INTEGRAL SEAT DESIGN

OVERVIEW

As the premier manufacturer of zero-leakage, metal sealed, severe service, valve solutions; ValvTechnologies understands the intricacies of designing product which can perform in harsh environments while providing absolute shutoff internally and externally. The technology at the core of how we achieve such superior performance is our integral seat. There are several advantages to the integral seat of the ValvTechnologies V Series valve which not only eliminate through leakage but external leakage as well.

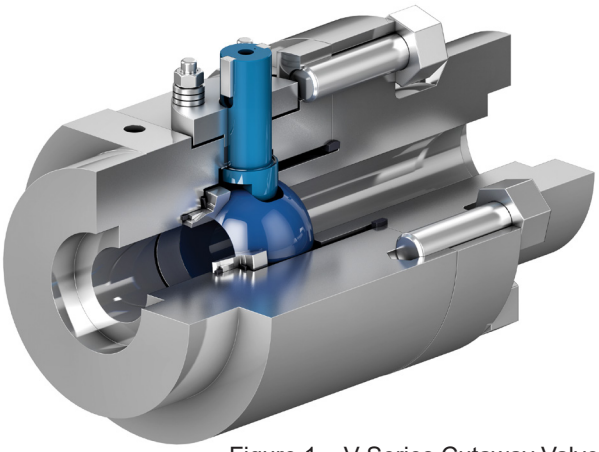

Figure 1 – V Series Cutaway Valve

THE CORE CONCEPT

The core concept of the V Series valve is the integral seat. The integral seat makes possi- ble many of the benefits present in the V Series which could not be accomplished with valves utilizing inserted seats.

- No secondary leak path or place for debris to get trapped
- Constant contact between ball and seat
- Constant contact during thermal expansion
- Stem stays on center during rotation

NO SECONDARY LEAK PATH

Most ball valves used an inserted seat design where the seat is made of a material (typically different from the body) and inserted into a ma chined cavity in the body. The idea of using this type of seat is to make maintenance easer. The irony is that the use of inserted seats is the root of why maintenance is often necessary. This is due to the inability to lap the seat pockets and the use of soft materials which break down.

The issue of secondary leak paths is especially prevalent in severe service metal seated valves. In metal seated valves, it is possible to achieve a good lap between the seat and ball surfaces creating a consistent mated surfaces. The ability to lap a bored pocket area inside of the valve cavity is very difficult. One of the most common methods of achieving a seal on the back side of an inserted seat is to use flexible graphite (Grafoil®). Since it breaks down each time it flexes, thermal and pressure cycling of the valve (i.e., open/close) will cause the seal on the seat back to break down and a leak around the seat. Once a leak forms across the seat back it is not possible to stop the leak without bringing the system down for maintenance.

Notice Figure 4 highlighting the secondary leak path. Note that once a leak begins, if it is not maintained immediately, erosion from high pressure will cause body damage in an insert- ed seat design. This would result in the need to replace the damaged body or endcap.

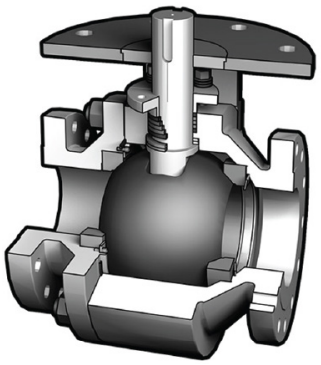

Figure 2 – Inserted Seat Design (competitor)

Figure 3 – Integral Seat Design (V Series)

