

## LKS® High PV Seal for the Oil and Gas Industries

Custom components that drive tomorrow's technologies.®







## Contents

- 2 The LKS® High PV Seal: Better Performance and Predictability
- 3 Understanding “PV”
- 4 LKS® Seal Applications
- 5 LKS® Performance Data
- 6 Product Innovation Through Engineering Collaboration
- 8 Important Information



## The LKS® High PV Seal: Better Performance and Predictability



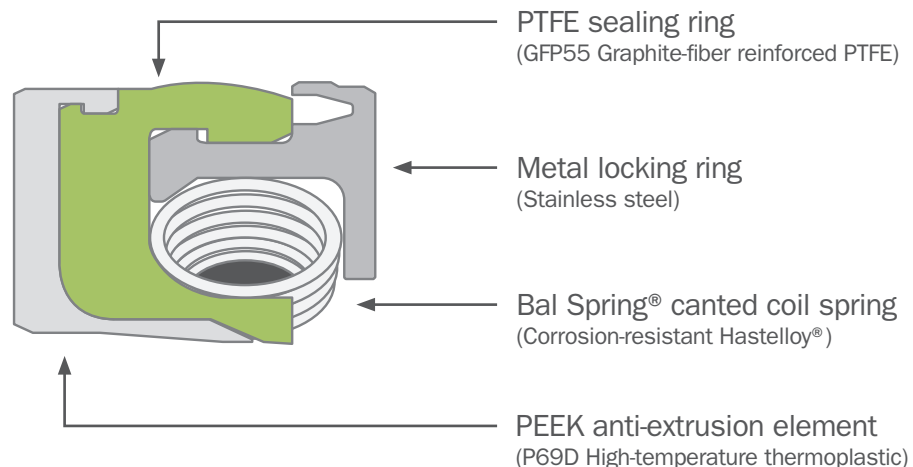
For over 25 years, Bal Seal Engineering has been helping oil and gas industry OEMs and tier suppliers solve their toughest upstream and downstream sealing challenges.

Our LKS® high PV seal continues this tradition by delivering reliable, consistent performance and offering unprecedented levels of service life and predictability in the most demanding rotary and reciprocating applications. The innovative, multi-component LKS seal offers exceptional protection against leakage in harsh media, temperatures, pressures and speeds, and it replaces costly sealing assemblies.

### LKS® Technology

The LKS high PV seal consists of a graphite-filled PTFE sealing ring energized with a Bal Spring® canted coil spring. The seal is reinforced with a high-temperature engineered thermoplastic anti-extrusion element and a metal locking ring. Under high pressures and velocities, this combination of components guards against extrusion of the seal jacket material by supporting it in hardware with little or no clearance between the seal and rotating shaft. The LKS seal's unique design forces the wear of the jacket material to occur at the lip contact area, not the hinge point. This ensures longer life and superior sealing performance.

