



Flow Solutions Division

BW Seals

Durametallic Seals

Pacific Wietz Seals

Pac-Seal

GASPAC[®] Compressor Gas Seals



Offering a full line of fluid sealing technology for virtually every service and application



A New Era in Fluid Sealing

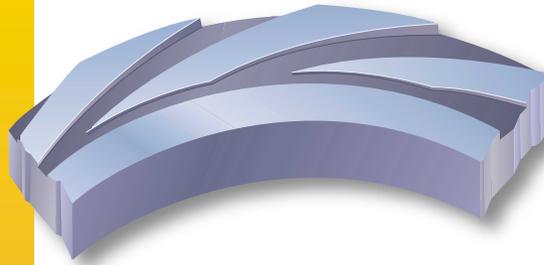
Industry leaders Durco International Inc. and BW/IP International, Inc., makers of Durametallic® GC Compressor Gas Seals and Pacific Wietz™ GASPAC® seals, have come together to form Flowserve Corporation. In an industry first, we have combined our technologies and experience to present you with more opportunities for success than ever before. The Flowserve Flow Solutions Division offers the best of existing technology in one comprehensive product line, with configurations tailored to each application.

Not only do we provide the best service, responsiveness, and innovation, we also make superior fluid seals.

As you review the features of our compressor gas seal line, you will find innovative solutions to hang-up, reverse rotation, reverse pressurization, and centering of rotating components.

Our GASPAC Compressor Gas Seal line now features a choice of the patented Advanced Pattern Groove unidirectional face pattern and the bidirectional, symmetrical “T” groove face pattern, plus a choice of dynamic sealing options, all within a universal housing.

Advanced Pattern Groove (APG) Unidirectional Face Pattern



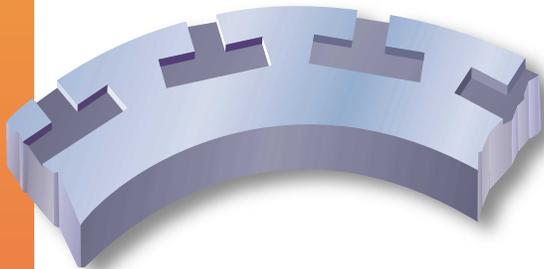
Our unidirectional Advanced Pattern Groove face represents a breakthrough in dry-running gas seal face technology. The APG incorporates specially designed tapered grooves that become progressively more shallow as they reach the circumferential groove. Flowserve's APG design outperforms traditional spiral groove designs with lift-off at lower speeds, low-pressure hydrostatic lift, and better film stiffness performance.

- Under static conditions, the APG allows the sealed gas pressure to penetrate deeply across the face. The circumferential groove next to the sealing dam ensures uniform pressure

distribution. The combination of these design features provides extraordinary hydrostatic lift, resulting in low torque at start-up.

- During dynamic operation, any face pattern creates additional pressure to separate the faces so they are noncontacting. The APG extends farther across the face than conventional unidirectional patterns, providing early lift-off and better performance at extremely low speeds. The tapered groove depth of the APG allows the faces to rapidly adjust, providing stable operation during changing process conditions. The deeper grooves at the face periphery pump the sealed medium toward the center dam, developing pressure to cause hydrodynamic lift. The APG operates with noncontacting seal faces, thus keeping parasitic horsepower requirements low.

Symmetrical T-groove (SMT) Bidirectional Face Pattern



Flowserve's GASPAC seals are the industry leader in bidirectional technology. The SMT also provides increased protection with a unique bidirectional T-groove face design, and can operate in a clockwise or counterclockwise rotation. This attribute provides optimum protection from reverse rotation. It also reduces the need for separate spare seal cartridges for each end of a beam-type compressor, because the same seal can operate in either end of the compressor.

- In static operation, the aerostatic balance of the SMT results in face separation above 30 psig. Optimized face balance allows for stable operation and minimal leakage rates.
- During shaft rotation in either direction, gas flows into the symmetrical T-grooves and is pumped circumferentially toward the edge of the groove. Stagnation of gas flow at the edge builds pressure and results in hydrodynamic lift-off—even at low peripheral speeds above 6.6 ft./sec. The unique design of the SMT also provides lower leakage than conventional patterns. The SMT also operates with noncontacting seal faces, thus keeping parasitic horsepower requirements low.

