in valve position has a large effect on flow. This leads to poor control performance because any valve positioning errors, like stiction and dead band, are greatly amplified by the oversized valve.

## **Symptoms & Indication of Incorrect Valve Sizing in Control Valves**

Frequent opening and closing of the control valve causing it to be unstable indicates that the valve is oversized. The valve is constantly trying to meet your desired setpoint, but due to its sizing issue, it cannot precisely meet the desired flow of pressure at the setpoint.

Another symptom is water hammering, and it may occur in gas or oil applications when there is a sizing problem in control. This can cause the valve to shut violently, leading to stretch and eventually compromise on the valve stem. Water hammering over time may also stress the coupling block and valve seat to break.

The incorrectly sized valve can also lead to a high stroke count causing the valve to wear down over time much faster than it is supposed to be in normal operating conditions.

## **How to Fix Incorrect Valve Sizing in Control Valves**

Incorrect valve sizing can cause poor control performance due to valve positioning errors, such as stiction and Dead band, which are results of oversized valves. Sizing problems can also be fixed by conducting a few changes in the output by controlling it in manual mode or by managing setpoint changes in auto mode. At least two changes in process in each direction; the larger the change is, the better.

An adequate percentage of the control valve should be optimized when the pressure across the valve decreases as the flow rate increases, to be used in control loops where the process again decreases and flow increases repeatedly.

## **How to Avoid Incorrect Valve Sizing in Control Valves**

As a general rule, it is preferable always to have a minimum opening up to 20% and a maximum of 80% for keeping the safety factor on both ends. In high-rangeability applications, Mascot can extend this range from 5% - 95% opening. The flow characteristic is inaccurate if a set of tuning parameters only works towards one end of the control range and not the other.

A proper-sized full-ball valve, segment-ball control valve, and high-performing butterfly valves are often two sizes smaller than the actual line. Even the smallest changes made in the positioning of the valve can cause a significant change in inflow.

An oversized valve is extremely sensitive to operating conditions, making it difficult or even impossible for the valve to adjust exactly to the required flow.

This is where our Sizing Software can assist in ensuring you have chosen the correct valve size so that problems don't occur.

## **What is Nonlinearity in Control Valves?**

A valve with a nonlinear flow characteristic can also lead to tuning problems. A control valve's flow characteristic is the relationship between the valve position and the flow rate through the valve under normal service conditions. Ideally the flow characteristic should be linear. With a nonlinear characteristic, one can

have optimal controller response only at one operating point. The loop could become quite unstable or sluggish as the valve position moves away from this operating point.

## **Symptoms & Indication of Nonlinearity in Control Valves**

Nonlinear flow in the control valve shows signs at the first hint of trouble; this valve will start vibrating and loosen some internal parts with rising problems. There can be seen reverse flow and excessive wear and tear of components. As these valves break down due to nonlinear flow, they create noises, also known as water hammering.

This type of water hammering leads to disturbing the flow and causes disc slamming into the valve's seat. Thus, causing ruptured pipelines and severe damage. Damage in the flow characteristic also gradually causes sticking and valves' leakage as they break down.

## **How to Fix Nonlinearity in Control Valves**

The most important measures for solving control valve issues are ensuring the valves are used properly as directed; each valve must be installed and maintained correctly. Selecting the appropriate valve for its defined application helps keep the concentric butterfly valves functioning properly.

Also, replacing the valves when there are symptoms noticed for ensuring optimum operation and safety—failing to replace the valves after indications of wear and tear may lead to an ultimate system failure.

## **How to Avoid Nonlinearity in Control Valves**

Keep these valves clean as there may be contaminants and debris, leading to blockages and leaks causing valve failure and nonlinear flow; keeping the pipes clean is the easiest and effective way to save from any harm.

Installation of filters and covers can avoid debris from entering the system wherever appropriate. Regular flushing of the liquid systems and pumps also helps to keep the system clean.

Use appropriate lubrication for valves regularly for achieving enhanced performance and smooth operations. Lubricating regularly also extends the life of the valves and the system they are working.

## **What should the end-user do if a control valve fails?**

General guidelines once valve failure has occurred and been identified are as follows:

- Identify location of valve failure (seat, body, actuator, etc.).
- Take necessary troubleshooting steps to further identify root cause or to resolve while the valve is in place.
- Ensure appropriate spare parts are on hand before removing valve from service.
- Remove valve from piping (if necessary) following appropriate procedures, including air and electrical disconnection and lockout tagout.
- Follow proper disassembly and maintenance procedures to resolve issue and reassemble valve.
- Re-install valve into piping with correct air and electrical connections.

- Actuate and test valve to ensure proper function before production startup.
- Monitor valve during initial production run to ensure valve is operating correctly.

**At last**

**With us if you need any Troubleshooting for all control valves type .**

**You will find everything with us.**

**Do not hesitate to contact us**

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