The Case for Rising Stem Ball Valves

Rising stem ball valves (RSBV) were created to address the needs for tight sealing and the resistance to abrasive particles over a wide temperature range. The range of applications is expanding but so is the competition. 

By Robert McIlvaine – The McIlvaine Company

Applications for Rising Stem Ball Valves

Rising stem ball valves originated to solve tough problems with molecular sieve switching in the gas industry. They are established as the default choice for this application. Metal seated ball valve and triple offset butterfly valve suppliers are also pursuing this market. At the same time RSBV suppliers are moving in to other markets, some of which are listed in Table 1.

Hot Oil Applications: Rising stem ball valves are one of the types used with heat transfer fluids. A wide range of materials are suitable for use with Eastman Therminal heat transfer fluids. Carbon, low-alloy and stainless steels, copper and copper alloys, and aluminum alloys are all suitable. However, copper is rarely used in the rising stem design. While Class 150 flanges meet the pressure-temperature requirements for almost all Therminal fluid applications, the use of Class 300 flanges is recommended when the operating temperature exceeds 360°F (180°C) and when the operating temperature range exceeds a differential of 300°F (170°C). Eastman specifications for rising stem ball valves are:

- Carbon Steel Class 150 and 300
- Bolted bonnet
- Stainless steel seat
- Flexible graphite packing

Hydrogen: Over 30 million tons of hydrogen are produced annually. A big new application is direct liquefaction. Coal slurries are hydrogenated as the first step to making gasoline. China has a successful commercial plant. Hydrogen is an essential element used in the production of many chemicals. Experience has shown that some traditional ball valves require repair due to the abrasive nature of powdered additives or hydrogen production by-products such as carbon black dust. Additives and dust can coat the sealing surfaces of valves and fill cavities in the body, which contribute to valve leakage and inoperability. The long-distance transmission of gas in pipelines can also produce grit and scale that can further cause wear on the valve sealing surfaces. Damage and leakage to the isolation valves prevent effective isolation of production systems and lengthen planned outages. The abrasive resistant characteristics of rising stem ball valves make them an attractive alternative.

Sour Gas Service: Rising stem ball valves are available to comply with NACE standards for H2S service. Cameron introduced an enhanced NACE trim two years ago. MR0175 is a federally mandated standard in the United States and is globally recognized as ISO 15156. MR0175/ISO 15156 address requirements and recommendations for selection and qualification of materials for H2S service in oil and natural gas production. MR0175 addresses all forms of cracking caused by H2S and applies to equipment using conventional elastic design criteria. The standard addresses requirements and recommendations for the selection and qualification of carbon and low-alloy steels, corrosion-resistant alloys, and other alloys for service in equipment used in oil and natural gas production and natural gas treatment plants in H2S-containing environments. The sour gas composition includes metal- and seal coated ball valves with tungsten carbide coating on ball and seats.

Molecular Sieve Switching: Cameron cites the following needs for molecular sieve switching:

- The valve must seal tightly. If it is not possible to obtain tight shutoff, the leaky valve allows wet gas to enter the drying tower during the regeneration cycle. This leakage lengthens the regeneration cycle, wastes precious energy, and will not allow the desiccant to be fully regenerated, resulting in increased operating costs.
- The valve must also withstand high regeneration temperatures. Taking into consideration temperatures typically found in regeneration cycles and considering temporary excursions above typical regeneration temperatures, the switching valve should be designed for a maximum of 800 degrees F (426 degrees C).

- The valves must be capable of withstanding the frequent cycling that is characteristic of dehydration cycles. For example, if a system is on eight hour cycles, a valve could cycle three times per day, 7 days per week, and 365 days per year. If planned maintenance of the system is every five years and this maintenance includes rebuilding of the beds and repair of the switching valves, the valve could see 5600 cycles between repairs. Not many valve types can withstand this many cycles in a hot, dry, and sometimes hostile environment.

Cameron contends that the rising stem ball valve provides tight shut-off, withstands frequent cycling, and handles high temperatures better than other valve types in this service. Other valve types do not have an equal track record in molecular sieve dehydration service because no other valve provides the tight seat and friction free operation in the same manner as a rising stem ball valve (no rubbing between sealing surfaces). Suppliers say rising stem ball valves have longer lives than typical gate, plug, globe, or other ball valves.

Sizes

For molecular sieve switching the sizes typically range from 2” to 18”, but bigger sizes are possible in large gas dryers. Valves are typically required to have fail to close failure action. Pressure requirements are 150-1500.