Dynamic Seal Options:

Choosing a Face Pattern is NOT the End of the Story

While choosing the right seal face design is essential, dependable secondary seals are just as important to the reliable operation of any gas seal. Flowserve offers a

spring-energized O-ring seal within regular operating range, and a spring-energized PTFE J-ring seal for extended operating range. Our innovations in

secondary seals are designed to eliminate the causes of O-ring hang-up, the most common operational challenge in other compressor gas seal designs.

Spring Energized Standard Design O-Ring

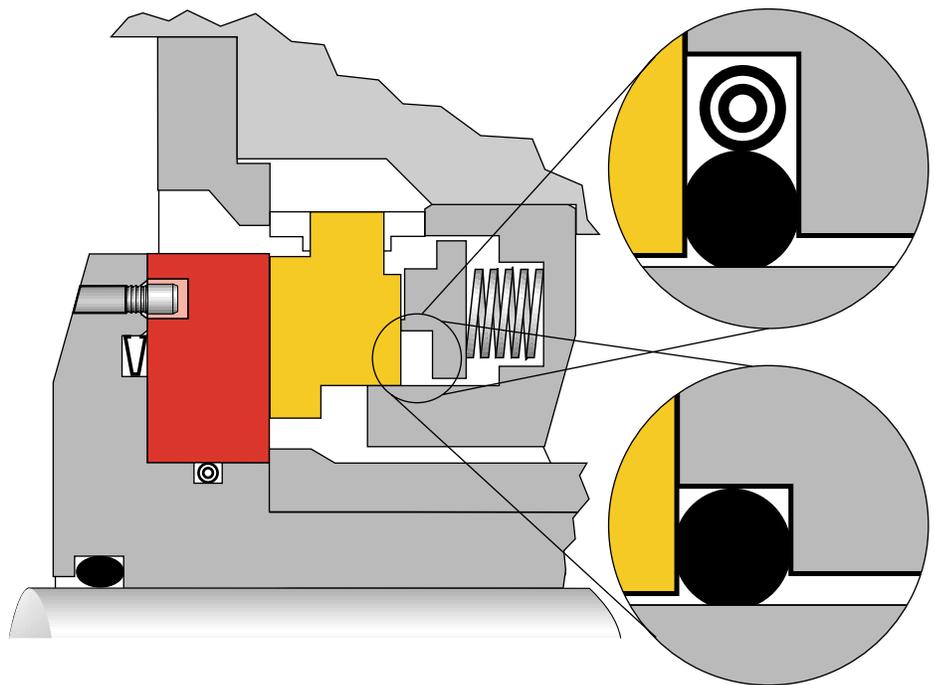
Our proprietary dynamic secondary seal arrangement does not squeeze the O-ring in a fully confined groove, as in conventional gas seals. Instead, a 90+ Durometer dynamic O-ring is energized with the aid of a garter spring located on its outside diameter. While closing springs provide the O-ring axial compression between the stator and spring retainer, the garter spring provides adequate radial compression to effectively seal the gas medium. Live loading of the dynamic O-ring provides constant sealing force while compensating for O-ring cross-section irregularities or swelling due to temperature or chemical reaction. The O-ring conforms to the sealing surface when inconsistencies exist on the surface or in the presence of dirt or deposits on the sealing surface. Drag and seal hang-up are greatly reduced.

Reverse Pressure Capability

The 90+ Durometer dynamic O-ring provides optimum properties for applications up to

105 bar (1500 psig). The O-ring is designed to resist extrusion. Its high density minimizes the possibility of explosive decompression. Additionally, because the O-ring is not confined

