

# Metal Bellows

Seal Range



**the AESSEAL® group of companies**

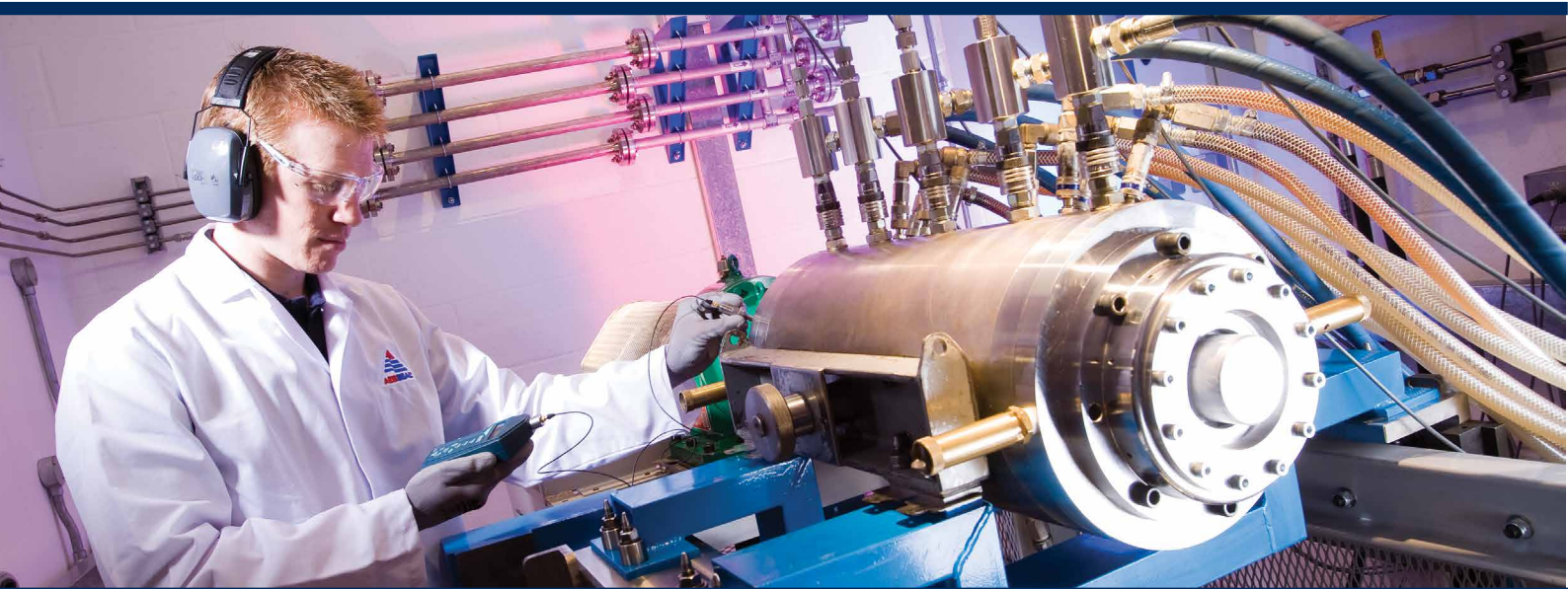
designers and manufacturers of mechanical seals,  
bearing protectors and seal support systems  
which maximize rotating equipment up-time.

## Company Overview

AESSEAL® is a leading global specialist in the design and manufacture of mechanical seals, bearing protectors and seal support systems. With operations in six continents, AESSEAL® is the world's 4th largest supplier of mechanical seals, achieving growth through exceptional customer service and innovative products that provide real customer benefits.

For every seal developed by AESSEAL®, we use state-of-the-art computational facilities and numerical tools to design and optimize seal performance prior to manufacture and testing. These tools include Predictive Software Code developed in-house, Finite Element Analysis (FEA) and Computational Fluid Dynamics (CFD). Our numerical tools are used for seal design, performance optimization, special product application and troubleshooting. In combination with an extensive test program the result is world-leading technology that keeps your equipment running longer.

Over 7% of annual sales revenue has been reinvested in R&D over several decades. This has almost certainly led to the most advanced range of sealing technology available globally.