### LKS® high PV seal cross section

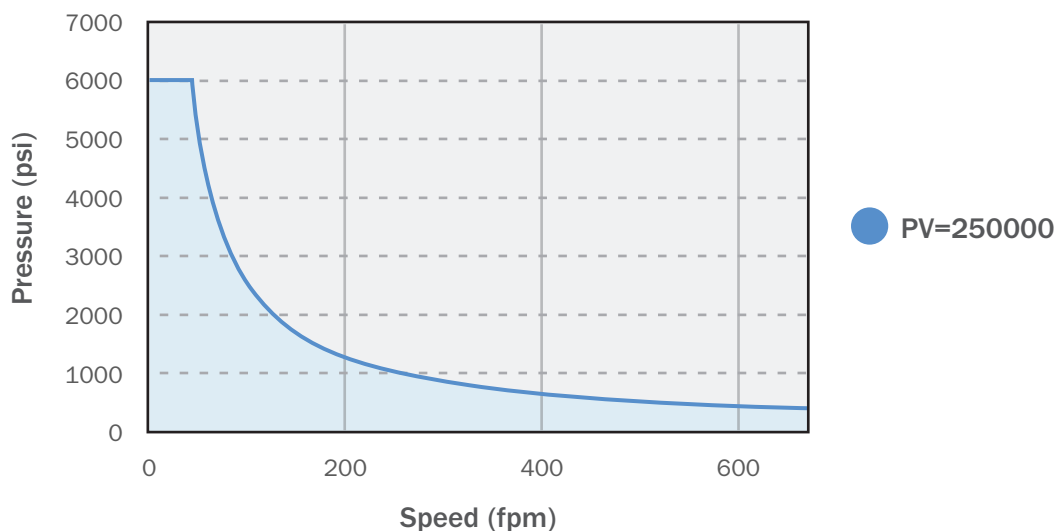


## Understanding “PV”

PV is the product of media pressure (P) and the velocity (V), or surface speed, of the shaft. It is commonly expressed in PSI-feet/min. Surface speed is calculated by multiplying shaft rotational speed by the shaft circumference. The PV number is determined by multiplying the resulting surface speed number by the pressure.

Seal materials subjected to increasing PV conditions will eventually reach a thermal failure point known as the “PV limit.” The PV limit of a material indicates the highest combination of speed and pressure at which normal wear may be expected. Above this limit, an abrupt increase in seal wear rate will occur, and the seal surface may begin to melt.

### Typical Constant PV Curve

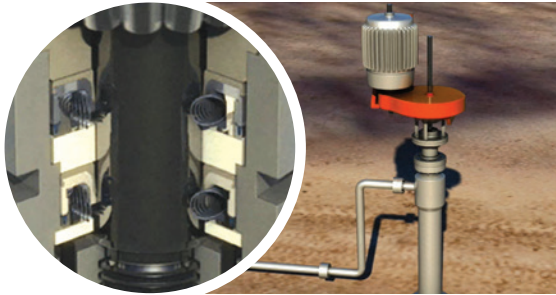


Effective sealing in high pressures and speeds is a balancing act. Designers should target a PV value of 250,000 or less in order to ensure optimal equipment service life.

The LKS seal's unique geometry and material combination enable it to outlast other sealing solutions in high PV environments.

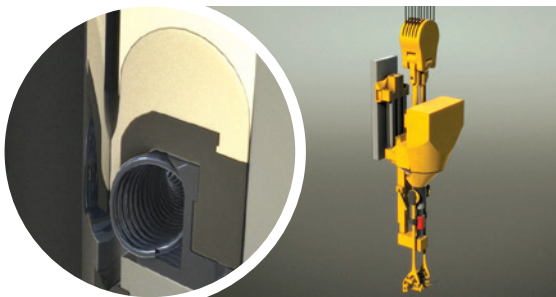


## LKS® Seal Applications



### Pump Systems

Pumps and pump systems rely on seals to protect costly bearings from damage and contamination. In these applications, the LKS® seal creates a barrier between the harsh mud, sand, oil, H<sub>2</sub>S, water, and other contaminants that can impede or even prohibit the operation of the bearings, motor, and other critical components. The LKS seal also helps guard against adverse environmental impact by minimizing the possibility of external leakage.



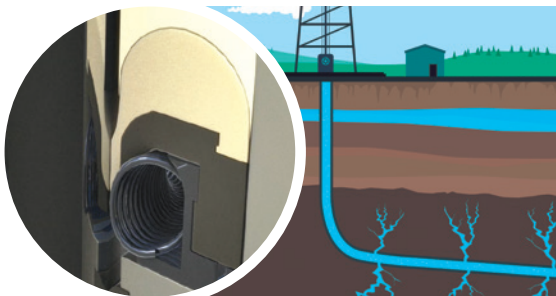
### Top Drives

Today's more aggressive drilling and exploration practices place an added level of demand on top drives, the units that provide rotational force to the drill string. A typical top drive assembly houses a wash pipe that allows drilling mud from the shaker to travel down the center pipe. The LKS seal's primary role in this application is to prevent the leakage of drilling mud from the top drive assembly.



### Rotary Steerables

A rotary steerable system is programmed by the directional driller, who transmits commands using surface equipment. The tools interpret the commands, and gradually steer in the desired direction. Continuous rotation of the drill string allows for improved transportation of drilled cuttings to the surface. In this application, the LKS seal creates a barrier and keeps rock, oil, mud, and sand from entering the tool and damaging hardware.