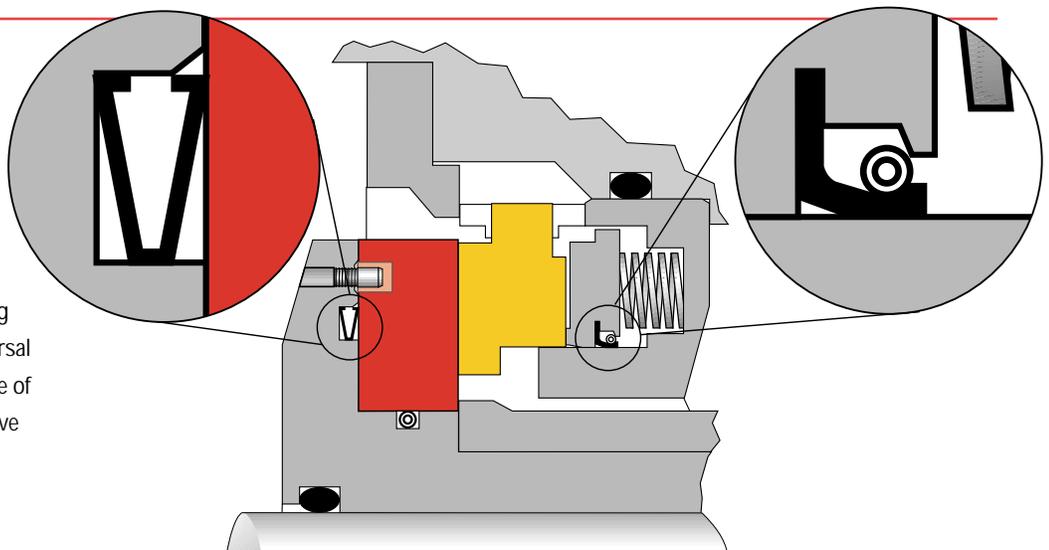
radially, reverse pressure is easily handled. Back pressure is relieved by the O-ring and garter spring system, reducing the reverse pressure buildup that can cause other seals to fail.



Polytetrafluoroethylene (PTFE) Sealing Elements Optional Design

PTFE J-Ring Seal

The PTFE dynamic seal, or J-ring seal, extends the operating range to temperatures of -100°C to 230°C (-148°F to 446°F) and pressures up to 230 bar (3,300 psig). PTFE is also used for its extended chemical resistance beyond that of O-rings. The J-ring has a spring energized lip that functions similarly to the spring energized O-ring. The lip maintains contact with the sliding surface to provide a reliable seal. Pressure reversal is also handled effectively. The nonporous nature of PTFE has proven effective at minimizing explosive decompression. The combination of GASPAC's hard-versus-hard face configuration and J-ring design has allowed us to handle the highest pressures across a single seal face.



Centering of Rotating Components

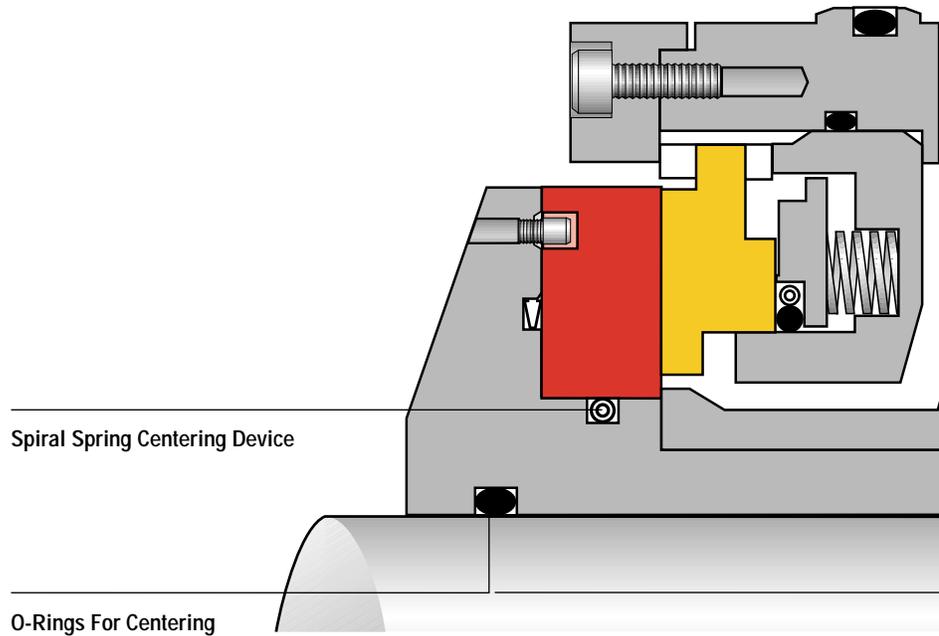
Rotating Face Centering

In both standard and advanced configurations, the rotating face is centered by a spiral spring to ensure concentricity with the seal shaft sleeve. The spiral centering spring is designed to provide a centering force that always exceeds the eccentric force. The spiral centering spring allows for even force distribution around the entire inner diameter of the rotating face. This even distribution minimizes radial stresses in the rotating face.