“Our purpose is to give our customers such exceptional service that they need never consider alternative sources of supply.”

**C.J. Rea**  
Managing Director

## Metal Bellows Range of Mechanical Seals

AESSEAL® produces a wide range of modular metal bellows seals, with an emphasis on high quality manufacture.

Compared to some competitor designs, our bellows are manufactured using superior materials of construction, a more expensive “edge welding” process, and feature 50% more convolutions as standard. We take this higher-quality approach to deliver our customers a longer lasting mechanical seal.

### Generalized Advantages of Metal Bellows Seals

The single undeniable benefit of using a metal bellows seal is the removal of a semi-dynamic sliding elastomer from a conventional pusher type mechanical seal. This removes the potential for mechanical seal hang-up. Bellows designs can also perform better in some high temperature applications.

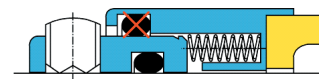
**High-Tech Quality Control** — Our metal bellows manufacturing process incorporates 12 separate verification checks and over 26 individual production checks. This ensures that the bellows manufacturing process is one of the most strictly controlled in the entire organization.



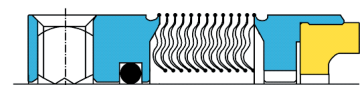
**Welding** — Computer Numerically Controlled (CNC) precision welding technology generates consistent high quality welds. These are then checked with three separate helium leak checks for each and every component to verify the quality of the process.

**Heat Treating on Full Bellows Assemblies** — The joint between the bellows stack and end fittings is often where bellows failure occurs, due to the last end weld not getting heat treated in some designs found on the market. Our entire bellows assemblies for extreme temperature applications go through an extensive three phase heat treatment process. In-house facilities include state of the art ovens and a subzero, temperature controlled freezer to conduct the necessary material transformation. Additional samples are produced for every heat treatment batch, which are subjected to a destructive micro-hardness check.

AES Pusher Seal



AES Bellows



The main advantage of metal bellows seals is the removal of the semi-dynamic sliding elastomer from a pusher seal (shown above with red cross) which removes the potential for mechanical seal hang-up.





## Global

Customer service is provided from 230 locations in 104 countries, including 9 manufacturing and 44 repair locations, with more than 300 customer service representatives who visit industrial plants every day.



### USA

"AESSEAL's ownership in the equipment is exceptional, as is its communication system. Our failure rate and reliability risks from seal failures have steadily declined. They provide maintenance and reliability with valuable information on the MTBF of the equipment."

### Argentina

AESSEAL has been extending rotating equipment MTBF at a leading refinery in Argentina for a number of years. In one application a Byron Jackson SJA pump, which operates in a hot light gas oil application at 300°C (572°F) was successfully sealed with a 1.750" AntCarb/SIC SAC BSFG, extending the equipment MTBF to 1,034 days from less than 365 days with the previous supplier. This success has been repeated on other applications within this refinery.

## Don't take our word for it...

### Canada

A plant was having trouble pumping high temperature oil: the mechanical seal supplied by a major competitor of AESSEAL was failing every 30 days, requiring 20 hours of maintenance to remove and reinstall each time.

The AESSEAL BQFD was installed due to the short working length of the pump, and API plan 62 low temperature steam quench was installed for the BQFD.

13 months after install (and counting) the seal was still in service, already a 1200% improvement on the previous seal life! The gland temperature had also dropped to 160°F (71°C), down from more than 450°F (232°C) in the previous arrangement.

### Germany

"I was delighted by the way the engineer at AESSEAL reacted. At 08:00hrs on a Sunday, the engineer measured up, opened up their workshop and we were running again on the Monday. AESSEAL jump immediately... Great service."

### Italy

"Our previous supplier indicated that it was impossible to better two months' performance on an application. AESSEAL implemented a solution that has been running for over 15 months without problems and are now a key supplier for the entire plant."

### Malaysia

"We in KTSB believe AESSEAL are reliable, dependable and above all a company that conducts its business with a high level of integrity."

### Spain

A customer had tried three different major competitors before AESSEAL, trying to achieve a reasonable seal life. Nothing worked, and despite everything they tried they were still getting just two weeks approximate average seal life.

