Smart Solutions. Powerful Products.





Accuseal[®] Hydrocarbon Processing Valves // 2017



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.



Hydrocarbon Processing



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 Accuseal® MSBV's?

There is a difference!	2
Optimized Ball Valve Design	2
Engineering Software	2
Superior Valve Coatings	3
Omni-Lap 360°™	3
Vacuum Seal Testing	3

Our Services

Manual Operations	4
Valve Automation	4
Testing	4
Valve Modification	4
Accuseal® Features	_4

Refinery Overview

Refinery Flow Chart	5
Continuous Catalytic Reformer	6
Fluidized Catalytic Cracking	7
Delayed Coking	8
Gasification	9

Critical Service Valve (CSV)

Ball & Seats1	10
Unidirectional & Bidirectional Flow1	11
Dual Spring1	11

CSV - Metal Seated Ball Valve

Applications	
Materials of Construction	
End Connections	
Actuator Options	
Features & Benefits	
ASME Certification	
Dimensions	13
Testing Procedures	13
Purge Port Options	

Why Accuseal[®] MSBVs?

Why make Accuseal® your severe service metal-seated ball valve of choice?

Demands on power generation plants are unprecedented. In combined cycle plants virtually every unit is required to perform as a flexible generating plant, swinging in response to fluctuations in energy demand. Mechanical equipment, including valves, must meet the frequent 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 isolation under the most challenging of conditions? You choose severe service valves with care because the consequences of failure are severe. COOPER® Valves provides many advantages in power generation applications.

Accuseal® Valves delivers 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.
- Omni-Lap 360° tm

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

01999.6

Computational Huid Dynamics

• 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 that informs 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



100% contoc

5eols in

Superior valve coatings

Not all HVOF coatings are equal. Accuseal®'s specified 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.

- 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
- *– Highly engineered Fused coatings available for Class 3200 and 4500 extreme applications.

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. OMNI-LAP 360°TM 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°™	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 ev ball-to-seat seal to Class VI shut-off.	very ball and seat prior to assembly verifies 100%

Vacuum seal testing

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

Our Services

Manual Operations

- Worm Gears, Spur Gears, Bevel Gears, and Reach Rods
- Table Stands, Extension Systems, and Brackets
- Shop Installation Services

Testing

- Radiography Testing
- Dye Penetrant Testing
- Ferrite Content Testing
- Hardness Testing
- Corrosion Evaluation Testing
- Chlorine Cleaning
- Oxygen Cleaning
- Phosgene Cleaning

Accuseal[®] Features

- Largest Offering of Nickel Alloy Materials
- Wide Range of Severe Service Applications
- Material Test Reports
- Traceability / Serial Numbers
- RFID Enabled with IDS Tracelt+
- API-591 Tested
- API-598 Tested
- Major End-User Approvals

Valve Automation

- Electric, Hydraulic, and Pneumatic Automation
- Multi-turn, Quarter-turn, and Linear
- New Applications

Valve Modification

- By Passes
- Bore Changes
- Mounting Plates
- Stem Extensions
- Limit Switches
- Trim Changes
- and More!
- Extensive Engineering Capabilities
- Excellent Customer Service
- Extended Warranty Program
- Quick Deliveries & Stock
- Recognized Highest Industry Quality
- Extensive NDE Availability
- Tested for Low Fugitive Emissions
- International Organization for Standardization (ISO 9001)







Refinery Overview



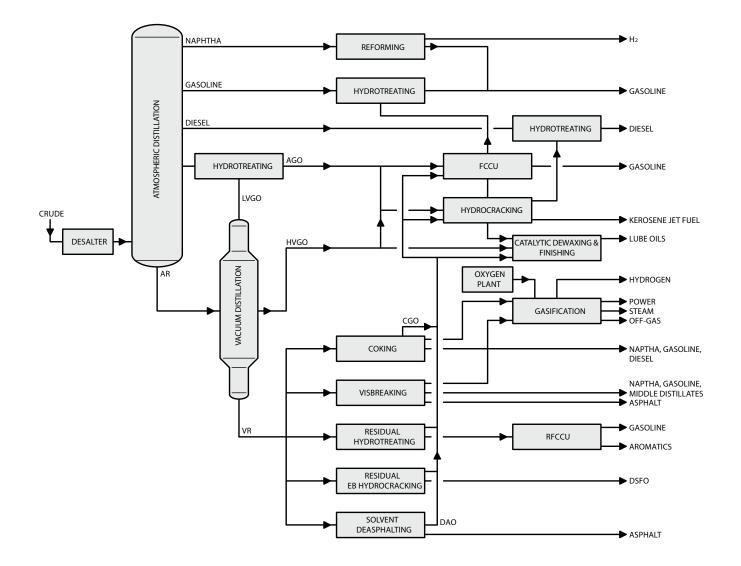
Distillation Unit: The purpose of atmospheric distillation is primary separation of various 'cuts' of hydrocarbons. The heaviest hydrocarbon residue taken out from partial reboiler is sent to the vacuum distillation column for further separation under reduced pressure. The different cuts of hydrocarbons taken out at this stage are the result of primary separation and undergo further processing before being transformed to end products.