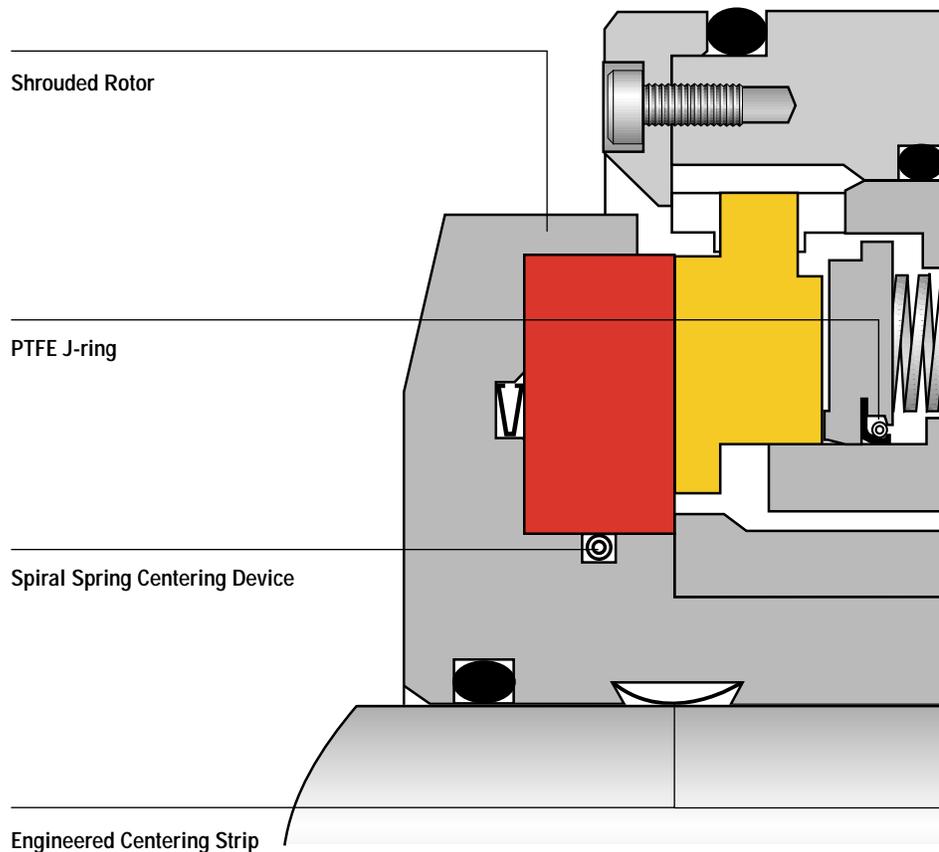
Shaft Sleeve Centering

The shaft sleeve is centered utilizing O-rings as a standard where size and speed permit. The O-ring provides ease of installation and enhanced dampening characteristics. An engineered centering strip is used on seals that exceed the size and speed permitted for O-rings. The engineered centering strip is fully captured in a dovetail groove, ensuring positive retention during seal installation and removal. The centering strip is engineered to provide proper force to maintain concentricity without damaging the compressor shaft. The centering strip is available as an option on any seal.