The application was reclaiming used mineral oil, and was difficult because of a combination of 220°C (428°F) product temperature, 3000 RPM pump speed, and a corrosive product containing potassium hydroxide.

The AESSEAL solution avoided the use of elastomers entirely with a full-graphite, special metallurgy seal – a "BSFG-HHH FULL ALLOY 276" – and used API Plan 62 low pressure steam quench as a flush plan. This seal vastly outperformed the previous 2 week average life from the various competitors, and lasting over 14 times as long in this highly challenging application.

### South Africa

"We are not customers of AESSEAL but partners. With our input and AESSEAL's technical skills and reliable service, problem mechanical seals are a thing of the past."

### Australia

"A seal repair and installation within the same day allowed us to keep production going – and the technical ability and speed of AESSEAL is impressive. A very solid performance."

# AESSEAL® Metal Bellows Advantages

## Edge Welded

AESSEAL® only produces edge welded bellows. Tests have proved that such bellows offer a more linear “spring rate” compared to a rolled bellows favoured by other manufacturers. This has a direct effect on seal face pressure during seal operation, leading to longer seal life. Edge welded bellows are exactly what they say — two diaphragms, male and female, welded along their circumference to produce a convolution. These convolutions are then welded together to form a bellows stack.

## Superior Materials

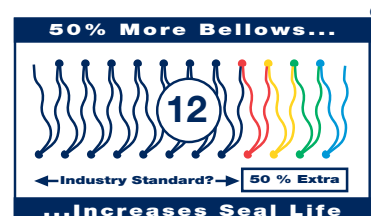
Alloy 276 has been selected by AESSEAL® as the material for its standard inventoried range of bellows.

Alloy 276 is a high Nickel alloy that has superior mechanical and corrosion resistance properties in comparison to bellows cores (such as 300 series Stainless Steel or Alloy 20 materials) which are frequently encountered in the market place.

Bellows manufactured from heat-treated AM350 and Alloy 718 are used where stable high temperature operation is required

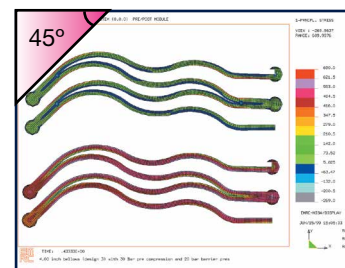
## Reduced Stress

12 convolutions are amongst the highest number of convolutions to be found in a standard metal bellows seal in the mechanical seal industry. With more bellows convolutions the less stress there is on each convolution in the bellows stack. Axial and radial deflections will also impact less on each of the bellows convolutions in a 12 convolution stack compared to an 8 convolution stack. Our 12 convolutions stack is more able to accommodate installation tolerances and will maintain a more consistent face pressure as the seal wears during use.



## Design

The bellows range of seals were created with the aid of the latest Computer Aided Design and Manufacture. Programs including Finite Element Analysis (FEA) showed that the 45° AESSEAL® male and female diaphragms are optimized to reduce stress on the weld beads.



## Testing

Computer simulation is increasingly effective in predicting performance, but all AESSEAL® mechanical seals still have to undergo thorough physical testing in a range of arduous environments. Tests are conducted on rigs which are capable of testing to API 682 requirements. The rigs are capable of testing seals in temperatures up to 300°C (572°F) at various speeds and pressures.





