Smart Solutions. Powerful Products.







Accuseal[®] Mining & Slurry Transport



EXPERIENCE, DEDICATION AND VISION

Introducing Forum Energy Technologies – a global provider of manufactured technologies and applied products and services. We may be a new name to you but our equipment and employees have a long history of solving our customers' challenges. FET brings together some of the most well-known brands in our industry with an extensive range of mission critical products and services. We are building a world class company to bring innovative solutions to our worldwide customers. With offices in the key oilfield distribution centers of the globe, Forum is well-positioned to supply our clients with the equipment and related services that improve safety and performance and lower operating costs.

Forum's products and services range from the underwater reservoir to the refinery, from the sea floor to the above ground transportation line. We pride ourselves on giving you a comprehensive offering of solutions to maximize your operations and improve your bottom line. Our customers are our partners and we work with them to solve their ever-changing challenges.



Mining & Slurry Transport



FORUM provides a broad range of chokes/control valves, to meet most applications from basic manual operated to fully automated systems. As the industry continues to increase technology demands, operators select FORUM to obtain best-in-class service, performance and value. We are ISO-9001 certified, thus assuring design and manufacturing of the highest quality products available in the market.

Why Accusea[®]?

There is a difference!	3
Optimized Ball Valve Design	3
Engineering Software	3
Superior Valve Coatings	4
Omni-Lap 360°™	4
Vacuum Seal Testing	4

Applications

Critical Isolation for Slurry Transport	5
Reliable Isolation = Profits	5
Typical Severe Service Valve Locations	5
Typical Severe Service Valve Functions	5
Slurry Ore Concentrates	5

Accuseal[®] Critical Service Ball Valve (CSV)

The Benefits	.7
Ball & Seats	7
Unidirectional & Bidirectional Flow	8
Cutaway Image with Labels	8
Dual Spring	8

Accuseal[®] CSV

Bill of Materials	9
Size & Pressure Class	9
End Connections	9
Dimensions	10
Testing Procedures	10

Accuseal® Valves Quality

Accuseal® Valves Certifications	11
Actuation	11
Accuseal® Valves Product Warranty	11
Accuseal® Valves Product Test Procedures	11

Why Accuseal[®]?

Why make Accuseal[®] your Severe Service metal-seated ball valve of choice?

Demands on power generation plants are unprecedented. In combined cycle plants nearly every unit is required to perform as a flexible generating plant, swinging load in response to fluctuations in energy demand. As coal fired plants age, thy experience more frequent outages and more starts. Mechanical equipment, including valves, must meet the ever increasing challenges relating to cycling and thermal transience. Reliable, repeatable isolation has never been more critical.

There is a difference!

Many claim to be the best. All have a ball, seat and stem. But which valve most consistently provides tight shutoff under the most challenging of conditions? You choose severe service valves with care because the consequences of failure are severe. Accuseal® Valves provides many advantages in power generation applications.

Accuseal[®] Valves deliver predictable reliability and performance

- Optimized Ball Valve Design and Engineering Software. Proprietary software fast tracks optimal valve engineering.
- Superior Valve Coatings.
- Accuseal[®]'s state-of-the-art HP-HVOF (high pressure high velocity oxygen fuel) coatings provide maximum protection for longer valve life.
- Exclusive Accuseal Fused and thermally stabilized coatings are metallurgically bonded to the base material, to handle even the most severe thermal stresses.
- Omni-Lap 360° ™

The proprietary Accuseal[®] mate-lapping process laps the entire spherical surface of the ball and seat surface, not just the sealing band areas.

019946

Computition Into Drom

onoucleord fue on one of the second

 Vacuum Seal Test Accuseal® ball and seat sealing is tested prior to valve assembly, ensuring seal integrity.

Optimized ball valve design and engineering software

Extensive severe service ball valve engineering experience is combined with proprietary valve optimization CAD/CAM/CAE software and fast-tracks optimized valve design. Service conditions are simulated, providing feedback with engineering analysis, FEA (Finite Element Analysis) and CFD (Computational Fluid Dynamics). Beginning to end, the most current Product Life-Cycle Management (PLM) software is used.

