



White Paper

Eccentric Plug Valves

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Introduction

Wastewater systems present many challenges to pumps and valves because wastewater can contain grit, solids, and debris depending where in the process the equipment is located. First used in the 1930's in paper industry, the eccentric plug valve can handle fluids with solid content like a gate valve, but also provide some important advantages of a quarter-turn valve such as modulating service. These plug valves consist of a cast iron body and bolted removable cover.

The plug has a resilient coating for sealing against a nickel welded seat in the body. The valve shaft is typically integrally cast as part of the plug and rotates in stainless steel bearings in the bottom of the body and the cover. In Figure 2, the plug valve is actuated with a worm gear actuator, which is necessary on valves larger than 8 in.



FIGURE 1. Installation of 24 in. plug valve in a vault in Collingwood, Ontario

Eccentric Action

The most unique feature of this valve is that its seat is offset from the valve shaft thereby providing eccentric action. Figure 3 illustrates the offset centerlines of the seat and shaft. A mid-size valve may have a ½ in offset. As the valve opens counterclockwise about the shaft, the plug will lift off the seat as it rotates. The lifting action helps prevent wear in gritty wastewater service. The sealing function of the valve is assisted by the “direct pressure”, which pushes the plug tightly into the seat. The valve will also seal with pressure in the “reverse pressure” direction, but the plug will need to be turned clockwise past the center of the seat. Because of the eccentric action, the greater the closing rotation, the tighter the seal. In service, if the valve becomes worn, it can be closed further to restore a leak-tight seal.

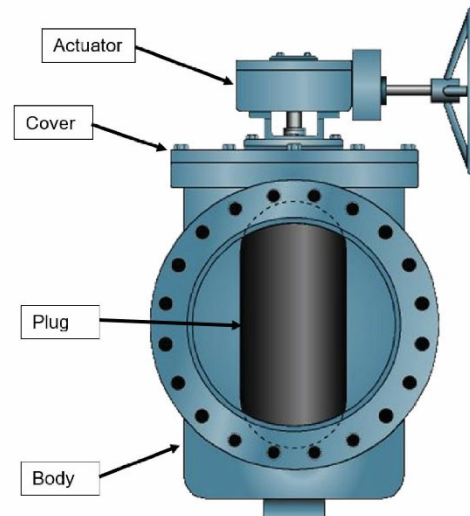


FIGURE 2. Construction of an Eccentric Plug Valve

Plug Valve Standards

The eccentric plug valve was first standardized in MSS Standard SP-108 in 1991. As the American Water Works Association expanded into wastewater applications, they published AWWA Standard C517 in 2005. Both standards are congruent with similar materials of construction and scope. Eccentric plug valves are provided in the size range of 3 in through 72 in with a CWP pressure rating of 150 or 175 psig depending on size and have a flow rating of 8 ft/sec. The valves are provided in short-body and long-body configurations. The valves are seat tested in the direct pressure direction unless otherwise specified.

Eccentric Plug Valves

Despite published standards, there are alternate plug valve designs available that comply. The most common design has a cylindrical plug face and cylindrical seat, see Figure 2. The cylindrical seat provides a relatively wide sealing surface. Alternatively, the port and plug face can be round, similar to a half ball valve. While a round port can have a less restricted flow way, it may have a thinner seating surface contact area and be subject to greater wear and misadjustment than a cylindrical seat design. Both styles, rectangular and round, can be provided with standard 80% port openings or full 100% port openings. Finally, plug valves can be provided with metal-to-metal seats for severe applications such as activated sludge service.

Plug Valve Installation

Because of the geometry of the eccentric plug valve and its use in wastewater service, special installation recommendations should be followed. As shown in Figure 4, when settling solids are expected, the valve should be installed with the shaft horizontal so that when the valve is open, the plug is at the top of the pipe. Also, the seat end should be towards the pump so that when the pump is off, the system pressure pushes the plug into the seat.

As shown in Figure 5, for vertical pipes regardless of flow direction, the valve should be installed with the seat end up so that settled solids will not collect in the valve when closed.

Figure 6 illustrates the construction of a worm gear actuator. A worm gear actuator has a segment gear and worm that converts many turns of a handwheel or nut into one-quarter turn operation of the valve. The gear also provides mechanical advantage so that large valves can be operated easily with no more than 80 pounds pull on a handwheel. The gear is equipped with external open and closed stop bolts. The closed stop positions the plug in the seat to provide smooth operation and a leak tight seal. If leakage is found in the field, the closed stop bolt can be adjusted to allow the plug to rotate further closed and provide a tighter seal. The worm gear can be equipped with a multi-turn motor to allow the valve to be operated automatically or modulated in response to a process signal.

Conclusion

The resilient-seated eccentric plug valve is a unique valve in that it is designed to handle wastewater fluids and when equipped with rubber or glass lining, can handle abrasive fluids. Because it is a quarter-turn valve, it is easily automated for controlling process flow or pressure.

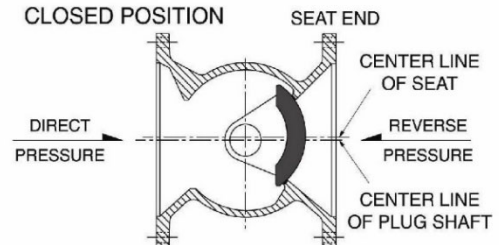


FIGURE 3. Eccentric Plug Valve Geometry

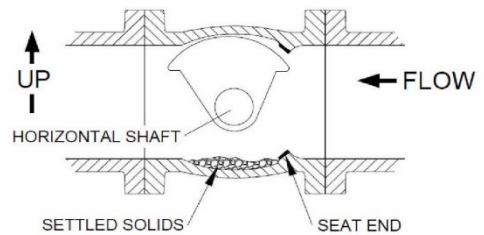


FIGURE 4. Horizontal Installation Guidelines

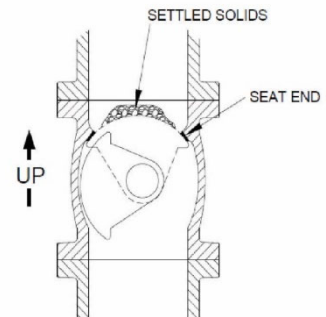


FIGURE 5. Vertical Installation Guidelines

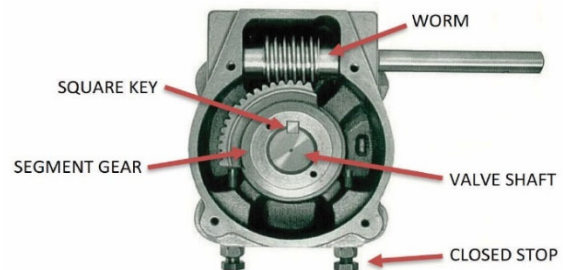


FIGURE 6. Plug Valve Worm Gear Actuator

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