The Essential Guide to Preventing Check Valve Failure

thomasnet.com/insights/guide-to-preventing-check-valve-failure

Engineering & Design

Staff Writer Aug 08, 2018

Share:

Welcome to Thomas Insights — every day, we publish the latest news and analysis to keep our readers up to date on what's happening in industry. Sign up here to get the day's top stories delivered straight to your inbox.

Almost every industry making use of piping to transport fluids relies on the use of check valves. A check valve — also called a one-way valve, non-return valve, or clack valve — only allows flow in one direction while preventing reverse flow, or flow in the opposite direction. These valves open and close based solely on the hydraulic pressure from the flow of water acting on the valve mechanism.

Check valves are often used in steam lines, condensate lines, water lines, HVAC systems, and chemical feed pumps, to name just a few common applications. These valves are critical components in many situations, as reverse flow can be very damaging to some equipment. Therefore, it's essential that the symptoms of check valve failure be detected as early as possible to prevent facility downtime and costly repairs.

Common Check Valve Problems

- **Water hammer** — Water hammer is a pressure surge or high-pressure shock wave that occurs when a fluid in motion is forced to stop or change direction suddenly. This typically happens with swing-type check valves, in which flow reversal downstream causes the valve to close abruptly, resulting in a pressure wave that propagates throughout the pipe. Water hammer can lead to pipe, fitting, and valve damage alike.
- **Reverse flow** — Reverse flow occurs when the valve permits water to flow back to the upstream side of the check valve; in other words, there is a two-way flow through the valve. This can be detrimental to equipment such as discharge pumps, in which flow back to the pump can cause the impeller to spin in the other direction, leading to pump damage.
- **Improper installation, maintenance, and assembly** — As with any mechanical equipment, improper installation, maintenance, and assembly of check valves can lead to costly, time-consuming damage and, ultimately, failure. During installation, the valve should be oriented in the proper direction for the piping system. It's also important to keep in mind that not all check valves work the same way. Consideration must be given to pipe flow capacity requirements, the location of the valve installation, and whether the valve will be installed in a horizontal or vertical position.
- **Debris in pipeline** — Debris in the piping can get lodged in the check valve, causing it to remain stuck in the open or closed position. Plus, rapidly traveling debris can affect the one-way check valve and damage the internal mechanism. This can cause pieces of the valve to break or become dislodged, causing more debris to flow in the downstream direction.

Check valve failures may also result from worn elastomers and seat seals, as well as excessively high operating temperatures.

Preventative Measures to Avoid Check Valve Failure

The key to preventing check valve failure and ensuring valve longevity is proper and regular preventative maintenance.

The first and most effective step for avoiding valve failure is keeping the pipeline and valves clean and free of debris. This can be achieved by installing filters and covers where required. Regular flushing of the piping system can also be performed to remove settled debris and minimize the buildup of contaminants.

Valve lubrication is another effective method for preventing premature valve failure. Check valves consist of several moving parts; therefore, minimizing friction between these components through lubrication can extend the life of the valve components, enhance overall performance, and ensure efficient operation.

Finally, valves must be installed correctly and used as directed. Improper valve installation, or using the wrong type of check valve, can reduce the lifespan of the valve. A regular maintenance schedule should also be implemented to ensure that faulty valves are replaced at the first sign of failure.

Selecting the Right Size of One Way Check Valve

When selecting a valve size, remember to assess the check valve based on the given application, not the size of the pipeline.

Oversizing pipes is a common practice that takes into account future capacity requirements. However, large pipe diameters produce lower flow rates, which means that there may not be enough fluid velocity to fully open the check valve. This can cause swing valves, which are sized for the pipe diameter, to flutter back and forth between the partially open and closed positions. This phenomenon is known as chattering. The frequency of movement due to chattering can eventually increase the rate of valve wear and cause components to fail, leading to further damage to other downstream equipment.

Therefore, check valves must be selected based on the expected flow. This involves choosing a valve with the appropriate valve coefficient (CV) value. The CV value describes the ability of the flow media to open the valve fully; the higher the CV, the greater the flow rates required to open the valve.

Consideration must also be given to the type of media that will be passing through the valve. For instance, corrosive or abrasive media may require the use of certain valve materials, such as carbon steel, stainless steel, or brass. Also, the properties of the fluid passing through the pipeline need to be considered to ensure that flow can occur uninterrupted. Solids, liquids, and gases all differ in viscosity, density, mass, and so on. The internal valve mechanism must allow these unique media to be accommodated.

Valve orientation is also essential for determining the right type of check valve for a given application. Some valves may not work as intended when installed for vertical flow situations. Furthermore, if the valve is deemed suitable for vertical flow, the direction (up or down) must be determined, as these conditions come with unique requirements.

Types of Check Valves

Although all check valves perform the same function, they differ in the way their internal mechanisms permit one-way flow. Each of these mechanisms lends itself to different situations; therefore, it is essential to understand the underlying mode of operation of these valves in order to determine their most suitable applications.

Some of the most common check valves include:

- **Ball** — Ball check valves consist of a ball that is pressed by a spring onto a seat in the closed position. When flow is induced on the upstream side, the ball moves and the spring is compressed. When the flow is shut off, the ball is moved back into the seat to prevent reverse flow.
- **Dual plate (double door)** — Dual plate check valves consist of two plates joined by a torsional spring in the middle. Fluid opens the check valves and builds up torsional stress in the spring. When the flow is stopped or reduced, the spring releases the energy to snap the valve shut.
- **Spring-assisted inline, nozzle, or silent** — Spring-assisted check valves are relatively new compared to other internal valve mechanisms. With this valve type, flow opens the valve by opposing the motion of an internal spring. When there is constant and sufficient flow, the valve remains fully opened, and the spring is held in compression. When the flow is removed, the spring releases the built-up potential energy to quickly snap the valve to the closed position. The valve is closed before the flow reverses, which reduces the possibility of water hammer.
- **Piston or lift** — In this type of check valve, fluid flow from upstream lifts a piston upward to open the valve and permit flow downstream. Once the pressure is removed, gravity pushes the piston back to its original closed position to prevent reverse flow.
- **Swing checks** — Swing check valves are the oldest and most common type of valves. Fluid flow swings open a disc that rotates on a hinge to open the valve. When flow is reduced, gravity and reverse flow move the valve back to the closed position.

The Importance of Proper Check Valve Selection and Upkeep

Different types of check valves — though all similar in concept — vary greatly in terms of internal valve mechanisms, opening pressures (related to CV), and construction materials. These valves' internal devices are also sensitive to debris, flow velocities, and pressure spikes. Therefore, appropriate valve selection and proper routine inspection are key for preventing premature check valve failure in any type of application.

Resources:

Image Credit: Yuthtana artkla/Shutterstock.com

.