Advantages Include:

- Optimized ball/seat sealing engagement
- Line of sight bore for totally unobstructed media flow
- Optimized ball/stem tang interface
- Thermally stabilized seat geometry allows for rapid sealing



00% contoc

Superior valve coatings

Not all HVOF coatings are equal.

- Accuseal[®]'s HVOF coating formulas are the most consistent and least porous available, matched to the ball/ seat material. State of the art technology applies the coating at the highest velocity for greatest density coverage, superior bond strength and surface hardness. Ongoing research ensures the most reliable coating is matched to service conditions.
- Accuseal[®]'s Fused carbide coating are thermally stablized to handle high cycle and high thermal cycle applications.
 - Superior coating performance under thermal stress and media bombardment.
 - Longer valve life with smooth surface integrity.
 - No place for leak paths to develop.
 - Reduced torque values to operate the valve.

Оми-Lap 360°тм

Proprietary mate-lapping produces the tightest, most reliable seal available. All metal seated ball valves rely on continuous, unbroken contact between the metal ball and seat to create an isolating seal. O_{MNI}-LAP 360°™ mate-laps the entire ball and seat for optimal roundness, producing 100% ball to seat contact, regardless of positioning.

Traditional cup-lapping methods mate only the sealing band of the ball to seat surfaces creating ridges that distort the ball's roundness and compromise the coating thickness. The sealing "sweet spot" originates a leak path if even slightly misaligned resulting in reduced valve life, more maintenance and higher actuation costs.

Omni-Lap 360° tm	Traditional Lapping
 Automated lapping of the entire spherical surface Consistent 100% roundness Uniform coating thickness Seals in any position 100% ball to seat contact Smooth surfaces reduce friction for lower torques 	 Laps only a sealing band Distorts roundness Compromises coating thickness Creates ridges around "sweet spot" Surface irregularities cause higher torques

Vacuum seal testing

Accuseal® Valves vacuum testing of every ball and seat prior to assembly verifies 100% ball-to-seat seal to Class VI shut-off.

- Seal reliability is ensured
- Greater manufacturing efficiency means lower cost
- Easier valve assembly in the factory and in the field

Applications

Critical Isolation for Slurry Transport

Accuseal[®] Metal Seated Ball Valves provide critical isolation for applications with extreme service conditions that exceed commodity valve parameters:

- High Temperature
- High Pressure
- Heavy Solids
- Abrasive, Erosive and/or Corrosive
- Critical Plant Safety
- Lethal Service
- Other Problematic Conditions

Reliable Isolation = Profits

Severe service valves must isolate reliably as mineral ore slurries are transported and processed. Dependable valve isolation means more productivity, less maintenance and more profitable operations.

Typical Severe Service Valve Locations

- Choke Stations
- Filter Plants
- High Pressure Slurry Transport Systems
- Isolation Stations
- Mineral Concentrators
- Pump Stations
- Upgraders
- Waste Disposal

Typical Severe Service Valve Functions

- By-pass Valves
- Charge Valves
- Discharge Valves
- Drain Valves
- Emergency Shut Down Valves
- Emergency Dump Valves
- Feed Valves
- Injection Valves

- Instrument Bleed Valves
- Instrument Isolation Valve
- Main Isolation Valve
- Pigging Isolation Valve
- Pig Launch Charge Valves
- Pig Receiver Discharge Valves
- Vent Valves

Slurry Ore Concentrates

- Copper
- Gold
- Nickel
- Coal
- Tar Sands
- Iron
- Silicon (ultra-pure granular polysilicon)
- Lithium, Molybdenum and others

Upgrade Your Expectations & Enjoy Longer Run-times

These photographs demonstrate the effectiveness of Forum Accuseal[®] Critical Service Ball Valve in punishing copper concentrate slurry transport service in Chile. This 8 inch 1500 ASME Class valve was removed from the choke station pipeline after approximately 1500 cycles at a working pressure of 2700 psig. Close inspection of the primary sealing side of the ball clearly shows the integrity of the HP-HVOF coating on Omni-Lap 360°™ ball and seat sealing components.