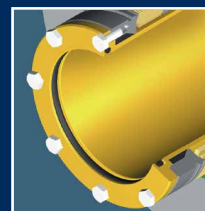


## Generalized Bellows Cartridge Seal Design Features

### Clamped Drive End

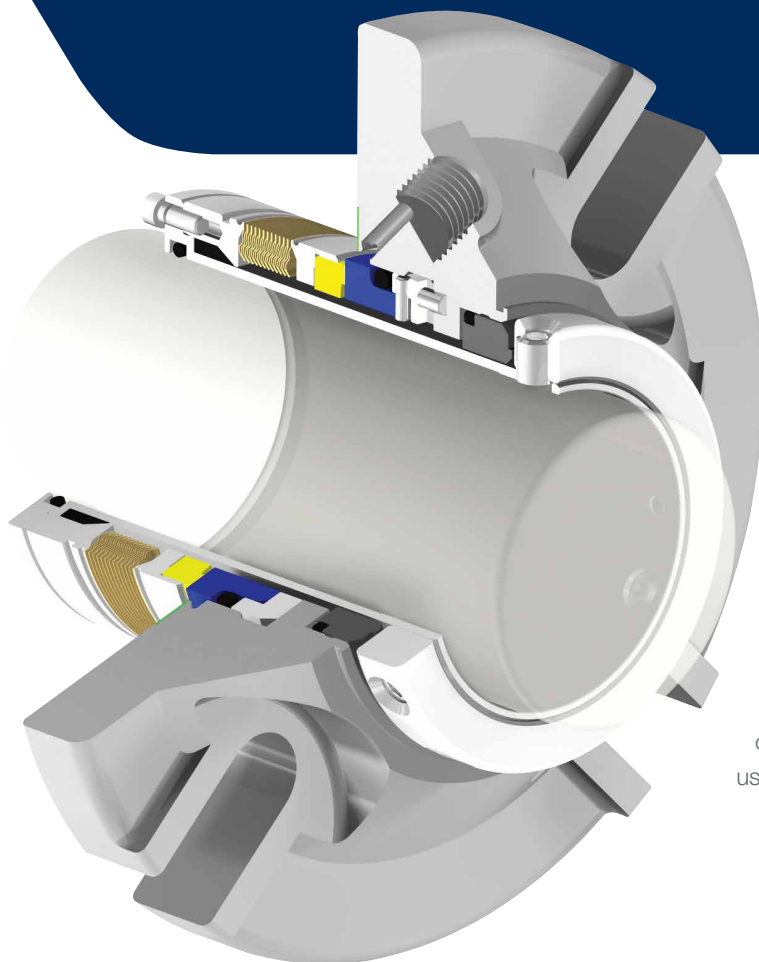
In many competitor designs socket set screws radially attach the bellows to the thin cartridge sleeve. This often results in radial sleeve distortion and assembly / disassembly problems.

AESSEAL's unique, thin cross section, **axially** clamped drive end prevents sleeve distortion.



### Advanced Bellows Design

The AESSEAL® bellows design includes 12 convolutions rather than the industry standard of 8. This can increase seal life by reducing the amount of stress on each convolution.



### Seal Face Design

Hydraulically balanced seal face design ensures optimum fluid film conditions. A wide range of stocked materials allows maximum flexibility and delivery performance.

### Reliable Drive

Drive screws clamp directly on to a shaft or sleeve to minimize drive loss. Drive screws which do not deform the seal sleeve ensure easy removal and refitting for equipment maintenance. Robust setting clips guarantee correct axial and radial positioning and can be re-used for removal and refitting.

## Metal Bellows Seals

### BSAI™ Component Seals with Elastomer Options

The seal is offered with the following features:

- Short working length suitable for BS EN 12756 (formerly DIN 24960) housings
- Suitable for limited space applications
- Hydraulically balanced for reduced seal-face loading
- No shaft fretting
- Excellent general service seal
- Fits 0.3125" (8mm) cross section in smaller pump models
- 12 convolutions metal bellows as standard

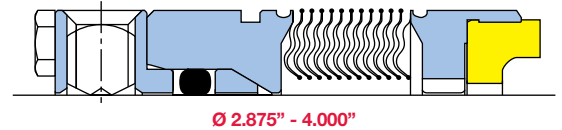
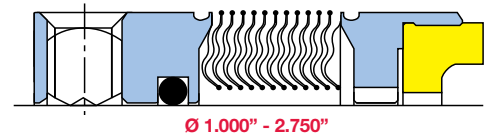


#### Imperial BSAI™

**Sizes available:** Ø1.000" - 4.000"

The BSAI™ range is available in a wide range of seal face and elastomer combinations, together with various stationary options.

Inventoried in 316L stainless steel with Alloy 276 bellows core. Other materials are available on request.