Coker Unit: Processes vacuum residuals, which is heated to over 900° F and put into the coke drums, where it undergoes thermal cracking as the oil decomposes under the extreme heat.

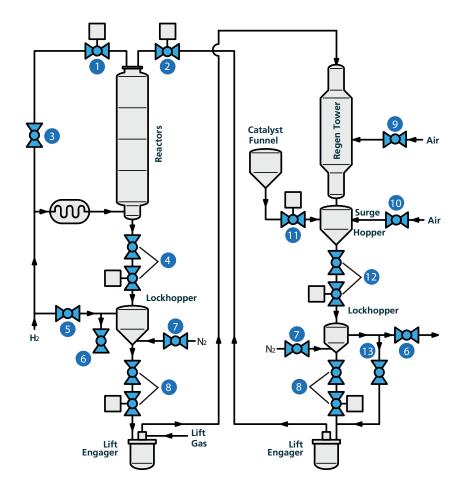
Reformer Unit: Using heat, catalyst and moderate pressure, the reformer changes the molecular structure of crude and coker naphthas to produce a high octane primary gasoline blend stock called reformate.

Alkylation Unit: Uses acid catalyst to combine small molecules into larger ones collectively called alkylate, which has a high octane and is the cleanest burning of the gasoline blendstocks.

Fluid Catalytic Cracking Unit: Uses heat and catalyst to break or "crack" large gas oil molecules into a range of smaller ones, specifically gasoline, low quality diesel stocks, and a residual oil called slurry (fuel oil).



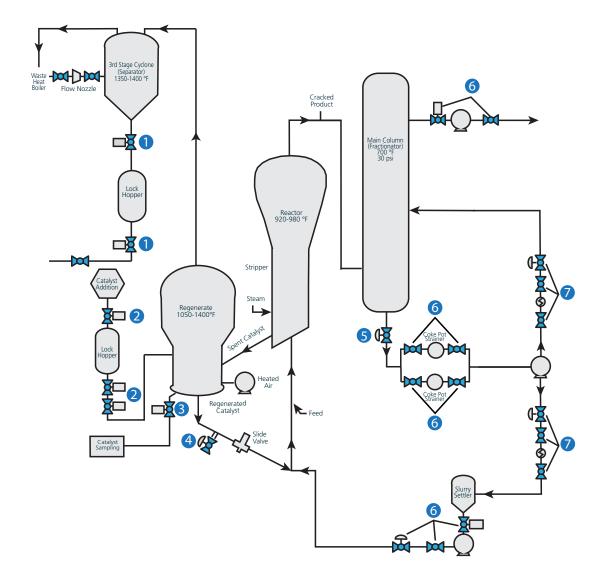
Continuous Catalytic Reformer



Valve	Specification			
Number	Valve Description	Temperature	Pressure	Pipe Size
1	Reactor Overhead Purge	400 – 1000 °F	300 – 800 psi	1 – 8 inches
2	Reactor Overhead Regeneration	400 – 1000 °F	300 – 800 psi	1 – 8 inches
3	Standby Reduction Zone Purge	400 – 1000 °F	300 – 800 psi	1 – 8 inches
4	Reactor Bottoms Unloading Valve	400 – 1000 °F	300 – 800 psi	1 – 8 inches
5	Hydrogen Loading to Lockhopper	400 – 700 °F	300 – 700 psi	1 – 8 inches
6	Hydrogen Vent for Lockhopper	400 – 700 °F	300 – 700 psi	1 – 8 inches
7	Nitrogen Purge for Lockhopper	400 – 700 °F	300 – 700 psi	1 – 8 inches
8	Catalyst to Lift Engager	400 – 700 °F	300 – 700 psi	1 – 8 inches
9	Air Valve to Regeneration Cooler	400 – 700 °F	300 – 700 psi	6 inches
10	Air Valve to Surge Hopper	400 – 700 °F	300 – 700 psi	6 inches
11	Fresh Catalyst Addition	200 – 300 °F	300 – 500 psi	2 – 8 inches
12	Regen Catalyst Unloading from Surge Hopper	400 – 700 °F	300 – 700 psi	6 inches
13	Pressure Balancing for Lockhopper / Lift Engager	400 – 700 °F	300 – 700 psi	6 inches