Standard Features, GASPAC® Compressor Gas Seal

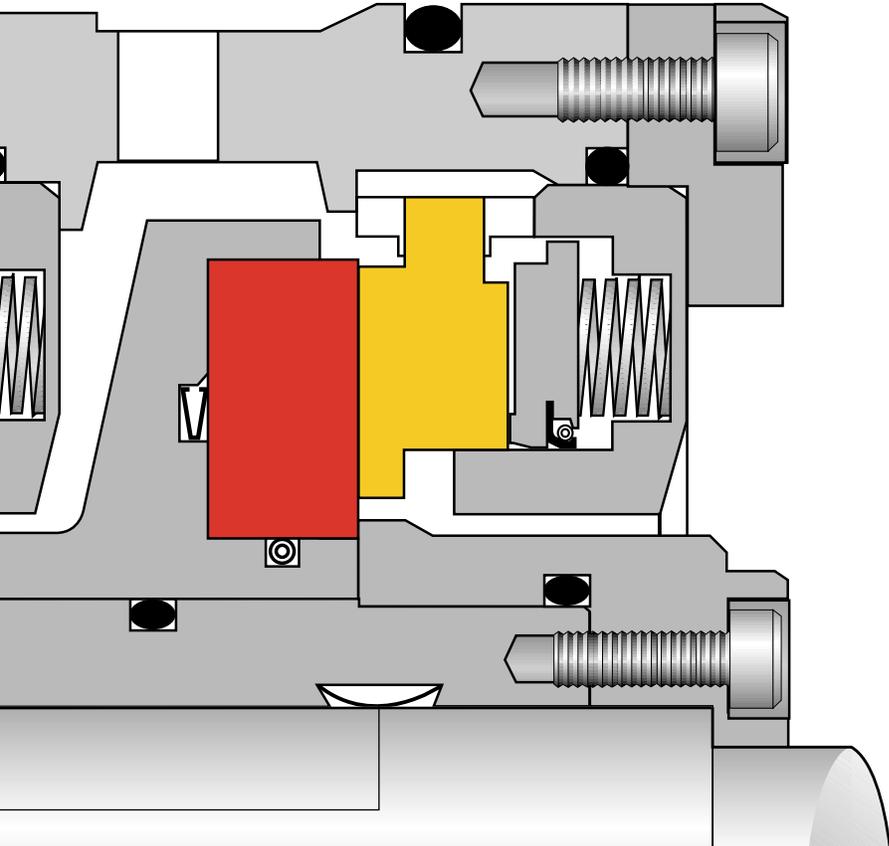
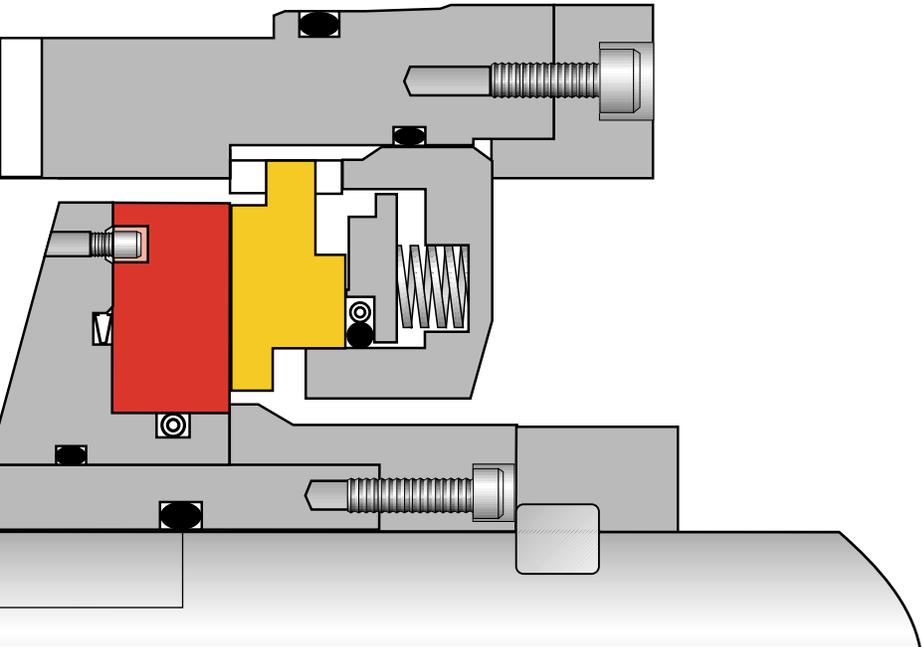


Advanced Product Features, GASPAC® Compressor Gas Seal

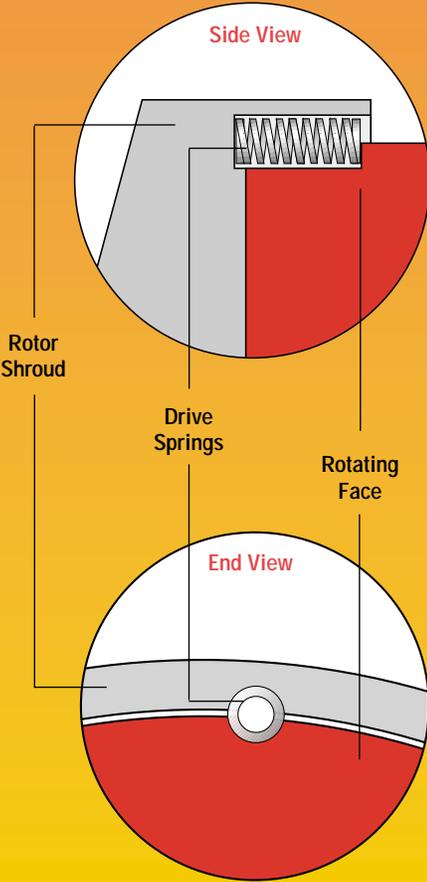


Shrouded Rotor Option

Shrouding the rotor provides extra protection in the unlikely event of a catastrophic seal failure. This design features a patented distributed-load arrangement utilizing drive springs. These drive springs ensure multiple-point contact across the length of the spring and at the multiple spring locations around the rotor. This further increases the reliability of the GASPAC compressor gas seal.



