

POTENTIAL FAILURE MODES

Even when a valve is designed with the previously discussed performance criteria and environmental factors considered, check valves may get damaged and fail to perform properly in service. It is important to be aware of certain failure modes to ensure a check valve is designed appropriately and the proper measures are in place within the system to mitigate the risk of failure. Below are some examples of potential failure modes. This is not a complete list, so all potential failure modes for a specific application must be evaluated.

CONTAMINATION / FOREIGN OBJECT DAMAGE (FOD)

The most common failure mode for a check valve is damage due to ingestion of foreign material, or simply contamination. Unfortunately, fluids can contain contaminants of various sizes and materials or those contaminants can be introduced by the system itself. This contamination can damage the valve's internal components, or may become lodged inside the valve. This may cause the valve to leak or even become stuck in either the open or closed position. In a worst-case scenario, contamination can become trapped in a place that prohibits the valve from closing, such as between the sealing surfaces, allowing fluid to unexpectedly flow in the checked direction. Adequate protection against contamination should be incorporated upstream of the check valve.

PRESSURE RISE AND DECAY RATE

As noted in the performance criteria, pressure requirements are important for valve selection. However, the minimum and maximum pressure differentials are not the only concern. The rates at which pressure increases and decreases generate additional forces on the valve due to the rate of acceleration of the moving parts. Unforeseen, extremely high rates of increasing or decreasing pressure can cause these moving parts to impact other components with forces high enough to potentially cause damage unexpectedly. This may affect decisions regarding the valve's material selection and internal design.

INSUFFICIENT FLOW

A check valve opens due to the overall differential pressure between its inlet and outlet ports, and this overall pressure differential is created by a series of pressure differentials across the valve's internal components. The valve is designed to achieve a flow rate at or before a certain differential pressure across the moving components to move them to a fully open position. If the pressure at the inlet port exceeds the valve's cracking pressure, but the valve is not supplied with sufficient flow to generate the pressure differential across the moving components to fully open the valve, the valve will be compelled to close after it has cracked open. Once closed, the pressure will again build until the cracking pressure is exceeded and the process repeats. This repeated opening and closing results in an unstable condition for the valve. This may be a problem for check valves that could result in excessive wear and damage.