### LWD/MWD Pulsing Tools

Many oil and gas wells are drilled directionally, and techniques known as "logging while drilling" (LWD) and "measurement-while-drilling" (MWD) allow important information about the drilling process to be continuously transmitted to the surface. MWD logs use mud pulse technology to send data from the tools on the bottom of the drill string to topside processors. The LKS seal prevents fluid, mud, sand, rock and H<sub>2</sub>S gas from entering the mud pulser casing, and it also helps keep moisture from migrating into the tool's sensitive electronics.

## LKS® Performance Data

Factors such as speed, pressure, and media play a major role in the performance of every rotary seal. To illustrate the performance difference between a standard rotary seal and the LKS® seal, we developed a side-by-side test to assess life expectancy in both lab and field environments.

In this test, our Bal Seal® spring-energized KS seal was selected to represent a current state-of-the-art rotary seal. The KS seal consists of a locking ring, filled PTFE seal lip, and a Bal Spring® energizer. The LKS seal is similar in construction to the KS seal, but it contains an additional element to aid in wear prevention and protect against extrusion under pressure.

The table below compares the performance of the KS Seal to that of the LKS seal. The parameters in the lab were 500 psi and 500 RPM, using water as the media. Under these conditions, the LKS exhibited a performance life increase of up to 4 to 1 over the KS seal. In actual field conditions where oil and sand were introduced, the LKS exhibited up to 9 times the performance of the KS seal.

Life Hours		Conditions
KS	LKS®	
2,400	10,000+	Lab (500 psi, 500 RPM, water and no sand)
1,000	9,000+	Field (100 psi, 100 RPM, heavy oil, with sand)



## Product Innovation Through Engineering Collaboration

At Bal Seal Engineering, we create custom sealing, connecting, conducting, and EMI/RFI shielding solutions that improve the performance and reliability of the equipment you design and manufacture. For over 60 years, we've helped some of the biggest names in worldwide industry gain a competitive edge. And in many cases, we've helped to develop breakthroughs and shape industry standards along the way. Our collaborative engineering approach enables us to forge "innovation partnerships" with engineers like you who want to make their products stronger, faster, lighter, and more functional.

In early development or existing product improvement stages, we combine our proven core products with application engineering, precision manufacturing and material science expertise to produce solutions that deliver.

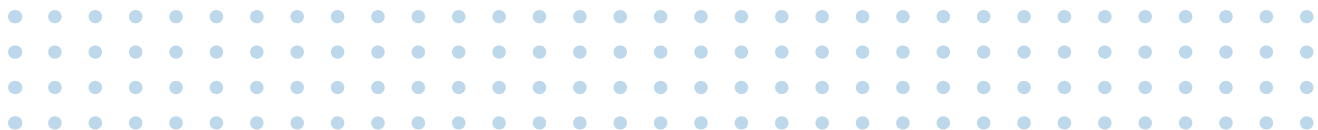
### More Solutions for Oil and Gas



#### Bal Seal® spring-energized seals

In addition to the LKS® high PV seal, we offer a complete line of Bal Seal® spring-energized seals for rotary, oscillating, reciprocating, and static/face service in upstream and downstream applications. All of our seals are custom-engineered to provide longer service life, more uptime, and increased profitability. Select seal materials are NORSOK and NACE compliant.





### Bal Spring® canted coil springs

As a stand-alone component, our Bal Spring® canted coil spring is a proven solution for making and maintaining critical mechanical and electrical connections in equipment used for exploration, drilling and production processes. This versatile component mechanically fastens, conducts electricity, and shields sensitive electronics from the harmful effects of EMI/RFI. The spring's independent coils, which serve as multiple contact points for optimal current carrying capability in electrical and shielding applications, ensure consistent, reliable connection—even under shock and vibration.

The Bal Spring is robust enough to withstand thousands of insertion and removal cycles, and it can be precisely engineered to meet virtually any connector force requirement—from just a few pounds to >10,000 lb.



### Bal Contact® electrical contacts

When combined with a precision-engineered metal housing, our Bal Spring canted coil spring creates a highly reliable electrical contact that enables OEMs to effectively manage high, medium, and low current in a wide range of applications, both large and small. Inside the Bal Contact®, the spring's coils act independently to compensate for misalignment and surface irregularities, ensuring superior multi-point contact and conductivity with minimal heat rise—even in shock and vibration.