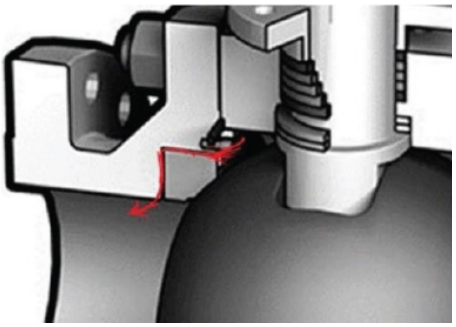

Figure 4 – Inserted Seat Leak Path

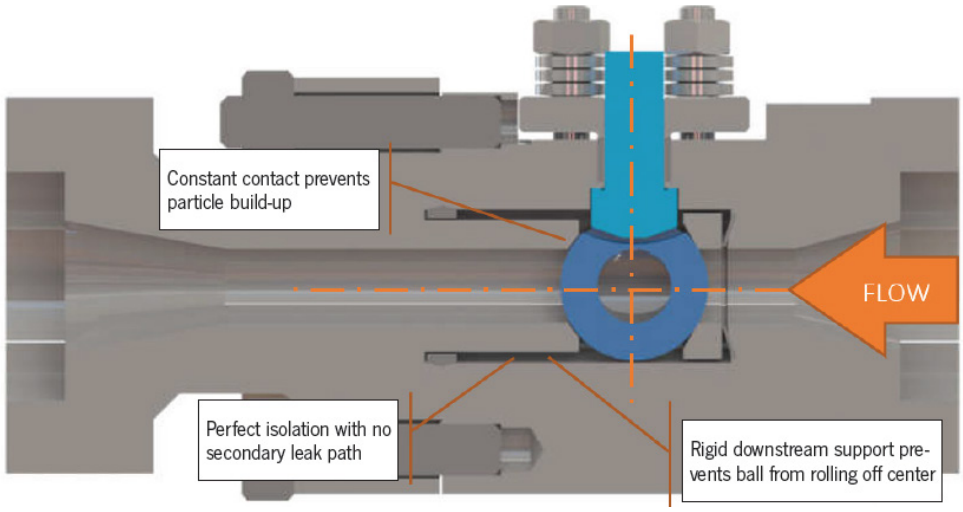

Figure 5 – The Integral Seated V-series valve

CONSTANT CONTACT BETWEEN THE BALL AND SEAT

The design of the Integral seat in the ValvTech- nologies' V Series ball valve promotes constant contact of the ball and downstream seat. The high compression load of a Belleville® washer behind the upstream seat provides a large positive force to maintain ball and integral seat contact loading even in low pressure situations. Low pressure situations are common during maintenance operations and reactor isolation. If there is not an effective low-pressure seal, excessive leakage will occur during restart causing valve and possibly system damage. The rigid integral design of the isolation seating face allows it to outperform inserted seat designs in applications where the flowing media solidifies when it stops moving. As media at- tempts to solidify, it is unable to buildup behind the seat and cause valve binding and lock-up.

THERMAL EXPANSION

One of the most difficult concepts to under- stand about the benefits of the integral seat de- sign is its ability to maintain seal during thermal expansion and why an inserted seat design has inherent issues with thermal expansion.

The first aspect to understand is the concept of the coefficient of thermal expansion of various materials. As temperature increases, different materials expand at different rates. This is typically not a major issue for anything operating at less than 225°C but plays a major role in inserted seat failure at higher temperatures.

The ball of a V Series valve is designed to have a similar coefficient of thermal expansion as the integral seat. This is observed in Figure 6 where the ball and seat are not growing at a similar rate and develop a reduced sealing area. Uneven thermal growth causes mismatched surfaces with high stress and galling of the materials eventually leading to valve failure. In the V Series valve, the coefficient of thermal expansion of the ball is matched with that of the seating surface to ensure constant contact and seal longevity.

At high temperatures, it is common to use 347H for the body of a valve and Inconel 718 (I718) as the ball and seat. This leads to premature valve failure. An example is displayed in Table 1 where we show the radius mismatch created by using I718 for the ball and seats instead of the more suitable Grade 660 Stainless Steel. Using I718 would cause a mismatched radius at temperature of 0.25 mm.

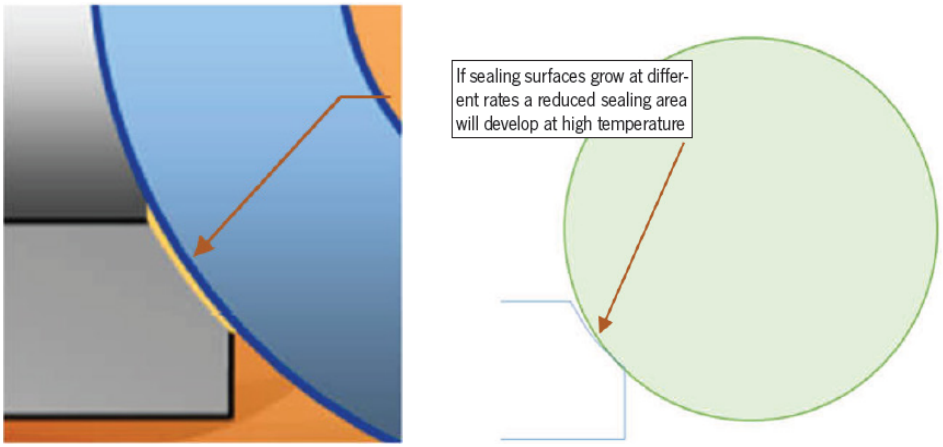

Figure 6 – Uneven thermal growth

Thermal Growth Comparison		
Material	Coefficient of Thermal Expansion (CTE µm/m-˚C)	Growth of 6.00 inch (0.1524 m) circle at 400˚C
Body and Endcap SA-182 F347H	18.9	1.094 mm
Ball of I718 SB-637 N07718	13.0	0.752 mm
ValvTechnologies Recommended Ball Material SA-638 660	18.5	1.071 mm

Table 1 - Thermal Growth Comparison

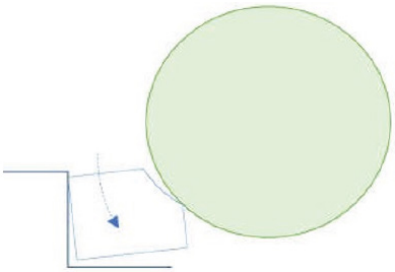

Figure 8 – Uneven Seat Expansion

Another issue common with inserted seats at high temperature is the uneven growth during thermal expansion. As depicted in Figure 8, the inserted seat warps as it grows, creating a leak path behind it and a poor contact band to the ball. This condition will cause damage to the body as well as the ball and seat when failure occurs.

