TE4 vs. Metal-Seated Trunnion Ball Valves in HRSG Service

A Cornerstone Valve Case Study



About the Author

Cornerstone Valve's Engineering Manager Garret Cei leads the engineering team responsible for the design, development, and technical support of Cornerstone's severe service ball valve product lines. He oversees valve design and analysis, engineering documentation and change control, and the engineering processes that support Cornerstone's quality management system.

Garret works directly with end users, EPC contractors, and Cornerstone's sales team on application reviews, design calculations, actuation and torque requirements, and customer-specific engineering. His focus on sound design fundamentals and practical maintainability helps ensure that every Cornerstone valve performs reliably in the field and remains serviceable throughout its life.

In HRSG systems, valve selection must balance thermal cycling durability, shutoff integrity at high temperature, maintainability in welded installations, fugitive emissions performance, and total lifecycle cost. This case study compares two severe service approaches that HRSG owners frequently evaluate side by side:

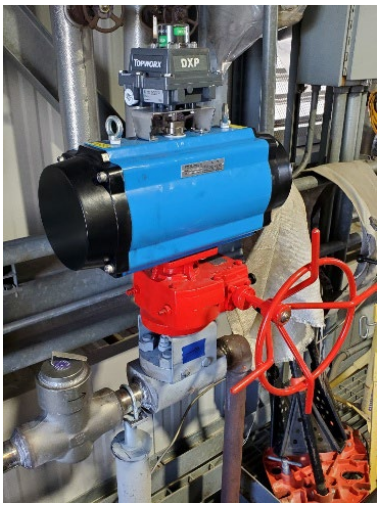
- **Cornerstone TE4:** a top entry, floating ball, zero leakage severe service valve.
- **A competitor's metal-seated trunnion ball valve:** a fully metal-seated trunnion design built for high-temperature service.

Both are capable severe service valves, but they are optimized for different priorities. In HRSG service, the deciding factor is usually maintainability in welded installations versus continuous high-temperature metal-to-metal sealing.

Design Philosophy

Cornerstone TE4. A second-generation floating ball design with a one-piece rigid body, top entry bonnet access, and a pressure-energized metal-to-metal bonnet seal, designed for in-line repairability. Primary objective: minimize outage time and eliminate hot work during maintenance.

Competitor metal-seated trunnion valve. A trunnion mounted, fully metal-seated ball valve engineered for extreme temperature and abrasive service, typically of multi-piece or heavy trunnion construction. Primary objective: durable metal-to-metal sealing under extreme temperature and erosive conditions.



Cornerstone Valve TE4 – HRSG Service

Sealing Architecture

Feature	Cornerstone TE4	Competitor Metal-Seated Trunnion
Ball support	Floating	Trunnion mounted
Seat type	Configurable, including severe service trim options	Metal-to-metal
Bonnet seal	Proprietary pressure-energized metal-to-metal	Conventional bolted body sealing
Shutoff	Type-tested zero bubbles	Dependent on metal seat condition

The competitor's design relies on continuous metal-to-metal contact at the seat interface for shutoff. The TE4 differentiates itself at the body/bonnet interface, using a pressure-energized sealing system designed to reduce external leak path risk under cycling. Where absolute internal shutoff under continuous extreme temperature

dominates, a metal-seated trunnion valve may be advantageous. Where startup and shutdown frequency is high, maintenance access drives cost, and external leakage under cycling is a concern, the TE4 offers significant advantages.

Maintenance and Outage Impact

Most HRSG valves are welded in place. A conventional metal-seated trunnion valve typically requires removal for major trim work, which can mean cutting and re-welding, hot work, pipe spreading, PWHT, NDE inspection, and a multi-day outage. The TE4's trim is replaced through the top while the body remains welded in-line, with no cutting, welding, PWHT, or pipe spreading, and the internal rebuild is achievable in hours.

Maintenance Factor	Cornerstone TE4	Competitor Metal-Seated Trunnion
In-line rebuild capability	Yes	Typically no
Hot work required	No	Yes, if removed
PWHT required	No	Often
Outage duration	Hours	Days
Safety exposure	Lower	Higher

In cycling combined cycle plants, this difference directly affects revenue.

Thermal Cycling Behavior

Competitor metal-seated trunnion valve. Metal seats resist high-temperature degradation and perform strongly in continuous high-temperature service. However, metal seats can gall or wear under frequent cycling, seat loading and expansion must remain precisely controlled, and repair requires full disassembly.

Cornerstone TE4. The floating ball simplifies the internal architecture, the pressure-energized bonnet seal compensates for thermal expansion, and trim replacement does not disturb the piping. For plants operating in load-following mode with frequent starts, the TE4 reduces lifecycle maintenance risk and avoids the repeated stress of cutting and re-welding.

Emissions and External Leakage

The TE4 references API 622, API 641, and ISO 15848 fugitive emissions requirements and uses a pressure-energized metal-to-metal bonnet seal designed to minimize external leak paths. Severe service metal-seated valves typically feature strong stem sealing, but their external sealing depends on conventional bolted body gasket integrity. Under HRSG cycling, bolted joints experience relaxation and re-torque requirements, while pressure-energized designs reduce preload dependency.

Total Cost of Ownership

Cost Driver	Cornerstone TE4	Competitor Metal-Seated Trunnion
Initial purchase	Competitive	Typically higher
Internal wear resistance	High (trim dependent)	Very high (metal seats)
Maintenance labor	Low	High
Hot work costs	Eliminated	Required
Outage cost exposure	Minimal	Significant
Lifecycle cost	Lower in cycling HRSG service	Lower in continuous extreme service

Application Suitability

The TE4 is best suited for HRSG main steam isolation in cycling plants, HP/IP bypass isolation, blowdown and drain service, welded-in applications with limited access, and plants prioritizing outage reduction.

A metal-seated trunnion valve is best suited for continuous extreme high-temperature service, abrasive particulate service, and applications demanding continuous metal-to-metal shutoff.

Conclusion

Both valves are severe service solutions. If the priority is maximum temperature endurance under constant operation, metal-seated trunnion valves are strong contenders. If the priority is reduced outage time, in-line repairability, minimized hot work, and lower lifecycle cost in cycling HRSG service, the Cornerstone TE4 provides a measurable advantage. In modern combined cycle plants operating in load-following mode, maintainability often proves more valuable than pure metal-seated endurance.