## Commitment to Quality

Under our ISO 9001:2015 certified quality system, every step—from design to manufacturing, packaging and shipping—is closely monitored and controlled. This comprehensive Total Quality Management approach results in custom-engineered solutions that meet or exceed your most demanding quality requirements.



## Important Information

### CLEANING

Bal Seal Engineering products may require cleaning and/or sterilization before use, depending on the application.

### TESTING

It is essential that the customer run evaluation tests to determine if the proposed, supplied, or purchased Bal Seal Engineering products are suitable for the intended purpose. Run tests under actual service conditions with an adequate safety factor.

Welded springs have an increased probability of breaking or failing at or near the weld. This probability is magnified if the spring is used in an application involving extension of the spring. In addition, temperature affects the properties of the spring (i.e., tensile strength, elongation, etc.) Failure of Bal Seal Engineering products can cause equipment failure, property damage, personal injury, or death. Equipment containing Bal Seal Engineering products must be designed to provide for any eventuality that may result from a partial or total failure of Bal Seal Engineering products.

Bal Seal Engineering products must be tested with a sufficient safety factor after installation and be subjected to a program of regular maintenance and inspection. The customer, through analysis and testing, is solely responsible for making the final selection of the products and for ensuring that all performance, safety, and other requirements of the application are met.

All information and recommendations contained herein are based on tests Bal Seal Engineering believes to be reliable, but the accuracy or completeness is not guaranteed. Any such information or recommendation is given solely for purposes of illustration and is not to be construed as a warranty that any goods will conform to such information or recommendation. No one, including Bal Seal Engineering employees, salespersons, representatives, wholesalers, or distributors is authorized to make any warranty or representation, and no customer or other user may rely on any such warranty or representation. Bal Seal Engineering reserves the right to make any changes (such as dimensional data, force, torque, materials, pressures, temperatures, surface finishes, surface speed, etc.) without notice to its products and to the contents of this document.

Nothing contained herein or in any of Bal Seal Engineering's literature constitutes a license or recommendation to use any process, or to manufacture, or to use any product in conflict with existing or future patents covering any product material or its use.

### DISCLAIMER OF ALL WARRANTIES

The implied warranties of merchantability and fitness for a particular purpose and all other implied warranties are expressly disclaimed. There are no express warranties, except those, if any, specifically enumerated in this document.