Accuseal[®] 8 inch, 1500 ASME Class Critical Service Ball Valve in choke station pipeline for copper concentrate in Chile.



Valve removal for inspection.



View through downstream bore, open position.



Close-up view of primary sealing surface of closed ball after approximately 1500 cycles at 2700 psig working pressure.

Choose Forum Accuseal® Valves on your next project.

Accuseal[®] CSV

1. Body / End Connection

- Machined from forgings for material structural integrity.
- End Connections: RFF-raised face flange Standard.
- Options available on request: BW-Butt Weld, SW-Socket Weld, RTJ, Hub Connectors, Threaded, Lens Joint, Wafer, etc.
- Weld overlay of wetted surfaces to protect from corrosion and erosion available upon request.

2 & 3. Ball + Seats = the sealing assembly

- Omni-Lap 360°[™] optimizes the matched roundness of the ball and seat for 100% seal, regardless of positioning. The sealing surface is maximized, providing the widest metal to metal seal possible. The seal is consistently reliable.
- Corrosion resistant materials with matched rates of thermal expansion are used on the sealing components to maintain seal integrity and reliability.
- Coatings are robotically applied with HP-HVOF (high velocity oxygen fueled) or Spray and Fuse processes for uniform surface thickness, coating density and maximum metallurgical bond to withstand extreme service conditions.
- Self-cleaning the seats remove all debris from the ball with every on/off cycle, extending valve life.
- Field repair is simpler and faster, when required. The ball and seat assembly is vacuum seal verified at the factory and easily replaced on site.

4. Dual Belleville Springs

- Provides resilient loading of ball to seat.
- Provides effective particulate exclusion.

5. Stem

- Surface modification eliminates galling with rotation.
- Blow-out proof per ASME B16.34.

6. Inner Stem Seal

• Provides primary metal-to-metal stem seal.

7. Packing Bushing

- Prevents stem packing intrusion into body.
- Works with stem bearing to prevent lateral stem motion.

8. Packing Rings

• Reinforced graphite.

9. Anti-extrusion Rings

• Prevents packing extrusion.

10. Packing Follower

- Thermally matched to stem material.
- Prevents galling and contains upper packing.

11. Articulating Gland Flange

• Spherically engages the packing follower to prevent stem binding and galling during adjustments.

12. Belleville Springs

- Live load on the bolted joint eliminates routine gland adjustments.
- Reduces maintenance.

13. Stem Retaining Ring

- Prevents stem misalignment during actuator installation.
- Stem cannot be forced into ball stem slot.

14. Mounting Flange

- Precision machined to ISO 5211.
- External mounting flange provides rigid mounting for ease of adjustment.
- Direct mounting option reduces hysteresis and stem deflection.

15. Body Gasket

- **Spiral Wound Gaskets**
- Grafoil filled.
- 1500 pressure class and below. Engineered Body Seal
- 2500 pressure class and above.
- Gold-plated Inconel 718.
- Pressure assisted seal.



Various Seating Options Available per Application



Unidirectional flow

- Flanged seat design.
- Sharp leading edges of the seat scrape the ball clean each time the valve is opened.
- Fully field service-able.
- Vacuum tested to Class VI shutoff.



Dual Spring

- Upstream Seat Landing is mate lapped to upstream landing for bi-directional seat.
- Line contact at the O.D. and I.D provides a particulate barrier protecting the landing.



Bidirectional

- Locked-in downstream seat.
- Fully bidirectional completely independent of flow direction.
- Redundant isolating seats both upstream and downstream seat are in continuous sealing engagement with ball.