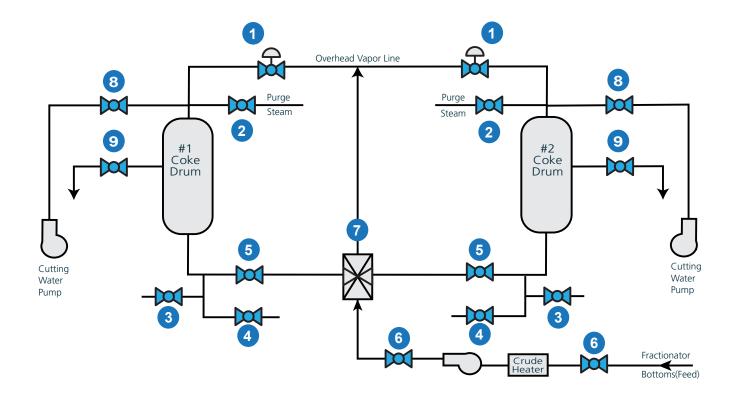
Fluidized Catalytic Cracking





Valve	Specification			
Number	Valve Description	Temperature	Pressure	Pipe Size
1	Catalyst Block	500 - 1400 °F	35 psi	6 – 8 inches
2	Catalyst Addition	500 - 1400 °F	35 psi	2 – 4 inches
3	Catalyst Withdrawal	800 - 1400 °F	35 psi	4 – 8 inches
4	Catalyst Sampling	800 - 1400 °F	20 psi	2 – 3 inches
5	Emergency Shut Down	500 - 850 °F	30 psi	10–14 inches
6	Pump/Strainer Isolation	500 - 850 °F	30 psi	8–14 inches
7	Catalyst Slurry	500 - 850 °F	35 psi	6 – 8 inches

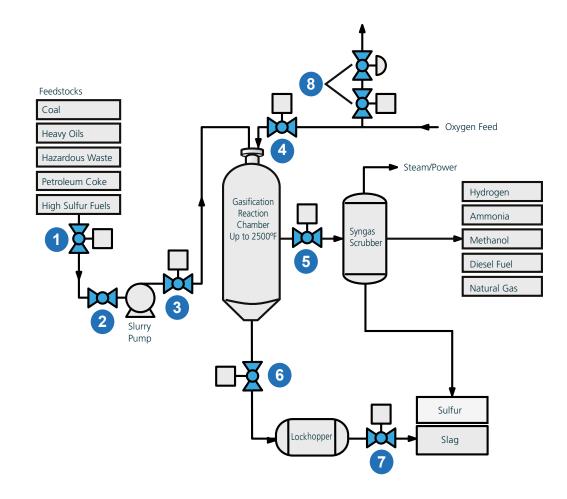
Delayed Coking



Valve	Specification			
Number	Valve Description	Temperature	Pressure	Pipe Size
1	Overhead Vapor	400 - 950 °F	50 - 100 psi	6 – 8 inches
2	Steam Blowdown Control	400 - 950 °F	50 - 100 psi	2 – 4 inches
3	Steam Warm-up	400 - 750 °F	50 - 200 psi	4 – 8 inches
4	Quench Water	400 - 950 °F	50 - 200 psi	2 – 3 inches
5	Inlet Feed	400 - 950 °F	50 - 100 psi	10 –14 inches
6	Furnace Isolation	400 - 950 °F	50 - 100 psi	8–14 inches
7	Switching	400 - 950 °F	50 - 100 psi	6 – 8 inches
8	Cutting Water	Ambient	2000 psi	2 – 6 inches

Gasification





Valve	Specification			
Number	Valve Description	Temperature	Pressure	Pipe Size
1	Slurry Tank EBU	500 – 900 °F	100 – 200 psi	6 – 10 inches
2	Feed Slurry Pump Isolation	100 – 300 °F	100 – 200 psi	6 – 10 inches
3	Gasifier Isolation	100 – 300 °F	900 – 1200 psi	6 – 10 inches
4	Oxygen Feed Isolation	100 – 200 °F	900 – 1200 psi	4 – 8 inches
5	Course Slag Lockhopper Isolation	150 – 650 °F	900 – 1200 psi	6 – 12 inches
6	Lockhopper Drum Inlet	400 – 600 °F	900 – 1200 psi	12 – 24 inches
7	Lockhopper Drum Outlet	400 – 600 °F	900 – 1200 psi	12 – 24 inches
8	Pressure Relief Valve	100 – 200 °F	900 – 1200 psi	4 – 8 inches

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°TM 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.

