# Why use Floating Ball Valves for Severe Service?

**Marvin E. Beasley, PE**

President, Virgo-EVS Valves Division

### *What is Severe Service?*

As processes become more demanding, service conditions require special valve considerations. Typically pressures above 100 barg and temperatures above 350$^0$C fit this definition. When the flow media is abrasive such as sand, catalyst or slurries this also constitutes a severe service application.

### *Examples of Severe Services:*

All industries have severe conditions. In a refinery, coker units, fluid catalyst crackers (FCCU) and upgraders have temperatures and abrasives which are considered to be tough conditions. The chemical processing industry has similar requirements where combinations of pressure, temperature and particles make it necessary to use special valves on units such as ethylene crackers and plastic manufacturing.

Power plants have high pressure steam and water that require severe service valves. For coal fired plants, there are additional requirements in the coal handling areas. Fluidized bed combustors and coal gasification units are typical of the services which have these valve requirements.

Natural resource production has many severe service valve applications. These vary from pipeline slurry transport to autoclaves used for high pressure acid leaching. In addition, some refinery operations such as direct reduced iron are considered severe.

### *What Valve Design can accommodate these Services?*

The valve of choice for these typical severe service applications is a metal-to-metal seated ball valve with special coatings on the seating areas. A valve design that has proven it can perform in these applications is shown in Fig. 1.

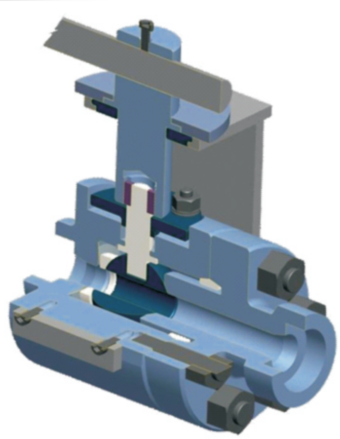

***Figure 1: Floating Metal Seated Ball Valve***

The key features of this valve that allow it to handle a variety of severe conditions are:

- An integral seat in the primary sealing direction which eliminates one leak path and the associated cavity
- Premium Hard-Surfacing processes used on the ball and seats. These are typically carbide coatings applied by the HVOF process.
- Blow-out proof stem
- Large spring load holding the ball into the seat for continual wiping action with every cycle so particles do not get between the ball and seat
- Grafoil® packing and gland arrangement that prevent fugitive emissions
- Metal body gasket which is self and

pressure energized

- Full flow area with seats protected from the flow in the open position
- Quarter turn automation with side mounting pad
- Fewer parts for less failures
- Minimal cavity area that can be easily flushed if required
- Ball that rotates in its own geometry and does not displace volume
- Bidirectional sealing available

***Why is this valve better than other designs?***

Gate valves, plug valves and trunnion mounted ball valves are candidates for these severe service applications. Each has built in design features which make them inferior to the floating metal seated ball valve described above.

With gate valves, problems are related to the gate-to-seat configuration. The gate displaces volume in the valve cavity and is not in contact with the seat under the full open-close cycle. This makes it problematic for use in particulate service. In addition, flow through the valve goes over the seats leading to possible erosion of the seats. Temperature effects could also allow stem expansion to unseat the valve.

Lubricated plug valves require only a quarter turn rotary motion to operate. However, they do require a lubricant/ sealant in the cavity between the plug and seat for ease of operation. This imposes temperature limits on the valve. In addition, when particles are present, they interfere with the lubricant making the valve difficult to operate.

Some other types of plug valves require a lift-rotate motion to operate. This also creates actuation issues since such motion is very complicated. Also, the lifting action means the plug and seats are not in contact so that upon closing particles could become trapped which could cause leakage. Such motion also renders the packing subject to particulate on the stem being pulled into the packing area.

Metal seated trunnion ball valves appear to offer advantages over the floating design in sizes above 2". They have lower torque and can be used for bi-directional sealing. A typical design is shown in Figure 2 below. However, these advantages must be weighed against the disadvantages such as:

- More parts which increases the potential for failure
- Non metal seals between the seat and body
- More cavities for particulates to pack into
- Higher cost due to more parts even when torques are reduced
- Thermal expansion of multiple components

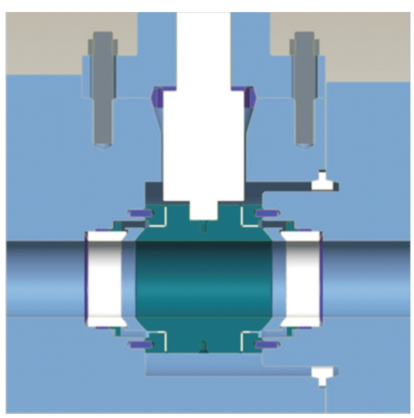

***Figure 2: Typical Metal Seated Trunnion Ball Valve***

***Summary***

The conditions that cause any application to be categorized as severe must be analyzed. If it is temperature, then material compatibility and ability to handle thermal expansion are important. If it is particulate matter then keeping material from getting between the seat and ball or gate or plug is critical. For higher pressures, structural integrity and ruggedness are major issues. In all cases, the metal seated floating ball valve can provide the solution.

Project engineers should consider such conditions during the plant design phase. When total cost of ownership, which includes initial cost plus in-service operation and maintenance costs, is considered, the metal seated severe service floating ball valve is the correct valve for these applications.

## Marvin Beasley

Marvin Beasley is currently President and Technical Director of Virgo Engineers, Inc.-EVS Valves Division located in Stafford, Texas. He is a Registered Professional Engineer (electrical and mechanical) in Texas and holds several valve patents. In addition, he has published numerous technical articles related to valves, and currently serves on Piping & Valves API standards writing committee. He is active in community volunteer work including mentoring and instructing students in the Capstone Design Course at the University of Houston Mechanical Engineering Department. He also served in the US Navy as a nuclear submarine officer. He is married with two children and 7 grandchildren, and has completed over 20 marathons.