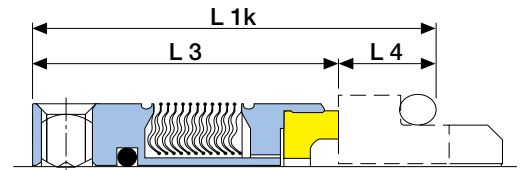


#### Metric BSAI™

The metric BSAI™ seals conform to BS EN 12756 (formerly DIN 24960) when used in conjunction with an AESSEAL® DIN stationary.

**Sizes available:** Ø 24mm - 100mm

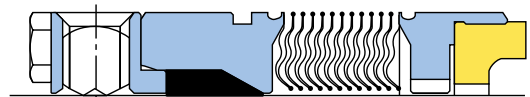
Inventoried in 316L stainless steel with Alloy 276 bellows core. Other materials are available on request.



### BSAIG™ Component Seals with Graphite Secondary Seal

The BSAIG™ component seal with secondary seal wedge employs the standard rotary unit in the AESSEAL® modular seal range. The seal is offered with the following features:

- Suitable for limited space applications
- Hydraulically balanced for reduced seal-face loading
- High performance single component seal
- Fits 0.3125" (8mm) cross section in smaller pump models
- Graphite secondary seal wedge offers excellent chemical resistance / thermal performance
- 12 convolutions metal bellows as standard
- No shaft fretting



**Sizes available:** Ø 1.000" - 4.000" (24mm - 100mm)





## BSIV™ / BSIV-N™ Bellows Single Cartridge Seal

The AESSEAL® BSIV™ range of single cartridge mechanical seals have been designed as a value for money, high performance sealing solution for general applications.

### The seal is offered with the following features:

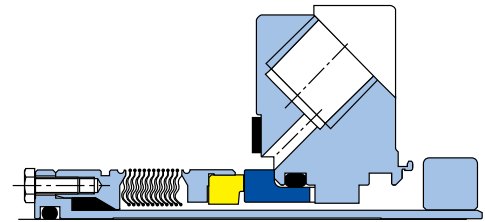
- Industry proven modular technology
- Cartridge design for ease of installation
- Requires no pump modification
- Ideal replacement for 2 part seals or previously packed stuffing boxes
- No shaft fretting
- Flush connection as standard
- 12 convolutions metal bellows as standard



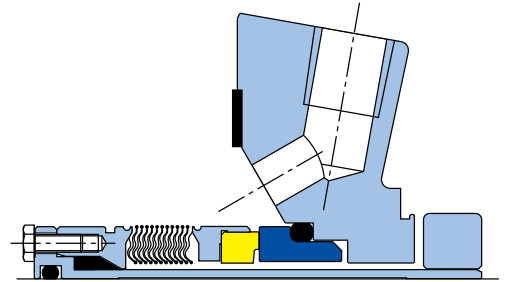
**Sizes available:** Ø 1.000" - 4.000" (24mm - 100mm)  
in a wide range of seal face and elastomer combinations.

**ANSI+ Sizes available:** Ø 1.125", 1.375",  
1.750", 1.875", 2.125", 2.500", 2.625", 2.750".

Inventoried in 316L stainless steel with Alloy 276 bellows core. Other material combinations available on request including a full Alloy 276 bellows and gland arrangement in all ANSI sizes.



Standard BSIV™



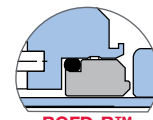
ANSI+ BSIV™

## BQFD™ / BQFD-R™ Bellows Quench, Flush and Drain Single Cartridge Seal

The AESSEAL® BQFD™ / BQFD-R™ range of single cartridge mechanical seals uses many of the same modular parts as a BSIV™ / BSIV-N™ but has the added features of Quench and Drain, making it usable in more diverse applications.

