

## Check Valves — A Tutorial

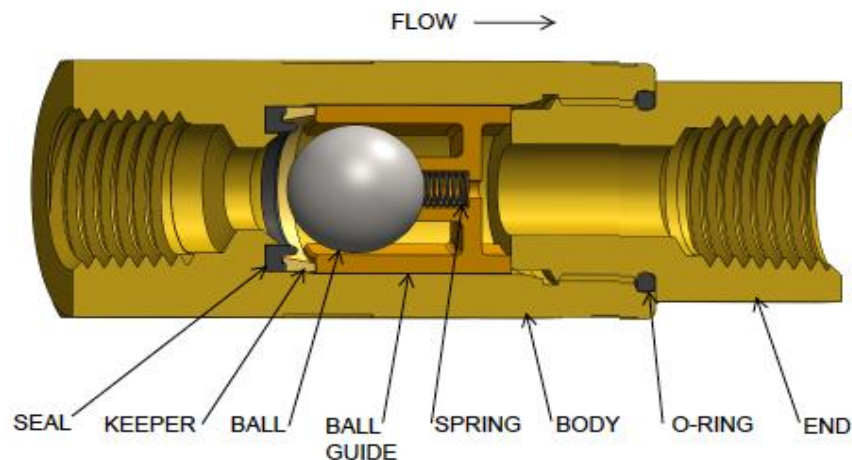
### *Exploring ideas around media flow management*

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Known also as back-flow valves, check valves ensure that media flows in one direction. There are a variety of check valve styles that perform one-directional flow, with ball, piston and poppet being very common. Check valves are frustration-free devices that can usually be used without modification, but many complex applications require check valve customization. Working with a valve manufacturer that is experienced and willing to collaborate with you is a key to successful design and manufacturing optimization.

Considerations include the media, pressure, temperature, cost constraints and the control required for a unique application. Does the seat have to be leak proof? Is a tight bubble seal needed? What material would work best? Are off-the-shelf O-rings robust enough? These are just some of the considerations for check valve selection.

### Metal Ball Valves



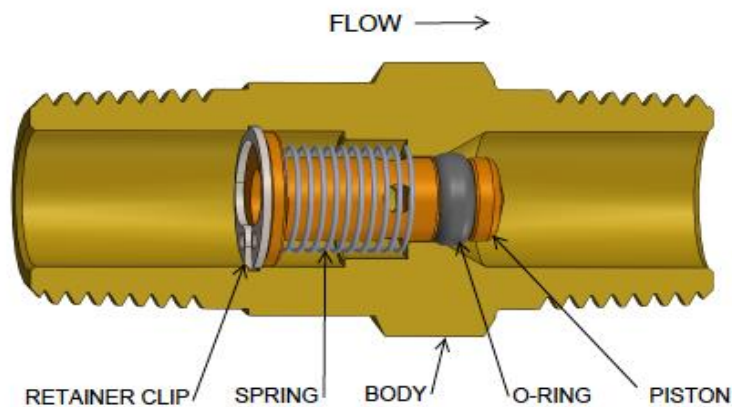
*Figure 1. Metal ball check valves are used in applications such as hydraulics and fluid power systems and chemical, fuel and beverage dispensing. Ball check valves are designed with or without an O-ring. Source: Specialty Manufacturing*

Ball check valves are one of the most common, simple and affordable check valve styles. A ball check valve features a closing mechanism in the shape of a ball to block flow. The ball is spring loaded to activate the ball's position, if designed without a spring, the design requires an inverse flow that moves the ball toward the seat to a seal. The interior surfaces of the main seats are conically tapered for the ball to fit into, forming a positive seal that stops reverse flow.

Ball check valves are often used in hydraulics and fluid power; chemical, fuel and beverage dispensing; liquid or gel minipump dispenser spigots; spray devices; rubber bulbs for pumping air; and a variety of pumps, including manual air pumps or refillable dispensing syringes. Available in metal and other materials, it is an appropriate choice for high pressure.

One application presented to Specialty Manufacturing involved an oil bath that required check valves to regulate oil pressure. The customer sought an economical valve that operated in extreme temperatures, from  $-20^{\circ}\text{C}$  to  $200^{\circ}\text{C}$ , which meant an O-ring was unsuitable. The design did not need to meet stringent pressure specifications or be completely leak-proof. In this case, a SST body, ball and spring were used to provide an economical solution.