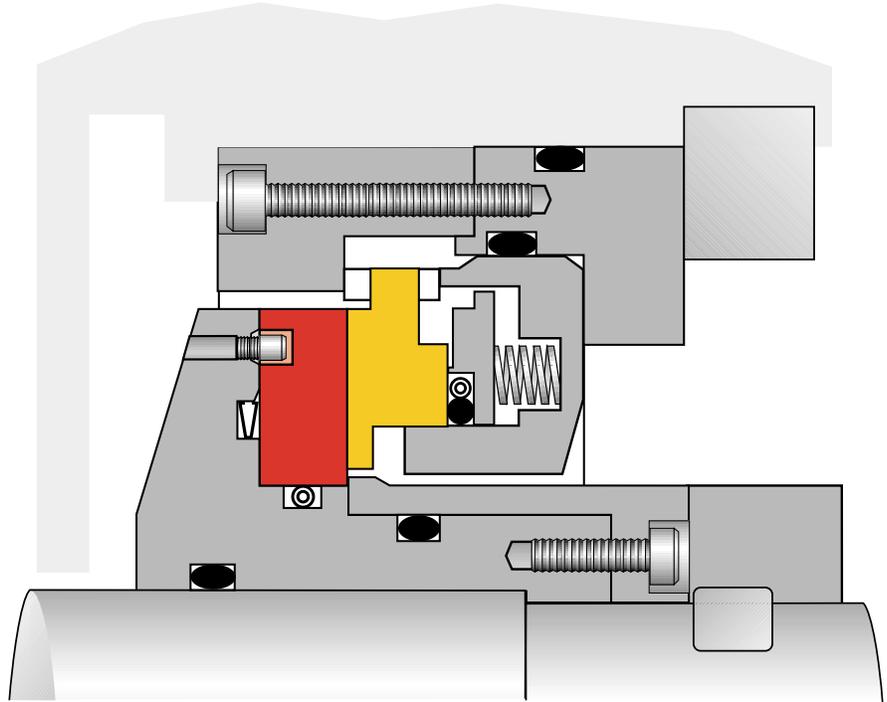
Product features can be configured separately.



