Flowserve – Anchor Darling
Isolation Valve Application

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Problem

Small Y-pattern globe valves installed in isolation service have one of the highest failure rates of any equipment in fossil power plants. It is not uncommon for maintenance personnel to have to replace these valves as frequently as every six months.

Solution

Flowserve Anchor/Darling Valves has developed a more cost-effective solution. Our double-disc gate valves installed in high-temperature isolation service have remained tight for as long as eight years.

Background

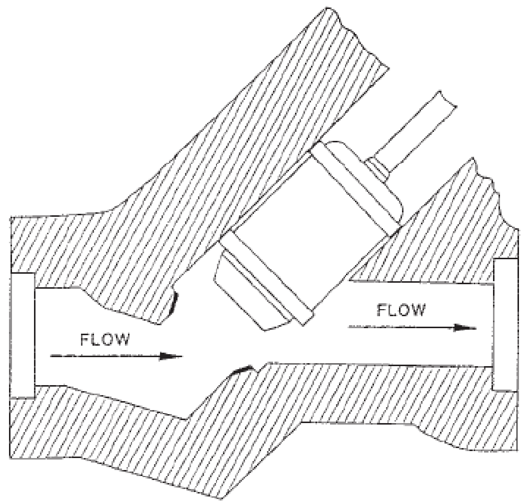
To keep pace with continually increasing demands for power in the last decade, dramatic changes were made in both the size and operating conditions of fossil electrical generating stations.

Unfortunately, as feedwater and steam temperature/pressure conditions increased, so did the incidence of system equipment failure. Many standard, commercial components which were designed for earlier plants have been unable to withstand the currently normal conditions of steam up to 1000°F and 3600 psi.

Why They Fail

Globe valves installed in the correct orientation (i.e., with pressure under the seal), (Figure 1) seal as a result of a force from the handwheel (or actuator) acting through the stem that pushes the disc against the seat. This force must be sufficient to counteract the force from the differential pressure that tries to push the disc off the seat. In addition, the stem force must provide an additional load to create the seal (Figure 2).

Figure 1 – Globe Valve Throttling Service



With a sufficiently rugged stem and topworks, and at lower temperatures (e.g., on the feedwater/condensate side of the plant), these valves rarely pose a problem. It is when these valves are exposed to higher temperatures that problems start to occur.

Isolation valves on the steam side of the plant are generally installed some distance from the main line and subsequent to closure become part of a dead leg. Deprived of flow, they experience a significant drop temperature. As the valves cool, their internal parts contract. The stem, under compression when the valve was closed at the elevated temperature, begins to relax as it is cooled. With the force pushing the disc into the seat either reduced or eliminated by virtue of the stem shrinking, the seating force is no longer present and the valves begin to leak.

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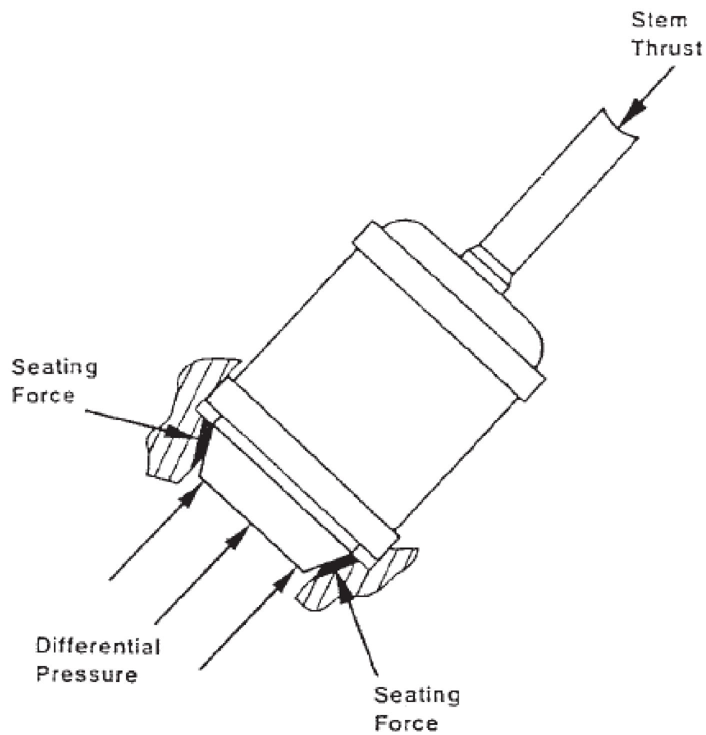
Figure 2 – Stem Thrust vs. Differential Pressure Plus Seating Force



A small leak which may be harmless at lower operating temperatures and pressures becomes a wiredraw at supercritical conditions and quickly erodes large portions of the seat area. The loss of up to 10 percent of a plant's total capacity due to eroded valve seats is not infrequent. But, initial equipment failure and subsequent capacity loss, measured now in energy dollars, is only the beginning of the cost spiral.