### Piston Check Valve



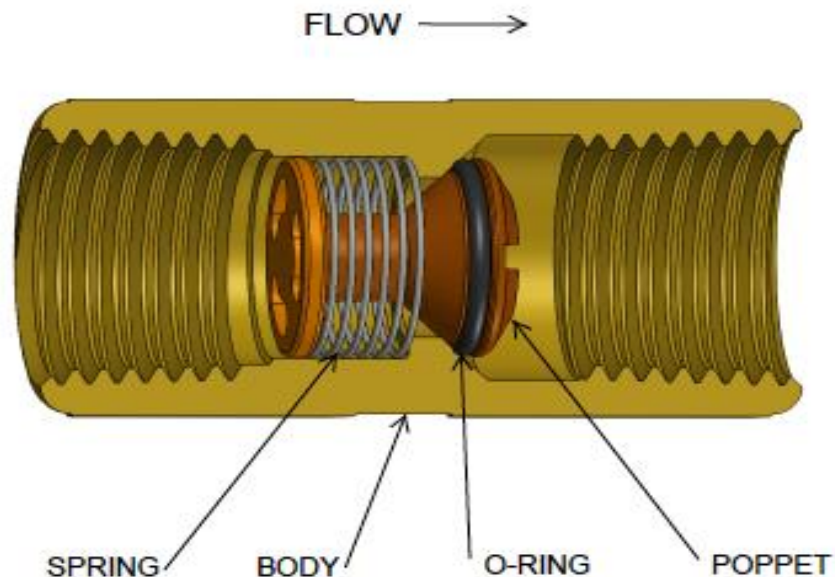
*Figure 2. Metal piston check valves are used in applications spanning fuel flow, injection cleaning and liquid dispensing. Source: Specialty Manufacturing*

The piston check valve is used in applications where seat leakage is unacceptable and they are ideal for low flow rates. Piston check valves are also highly customizable.

As the flow enters a piston check valve, the piston is raised by the pressure of the forward flow. When the flow stops or reverses, the piston seal is forced onto the valve seat by backflow and spring force.

One Specialty Manufacturing customer needed a check valve for an automotive cooling system used in emergency vehicles, with the objective of reducing energy used when the vehicle idles. The solution featured two piston check valves built within the system, which were optimized to deliver enough flow, are robust and worked within the customer's current system. This design incorporated O-ring material for the high-temperature environment and to ensure the valve had a leak proof seat. Specialty Manufacturing worked through many iterations before landing on the solution that met all of the complex requirements.

## Metal Poppet Check Valve



*Figure 3. Metal poppet check valves can be found in such applications as landfill outgassing, fire retardant foaming and carwash detergent dispensing. Source: Specialty Manufacturing*

When applications require high-flow and economical solutions, poppet check valves are often used. This valve features a poppet at the end of a stem or sleeve used as the flow-checking device.

An important consideration in check valves is cracking pressure, which is the minimum differential pressure between inlet and outlet at which the valve will operate. Fluid pushes against the poppet and spring to displace it, and creates a flow space around the seat and poppet to allow flow around the angled seat. Almost all check valves incorporate a spring, and spring force may be low or high to optimize valve performance.

A medical equipment manufacturer enlisted Specialty Manufacturing to design check valves for sensitive measurements in high-end medical equipment that required more than a dozen check valves per unit. The design needed to work with different cracking pressures throughout the piece of equipment. It was also imperative that the valve seats did not leak within the extremely sensitive equipment.

The solution was to modify an existing Specialty Manufacturing valve by installing an O-ring that would sit within the check valve and open and close with specific cracking pressures. The complex design took a number of iterations over the course of a year, and a solution evolved that allowed one check valve design to meet all specific requirements.

## Summary

It can be difficult to determine what specific type of check valve should be used for a specific application. Typically, the requirements of the valve need to be identified and analyzed. It is easy to say that an understanding of the dynamics associated with flow control and a willingness to customize will lead to an optimized solution.

Specialty Manufacturing provides both, continually using its engineering talent to innovate the right design, so it works the first time and provides a long and trouble-free service life. For more information on Specialty Manufacturing, visit the [Specialty Manufacturing check valves](#) webpage and contact the company to discuss customization for your unique application.