### The seal is offered with the following features:

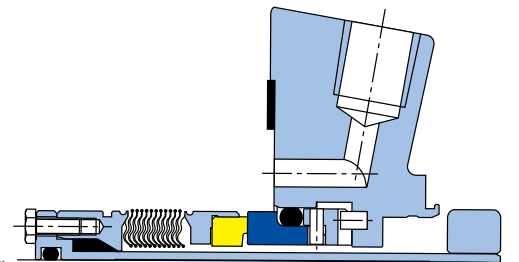
- Quench, Flush and Drain environmental ports with optional restriction bush (BQFD-R™)
- Alloy 276 wetted parts available
- Cartridge design for ease of installation
- Hydraulically balanced for reduced seal-face loading
- No shaft fretting
- 12 convolutions metal bellows as standard



BQFD-R™  
Restriction bush  
option



Standard BQFD™



ANSI+ BQFD™

**Sizes available:** Ø1.000" - 4.000" (24mm - 100mm)  
in a wide range of seal face and elastomer combinations.

**ANSI+ Sizes available:**  
Ø 1.125", 1.375", 1.750", 1.875", 2.125", 2.500", 2.625", 2.750".

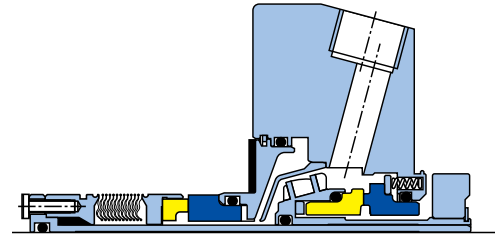
Inventoried in 316L stainless steel with Alloy 276 bellows core. Other material combinations available on request.

## BDFI™ / BDFC™ Bellows Double Flow Induction / Convection

The BDFI™ / BDFC™ is an innovative modular hybrid design combining the advanced features of two other AESSEAL® mechanical seals. The BDFI™ contains an integral, bi-directional pumping ring to improve barrier fluid circulation within the seal. Both the BDFI™ and BDFC™ contain a deflector to direct barrier fluid to both sets of seal faces. This effectively removes heat thereby helping to improve seal life.

### The seal is offered with the following features:

- Cartridge design unit for reliable installation
- Integral bi-directional flow inducer (on BDFI™)
- Directed barrier fluid circulation
- Fits on pumps with thin radial cross sectional spaces
- 12 convolutions metal bellows as standard
- No shaft fretting



Standard BDFI™

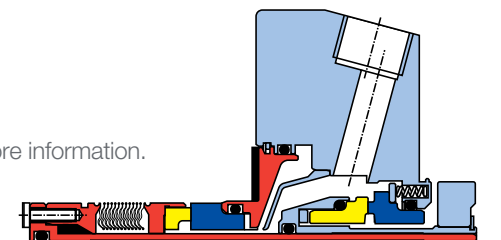
### Sizes available: Standard ISO / ANSI+ (Big Bore)

Ø 1.125" - 4.000" (28mm - 100mm) in a wide range of seal face and elastomer combinations.

Not all sizes are inventoried. Please contact AESSEAL® for more information.

Popular sizes inventoried in 316L stainless steel with Alloy 276 bellows core.

Other material combinations available on request.



Exotic BDFC™

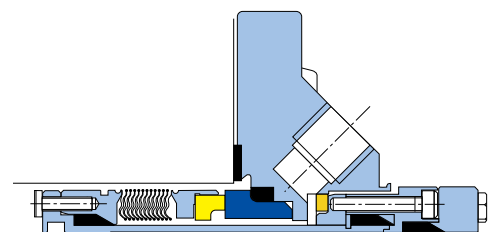
**Exotic BDFI™, BDFC™ and ANSI+** are all offered with wetted parts in Alloy 276.

## BSFG™ Bellows Single Full Graphite Cartridge Seal

The BSFG™ is specifically designed to eliminate the costly and often long lead-time issues of exotic elastomer compounds. This unique patent pending single cartridge mechanical seal has graphite secondary seals, completely eliminating the need for elastomers.