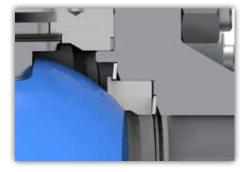


Various Seating Options Available per Application



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.

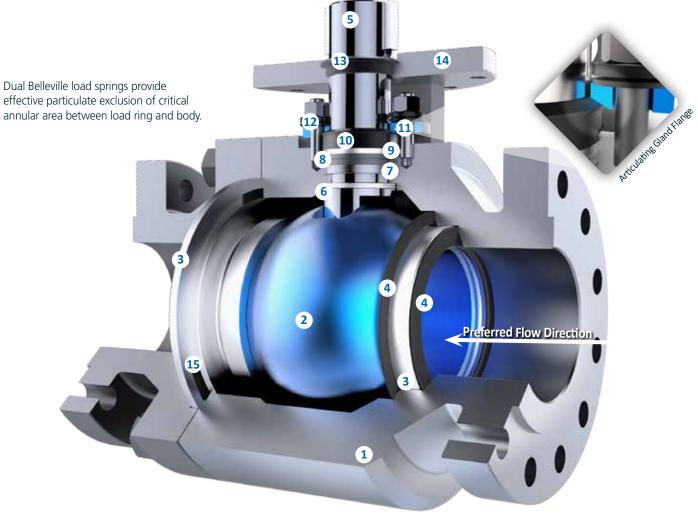


Dual Spring

- 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.



- 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® Critical Service Ball Valve

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

First Class Soutions to Meet Any Challenge Custom Design Examples



Coker Drum Isolation

- 12" 300# RFF A182 F317
- 14" 300# RFF A182 F9

Features and Benefits

- Flow Isolation Options
 - Unidirectional Standard
 - Bidirectional Shuts off flow in either direction
- Positive mechanical stops prevent over-travel
- Operator Per application requirements
- 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 360°™ ball and seat assemblies, vacuum seal pretested at the factory

1 year warranty standard (contact Forum Accuseal[®] for details)



Double Block and Bleed
3" - 2500# GR25 : 2 Balls 1 Body - Dual Linkage





Dimensions

- End to End dimensions per ASME B16.10
- Bore to match pipe ID available
- Special Face-to-Face available upon request.



Berrby	declares that
Coop	per Valves
4659 1	Vright Road
Stafford,	TX 77477 USA
Design Config chining, Manud	plied a quality system for arration Management, facturing, Assembly, Teo tion of Industrial Valves
No. of the party name	formed and descention had the
250	8001 200R
and the	and the second second second
the strends of the se	ageneration descent had
- Invent	the state of some
-	Aug. 10.1
Bar Flore 88 7.74	
	E makes
Concerned of	the statement

ISO 9001: 2008

Accuseal[®] Valves manufactures to ASME B16.34

Adul Randarda	Internet of the second se
Should be an	monomenes Carl++ Verse, 1.1.2
	Management and Annual States and Provide and Annual States
ressure Equipment Directive	Printed in colors of a subscription printed and the colors of the colors
Full Quality Assurance	A Design of the local sector of the local sect
Certificate Module H	- Manufacture and an and a second party of the second seco
the second se	 A second s
Concerne	 Franciscus processes and an ended since the data stepping International Jan ' J. Start J. Start J. Start J. Start J.
Couper Valves, LF 4555 Rough Read	DESIGN OF THE PARTY OF THE PART
Angeleng .	C039ER*
Taxas 1747	permanental headersheet station permanents and an exception
Names of a first in the surgery was as in factor.	Carrier, Weight Winn, Darming
where the property of the second participation of the second se	Gara Notan Gara Stora
The other sector of the sector	lidenty Vitoria
a pris Management of plans and of Management and an of T. S. W. Stree 124	(Mr), (ct. man) (Mr(n))
et Printer and	The second secon
TANK NAME	S Processor and the second of the second second second and second s
Concession of the	to be a set of the set
	NUMBER OF STREET
a la seconda de la final de la	the second state of the se
	interest int 1.1 Packs
10.000 (0.00.00)	
552* 9537	The spin of the second se
tear and and	(%
tsiz" styp	
Conseller Australity N.M. Magnific	There are a series and the series of the ser
Char In and Annual State	
52" 15/7	Terreterenterenterenterenterenterenteren

PED/CE

CRN

Accuseal® Valves Testing Procedures

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

Contact Accuseal[®] Valves for warranty information.



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_Hydrocarbon_Processing_REV050117 • Stafford, USA