Seal Configurations

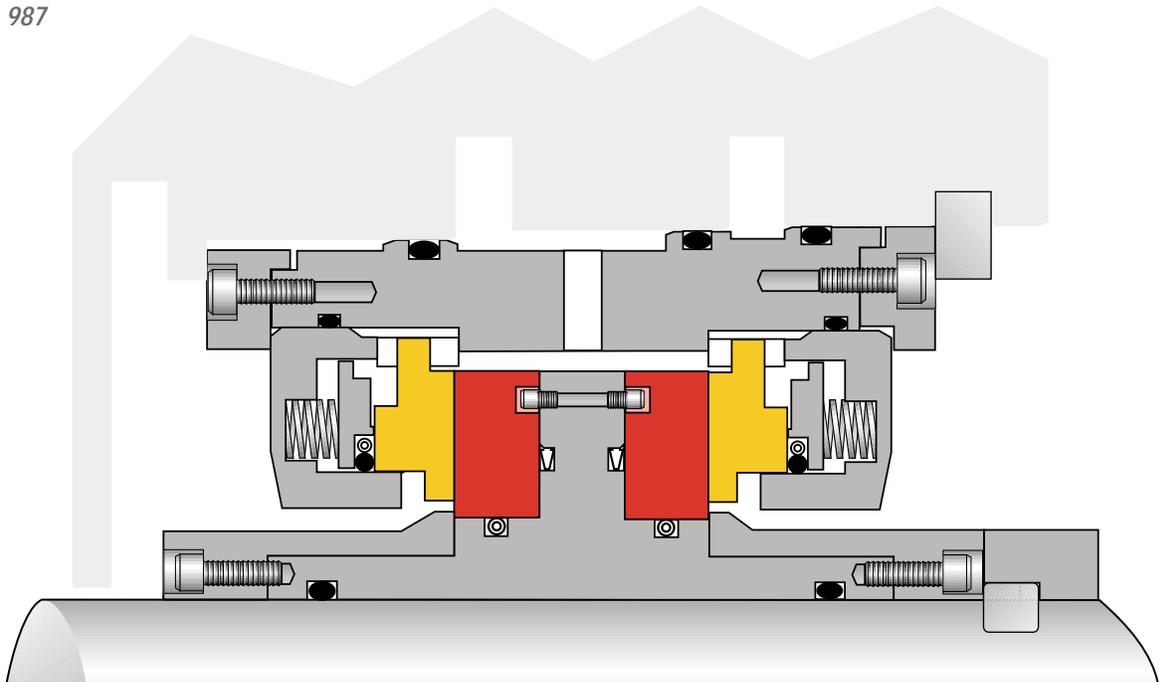
GASPAC S (Single Seal) 985

A single seal design is suitable for moderate-pressure applications where the gas sealed, such as air, nitrogen, or carbon dioxide, is neither flammable nor harmful to the environment. Seal leakage is to the atmosphere. A labyrinth seal may be integrated to reduce the amount of leakage in the event of a failure.



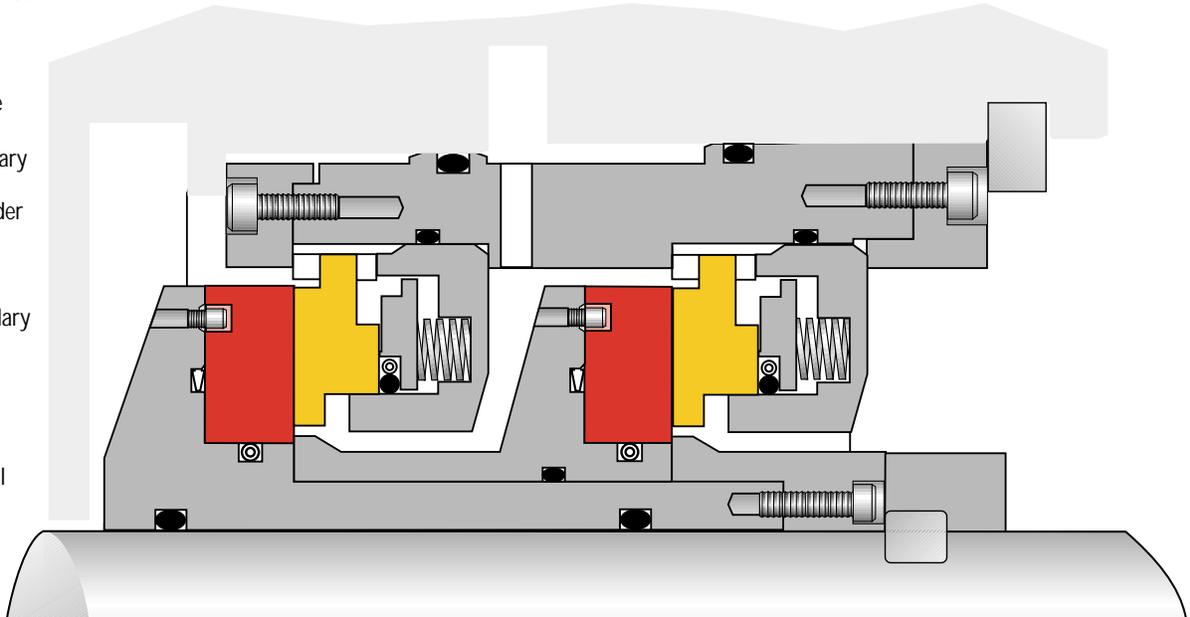
GASPAC D (Double Seal) 987

The double opposed seal configuration requires a barrier gas pressure higher than the pressure of the process gas being sealed. This configuration can be used where any leakage of the process gas is not permissible, where consumption of filter buffer gas needs to be minimized, or in dirty gas application.