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**Table 1**

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<thead>
<tr>
<th>Industry</th>
<th>Application</th>
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<tr>
<td>Gas Processing</td>
<td>Molecular Sieve Switching</td>
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<tr>
<td>Gas Processing</td>
<td>Other Dehydration</td>
</tr>
<tr>
<td>LNG</td>
<td>Cryogenic</td>
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<tr>
<td>Petrochemical</td>
<td>Hydrogen Service</td>
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<tr>
<td>Petrochemical</td>
<td>Hot Oil</td>
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<tr>
<td>General Oil/Gas/Petrochemical</td>
<td>Emergency Shut Down</td>
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<td>Heat Transfer Fluids</td>
<td>Hot Oil</td>
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<tr>
<td>Combined Heat and Power</td>
<td>Steam</td>
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<tr>
<td>Sour Gas</td>
<td>H2S</td>
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<tr>
<td>Tilt Oil</td>
<td>Produced Water</td>
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<tr>
<td>Gas Transmission</td>
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<td>Offshore</td>
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**Image courtesy of Flowserve.**
Its time-tested service record has proven that the RSBV, a metal seated, mechanically energized metal seat butterfly valve, continues to be the purposefully engineered rising stem ball valve (RSBV) that is ideal for pneumatic actuation. This mechanism is fully enclosed within the valve body, thus offering full protection against environmental influences and reducing the need for lubrication. Other suppliers also offer the fully enclosed mechanism.

Most suppliers offer a range of materials. Nanao Valve offers duplex stainless, high nickel alloys and carbon steel construction. A range of external protective coatings are also available for corrosive environments.

Competitors are upgrading materials. ValveTechnologies chrome carbide metal seated ball valves are offered for LNG applications. The coating is applied with an HVOF (high velocity oxygen fuel) coating process. Chrome carbide is melted and applied to the ball and seat of the valve. The resulting hardness is between 66-69 Rc (Rockwell C), which compares to stainless steel at 18 Rc, Stellite at 42 Rc, and diamond at 92 Rc.

### Pricing

How do RSBVs compare to globe, gate, and trunnion ball valves in price?

A 4-inch rising stem ball valve installed in an LNG application a decade ago cost $9,000 and required $5,000 in repairs every 18 months. It was replaced with a metal seated ball valve at more than twice the price but with much less repair cost and downtime.

### Actuators

Most rising stem ball valves are actuated. The cost of the actuator can equal or exceed the valve price. Because the design incorporates linear movement, it is ideal for pneumatic actuation. This ensures quick opening and closing.

### Competition

Metal seated ball valves and triple offset butterfly valves are being improved to resist abrasion and seal tighter. The market is rapidly evolving. Ross Waters of CGIS points to a number of advancements in the design of metal seated ball valves. On the other hand, the RSBVs are also making advances. Cameron is focused on improving performance and longevity. So, a comparison made last year may not be applicable this year.

One user reports switching to triple offset butterfly valves for larger applications in order to reduce cost and weight. He also switched to metal seated ball valves for smaller applications. Metso supplies trunnion mounted ball valves for smaller applications and triple offset ball valves for larger applications. Metal-seated, triple offset butterfly valves share some of the same drawbacks, including the lack of a top-entry bonnet and the inability to easily inspect or adjust the stem/gland packing arrangement, plus the following:

- Their body style reduces flow volume and is further restricted by the disc which is constantly present in the flow path.
- The disc reduces the open flow area, resulting in low Kv (Cv) values.
- There is slight seat contact while opening or closing, which may result in leakage.
- Its spring-loaded or laminated seat design prevents an increase of external sealing force.

For most molecular sieve unit operators, the preferred switching valve type continues to be the purposefully engineered rising stem ball valve (RSBV) with its friction-free linear movement and mechanically energized metal seat. Its time-tested service record has proven it to be the only suitable design for optimal long-term performance in severe applications, delivering unequaled reliability and availability. Of the three valve types, the RSBV is best at satisfying the competing priorities of cost versus performance.

### Components

BSM’s Non-Contact RSBV feature a uniquely designed turning mechanism. This mechanism is fully enclosed within the valve body, thus offering full protection against environmental influences and reducing the need for lubrication. Other suppliers also offer the fully enclosed mechanism.

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### Pricing

How do RSBVs compare to globe, gate, and trunnion ball valves in price?

A 4-inch rising stem ball valve installed in an LNG application a decade ago cost $9,000 and required $5,000 in repairs every 18 months. It was replaced with a metal seated ball valve at more than twice the price but with much less repair cost and downtime.

### Actuators

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### ABOUT THE AUTHOR

Robert McIlvaine is the CEO of the McIlvaine Company which publishes Industrial Valves: World Markets. He was a pollution control company executive prior to 1974 when he founded the present company. He oversees a staff of 30 people in the U.S. and China.

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