STEM MAINTAINS CENTERLINE

There are two primary categories of ball valves; trunnion mounted and floating. Each type of valve has its advantages, depending on the type of application. The primary benefit of the floating ball valve is that the pressure from the process fluid forces the ball into the downstream seat. As pressure increases, so too does the force generated to effect a seal. This happens because the ball is allowed to “float” in the closed position. While this allows it to maintain contact downstream in many cases, it drives the stem offcenter as it rotates back to open. This causes stem seal failure and leaks to atmosphere.

A significant advantage of integral seat supported design is that it maintains the stem centerline throughout its rotation. This gives the benefits of a trunnion mounted valve, that is, pressure from the process fluid increases the force generated to effect a seal. This allows the seat supported design to provide long-term zero-leakage performance both internally and externally.

CONCLUSION

As shown, the ValvTechnologies’ seat supported V Series valve design provides exceptional benefits over the traditional floating ball valve design with inserted seats. While the traditional valve design may work in many areas, any time there is severe service conditions such as high pressure, high temperature, or abrasive and solidifying media, the V Series valve with its integral seat has revolutionized expectations of what can be accomplished with a ball valve.

Although the floating ball valve design with inserted seats has been around for hundreds of years, it was time for improvement through product innovation. This is where ValvTechnologies stepped in.

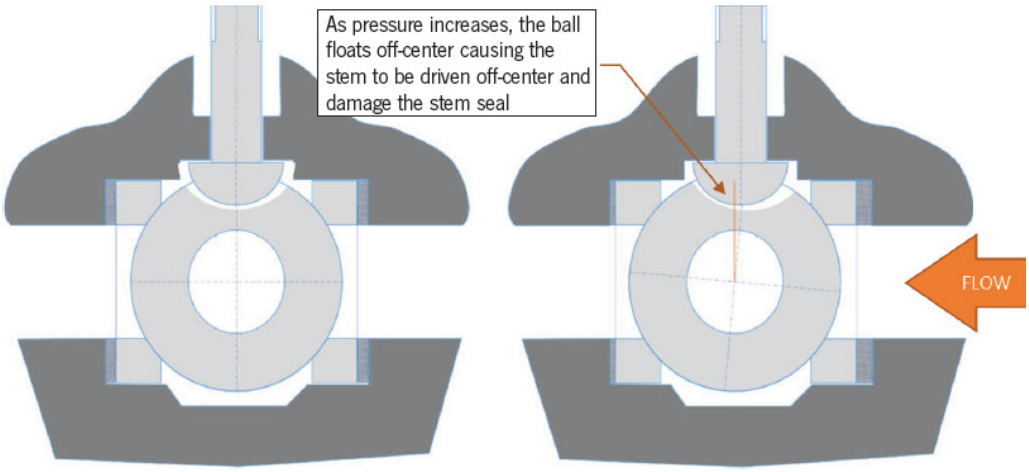

Figure 9 – The Floating Ball Valve with Inserted Seats

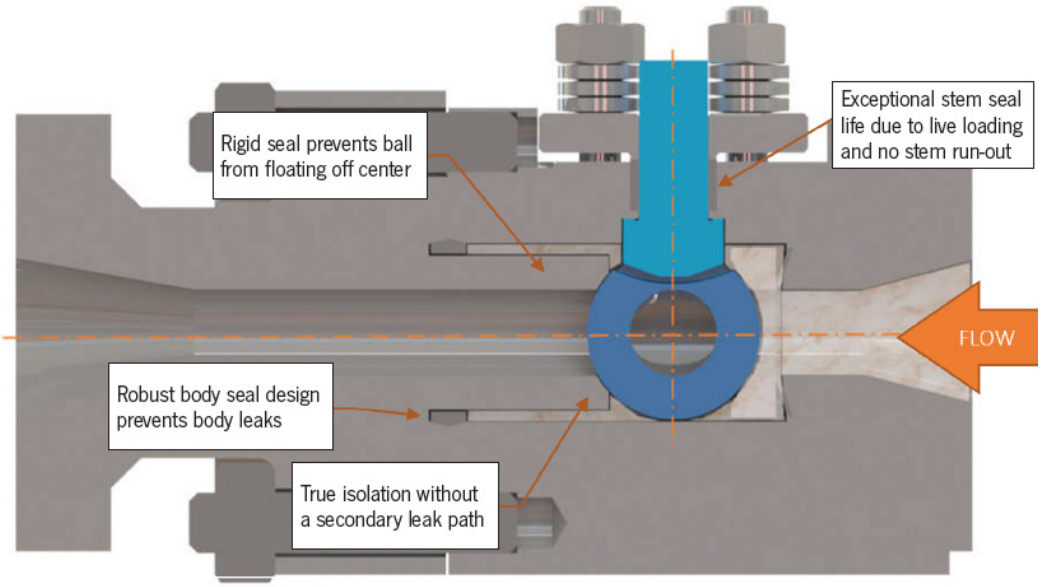

Figure 10 – The V Series Seat Supported Ball Valve