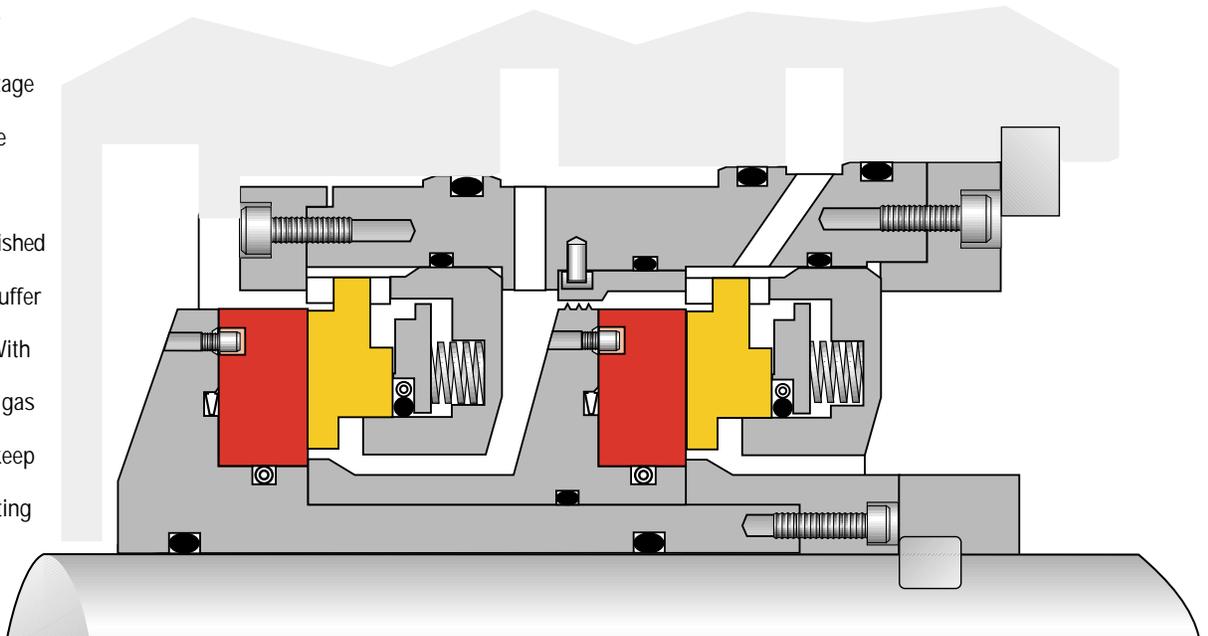
GASPAC T (Tandem Seal) 986

The tandem seal provides full pressure breakdown across the primary seal faces. The secondary seal faces normally operate under low pressure. In the event of primary seal failure, the secondary seal acts as an installed spare. The process gas has controlled leakage across both sets of seal faces. The tandem seal has become an industry standard for hydrocarbon or critical applications.



GASPAC L (Tandem Seal with Interstage Labyrinth) 984

The tandem seal with interstage labyrinth is used to eliminate process gas leakage to the atmosphere. This is accomplished by introduction of an inert buffer gas to the secondary seal. With a slightly higher inert buffer gas pressure, the labyrinth will keep the process gas from migrating to the secondary seal faces. The interstage labyrinth provides a low-pressure solution to controlling emissions across a gas seal.



Technical Information and Operating Parameters

Pressure	0 to 230 bar, 0 to 3,300 psi
Speed	Up to 200 meters per sec., up to 650 feet per sec.
Temperatures	-100°C to 230°C -148°F to 446°F
Rotating Face Materials	Silicon Carbide Silicon Nitride
Stationary Face Materials	Special Grade Carbon Silicon Carbide

While the above capabilities are extensive, Flowserve has successful experience beyond these parameters. Contact your local Flowserve Product Representative to discuss your specific applications.

Barrier Seals

Flowserve offers a complete line of barrier seals. The barrier seal is an integral component of successful compressor gas seal operation. Barrier seals are designed to keep oil within the bearing housing from contaminating the compressor gas seal. We manufacture center tap labyrinth barrier seals with abradable bushing, in addition to segmented carbon ring barrier seals.

Control Panels

A properly engineered control panel provides the right environment for successful operation of the compressor gas seal. The panel distributes filtered gas to buffer the seal and energize the barrier seal. It also monitors gas seal performance. Flowserve offers standard configurations that provide reliable, economical support for your gas seals. We can also custom-engineer panels to meet your specific requirements.

Flowserve's Retrofit Assistance Program

Converting from an oil seal to a GASPAC compressor gas seal can quickly pay for itself in improved reliability and lower operating costs. Yet, the logistical complexity of a proposed changeover can't be underestimated. Flowserve's Retrofit Assistance Program helps ensure an efficient changeover with minimal downtime. Beginning with an application engineering phase that analyzes your current system, the Flowserve program includes seal installation assistance, complete operating and maintenance documentation, instrumentation, seal commissioning, and training of plant personnel.



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For more information about the wide array of Flowserve fluid sealing options available to you, contact your Flowserve Product Representative. Also visit the Flowserve Compressor Seal Group at our corporate web site, www.flowserve.com

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