Installing globe valves with the flow over the seat eliminates the problem of thrust relaxation, but results in a flow turbulence which erodes discs, seats, and the internal contours of the valve. Over-the-seat flow also exposes packing to system pressure, which leads to more leaks and possible packing blowout.

Many plants have found that having operators re-close these valves several hours after the turbine was synchronized, significantly improved valve sealing ability. They also found this to be a very labor-intensive solution to the problem.

Completely replacing defective valves could also reduce capacity losses, again temporarily. But, that procedure is not only costly in terms of replacement and man-hours, but it also requires a shutdown of essential plant capacity to accomplish.

Replacement of seats or entire valves tends to be a stop-gap measure rather than a solution to the problem.

Conclusion

Since the double-disc gate valve uses differential pressure to achieve the disc-to-seat seal, stem force is not a factor in maintaining leak-tightness. Thus, while our valve's internals experience the same contraction when closed that a globe valve does, the contraction does not affect its ability to provide leak-free isolation.

In addition, the double-disc gate valve (unlike wedge-type gate valves, Figure 3), cannot become stuck in the closed position after the valve has cooled. Its unique disc pack, comprised of two free-floating parallel discs with a collapsible wedging mechanism between them, will move freely out of the seat regardless of the thermal transients it has been subjected to or the force that was used to close it (Figure 4).

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Figure 3 – Wedge Gate Valve

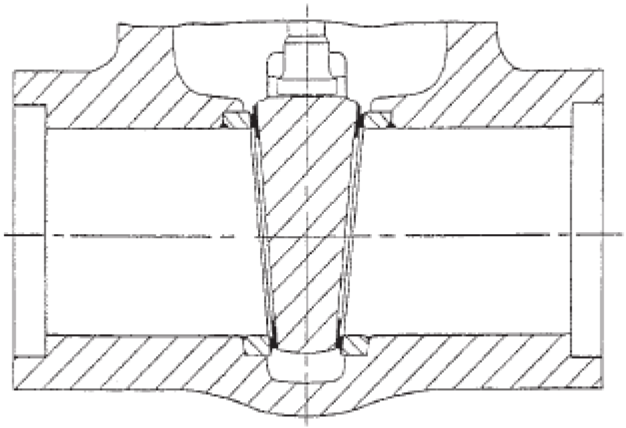
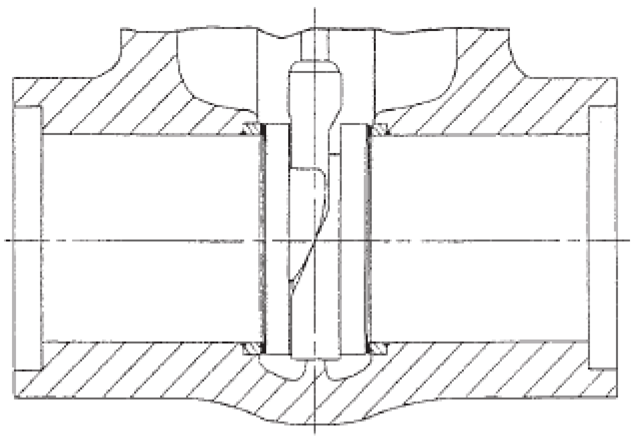


Figure 4 – Double-Disc Parallel-Seat Gate Valve



The Payback

Installation of Anchor/Darling double-disc parallel-seat gates does require a somewhat higher initial capital investment than Y-globes. But the reduction in maintenance costs, reduced capacity losses, and an extended service life make the parallel seat gate valve far more cost-effective.

A number of plant operators indicate a full recovery of the entire cost of retrofitting with Anchor/Darling double-disc parallel-seat gate valves in as little as one year.

The examples listed below, although limited, are representative of areas where valves are subjected to these conditions:

Chemical-Petrochemical
Divergency
Feed and Regeneration
Stack Blow-Down
Process Blocking

Fossil-Energy
Reheat
Main Steam
Feedwater
Turbine Vent and Drain

Petroleum
Manifold Gathering
Main Line Gathering
Water Flood

Nuclear-Energy
Main Steam
Feedwater

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