### The seal is offered with the following features:

- Full graphite seal for extreme temperatures or corrosive chemical applications
- Fits pumps with thin radial seal chamber cross-sections
- Quench, Flush and Drain ports for cooling or heating options to maximize seal life
- 12 convolutions metal bellows as standard
- Cartridge design for ease of installation
- Integral disaster bush
- No elastomers



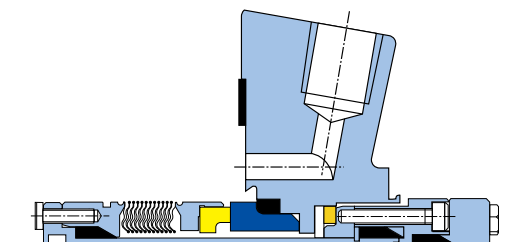
Standard BSFG™

### Sizes available: Ø1.000" - 4.000" (24mm - 100mm)

In a wide range of seal face combinations. Not all sizes are inventoried.

Please contact AESSEAL® for more information.

**ANSI+ Sizes available:** Ø 1.125", 1.375", 1.750", 1.875", 2.125", 2.500", 2.625", 2.750".



ANSI+ BSFG™

## Oil, Gas and Petrochemical Seals

Having supplied the Hydrocarbon processing and associated industry sectors since the early 1990s, AESSEAL® has a proven track record of extending equipment life, reducing expenditure on seals and optimizing inventory levels for customers in 104 countries.

### CAPI™ Type B Category II and III Single and Dual Seals



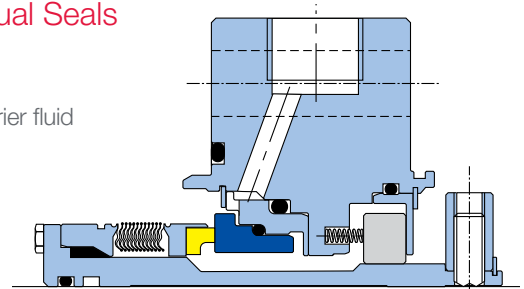
- Qualification Tested to API 682
- Effective seal-face heat dissipation achieved by a directed barrier fluid flow path, irrespective of shaft rotational direction
- Multi-port Flush design offered as standard for optimum seal-face cooling
- 12 edge-welded bellows convolutions as standard
- All sizes available from 0.750" to 4.375" (20mm - 110mm)

#### Bellows Convolution Materials:

Alloy 718, AM350 and Alloy 276 as standard

#### Seal-Face Holder Materials:

Alloy 42, Alloy 625, 316L S/S and Alloy 276 as standard

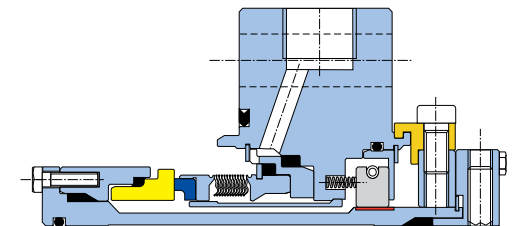


AESSEAL® CAPI™ Type B Single Seal

### CAPI™ Type C Single and Dual Seals

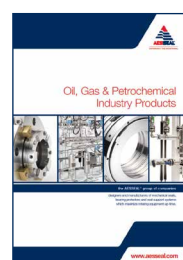


- Qualification Tested to API 682
- World-leading bi-directional pumping ring performance with 0.062" (1.5mm) clearance between rotor and stator, conforming with API 682 Section 8.6.2.3 **without compromise**
- Effective seal-face heat dissipation achieved by directed barrier fluid flow path in both single and dual designs
- Segmented floating containment bush operates on a hard plated cartridge sleeve as standard (single seal)
- Identical seal-face technology employed at the inboard and outboard positions (dual seal)
- All sizes available from 0.750" to 4.375" (20mm - 110mm)



AESSEAL® CAPI™ Type C Single Seal

For more information please see  
the product literature or visit:  
[www.aesseal.com/seals](http://www.aesseal.com/seals)



CAPIMAIN



PIPINGPLAN





ENVIRONMENTAL TECHNOLOGY

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[www.aesseal.com](http://www.aesseal.com)

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**AESSEAL plc is certified to:**

ISO 9001, ISO 14001, ISO/IEC 20000, ISO/IEC 27001,  
ISO/TS 29001, ISO 37001, ISO 45001 & ISO 50001



Net Zero champions globally



INVESTOR  
IN PEOPLE

Use double mechanical seals with hazardous products.

Always take safety precautions:

- Guard your equipment
- Wear protective clothing



**WARNING**

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