### LIMITATION OF LIABILITY/REMEDIES

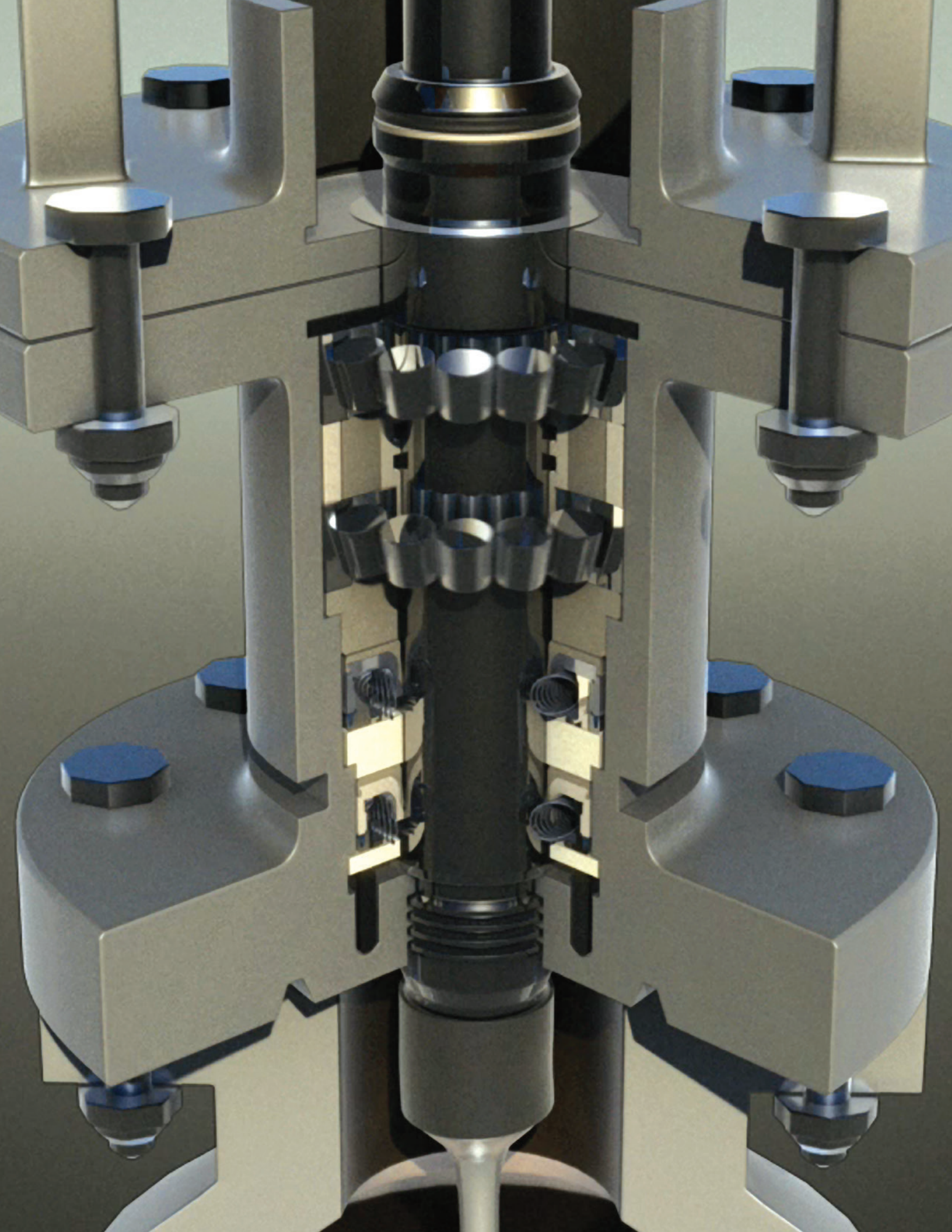
The liability of Bal Seal Engineering, whether as a result of breach of any warranty, failure to provide timely delivery products, product malfunction, negligence or otherwise, shall be limited to repairing or replacing the non-conforming products or any part thereof, or, at Bal Seal Engineering's option, to the repayment to the customer all sums paid by the customer upon return to Bal Seal Engineering of the non-conforming products or part thereof. It is expressly agreed that the customer's remedy, as stated above, shall be exclusive and that under no circumstances shall Bal Seal Engineering be liable for any other damages, including direct, indirect, incidental, or consequential damages (LE-173-5 Rev. 0).

### PATENTS

The products described herein include those which are the subject of pending and issued patents, both foreign and domestic, including patent 8,328,202 (LE-173 Rev. F).

Copyright 2018, Bal Seal Engineering, Inc.







We're more than just a component maker. In early development or existing product improvement stages, we combine our proven seals, springs, and electrical contacts with engineering, material science, and precision manufacturing expertise to produce solutions that break down performance barriers.



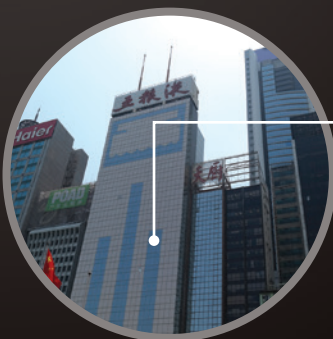
### Americas

Bal Seal Engineering, Inc.  
19650 Pauling, Foothill Ranch, CA 92610-2610  
Telephone +1 949 460 2100 or Toll Free +1 800 366 1006



### Europe, Middle East, Africa

Bal Seal Engineering Europe B.V.  
Jollemanhof 16, 5th floor, 1019 GW Amsterdam  
The Netherlands  
Telephone +31 20 638 6523



### Asia Pacific

Bal Seal Asia Limited  
Suite 901, Chinachem Century Tower  
178 Gloucester Road, Wanchai, Hong Kong  
Telephone +852 28681860



[www.balseal.com](http://www.balseal.com)   [sales@balseal.com](mailto:sales@balseal.com)

Custom components that drive tomorrow's technologies.®