ACCUSEAL® CSV SHOWN ABOVE: FLANGED SEAT DUAL SPRINGS

Accuseal[®] CSV

Applications

- Critical isolation of Slurry, Liquids, Solids, and Gases
- Custom designs to solve problematic applications
 Any application with service conditions too hot and/or abrasive/erosive for commodity valves

Bidirectional with Preferred Flow

- Size: 1⁄2"- 36"
- Full and reduced port valves
- Bore to match pipe ID available
- ASME Pressure Class: 150 thru 4500

Materials of Construction

• A105, Stainless Steel, Exotic Alloys and other materials by request

End Connections

• RFF Standard or to customer specifications (Butt Weld, Socket Weld, RTJ, Hub Connectors, Threaded)

Actuator Options

- Factory installation of actuator of your choice
- Mounting kits provided to mount to existing actuators

Features and Benefits

- Directional Flow Isolation Options.
- Unidirectional Preferred flow direction Standard.
- Bidirectional Shuts off in either directional flow.
- Positive mechanical stops prevent over-travel.
- Operator T-handle, lever, gear or actuated.
- Easily automated with ISO 5211 standard mounting pads.
- Self-cleaning ball and seats.
- Positive positioning feature prevents misalignment during actuation. Stem cannot force ball out of correct position.
- Field repairable with Omni-Lap 3600 TM ball and seat assemblies, vacuum seal pretested at the factory.

1 year warranty standard (contact Forum for details)

Bill of Materials - Accuseal [®] CSV			
ITEM	DESCRIPTION	MATERIAL	
1	Body	A105 A182 F22 Cl.3 A182 F91	
2	Ball	410 SS / CC Coating Inconel 718 / Spray & Fuse	
3	Seats	410 SS / CC Coating Inconel 718 / Spray & Fuse	
4	Belleville Spring	Inconel 718	
5	Stem	A-286 Hardfaced	
6	Inner Stem Seal	410 SS / CC Coating Hardfaced	
7	Packing Bushing	316 SS Hardfaced	
8	Packing Rings	Grafoil	
9	Anti-Extrusion Ring	Inconel Wire Reinforced Grafoil	
10	Packing Follower	316 SS Hardfaced	
11	Articulating Gland Flange	410 SS Hardfaced	
12	Live Loading Belleville Springs	Stainless Steel	
13	Stem Retaining Ring	Stainless Steel	
14	Mounting Flange	Carbon Steel	
15	Body Gasket	Spiral Wound Grafoil Filled/ Inconnel 718 Gold Plated	

Special alloys and coatings available upon request.

CC = Chrome Carbide coating



Body Gaskets

Spiral Wound Gaskets

- Grafoil filled
- 1500 pressure class and below

Engineered Body Seal

- 2500 pressure class and above
- Gold plated Inconel 718
- Pressure assisted seal

Accuseal® Valves Quality



Accuseal® Valves manufactures to ASME B16.34

Certifications







ISO 9001: 2008

PED/CE



IBR

Actuation

- ISO 5211 mounting patterns
- Accuseal® Valves automates to customer specifications

COOPER® Product Warranty

Accuseal[®] CSV – Critical Service Ball Valves

• Standard: 1 year

Accuseal® Product Test Procedures

- Standard valve testing to meet or exceed MSS SP-61, FCI 70-2, and API 598
- Exclusive vacuum testing of ball and seat to verify seal prior to valve assembly

Our goal is to become the leading provider of mission critical oilfield products and related services in terms of customer satisfaction, safety and financial performance.

Our experienced management team and employees are dedicated to solving our customers' problems. We invest in long term relationships and cooperate on product development with our clients, we consider them our partners.

OUR CORE VALUES

Integrity: In everything we do, in every interaction, both internally and externally, we strive to operate with the upmost integrity and mutual respect.

Long-term view: We are building our company for the long-term, a company that we can be proud of.

Open communication: We believe partnerships with our customers and co-workers must be based on trust, professionalism and transparency.

Customer focused: Our products enhance our customer's performance and we listen to their needs and work with them to solve their challenges.

Good place to work: We are committed to creating a workplace that fosters innovation, teamwork and pride. Every team member is integral to our success and is treated equally and fairly.

No one gets hurt: The safety of our employees and customers is our first priority coupled with a healthy respect for the environment.

For more information about our products and full Terms & Conditions please visit www.f-e-t.com.



12735 Dairy Ashford Road Stafford, Texas 77477 281.637.2000 [m] 800.256.6193 [tf] 281.340.5499 [f] www.f-e-t.com

Copyright © FORUM ENERGY TECHNOLOGIES, INC. All rights reserved • ACCUSEAL_Mining Slurry Transport_REV031717 • Stafford, USA

