AESSEAL®
ENVIRONMENTAL TECHNOLOGY

Compressor Dry Gas Seals and Systems

Capabilities and Facilities

the AESSEAL® group of companies

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

www.aesseal.com

Company Overview

AESSEAL® is a leading global specialist in the design and manufacture of mechanical seals, bearing protectors and seal support systems.

The company sets new standards in reliability, performance, service and cost. Service has been the key to the success of AESSEAL® and is at the core of the company purpose statement — **'to give our customers such exceptional service that they need never consider alternative sources of supply.**' Through continuous investment, unique modular technology and an unparalleled dedication to customer service we aim to constantly exceed expectation.

Customer Focus

"We aim to deliver a customer experience that surpasses expectation and truly redefines what the world expects from their sealing specialist."

Simplicity. Our modular technology means a streamlined ordering process.

Customer-centric. Our people are encouraged to champion the customers' cause.

Ethical and Responsible. AESSEAL® has been recognized as a Climate Change Champion and has won awards for corporate social responsibility and sustainability.

Partnership. We work with customers to deliver added value and long-term reliability solutions.

Investment. 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.

Engineered Excellence

With a history of world leading innovation, AESSEAL® has unique patented technology for compressor dry gas seals and gas seal control and monitoring systems.

AESSEAL® produces a full range of compressor dry gas seals, pump dry gas seals, contacting and non-contacting gas containment seals and gas lift mixer seals in both uni-directional and bi-directional formats. In addition AESSEAL® engineer dry gas seal conditioning systems to achieve consistently improved reliability, in accordance with API or customer specific requirements.

Global

Customer service is provided from 235 locations in 104 countries, including 9 manufacturing and 44 repair locations, with more than 300 customer service representatives who visit industrial plants every day.

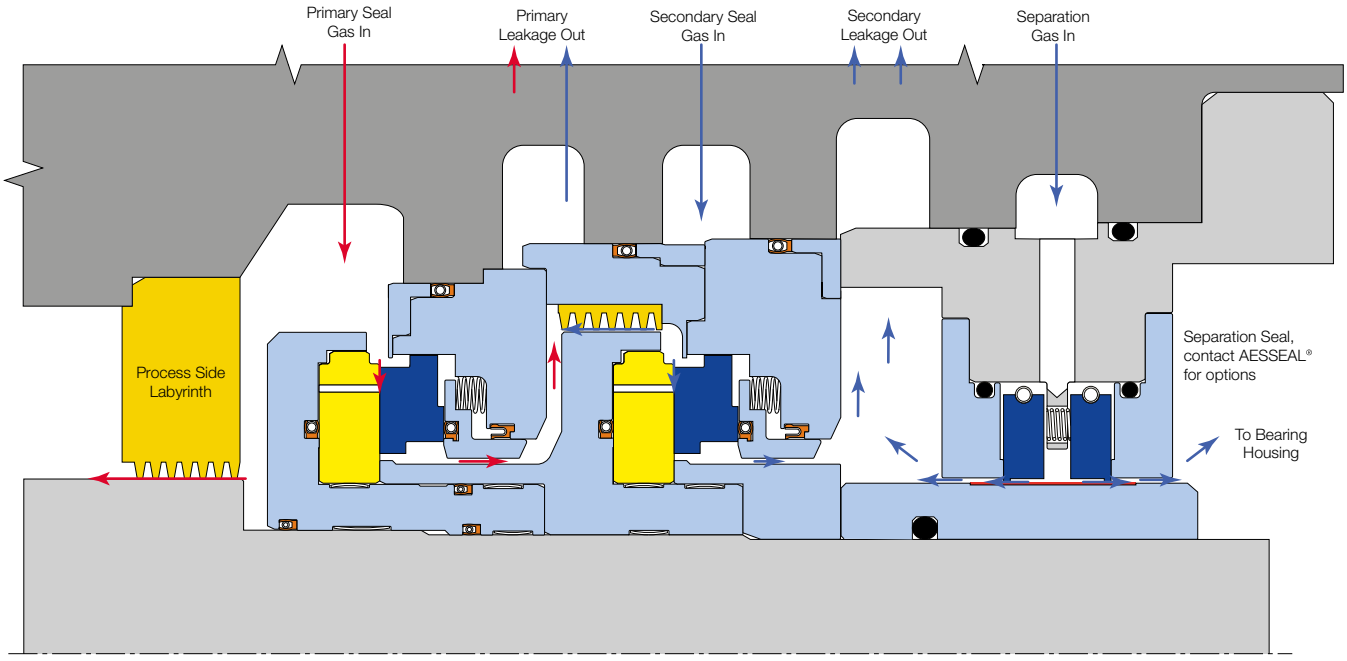
A full list of services are available on request from: **DGS-Services@aesseal.co.uk**

Compressor Dry Gas Seal Development Programme

The AESSEAL® compressor dry gas seal range has been designed to maintain an optimum sealing interface gap to ensure improved reliability, consistent performance and reduced gas consumption.

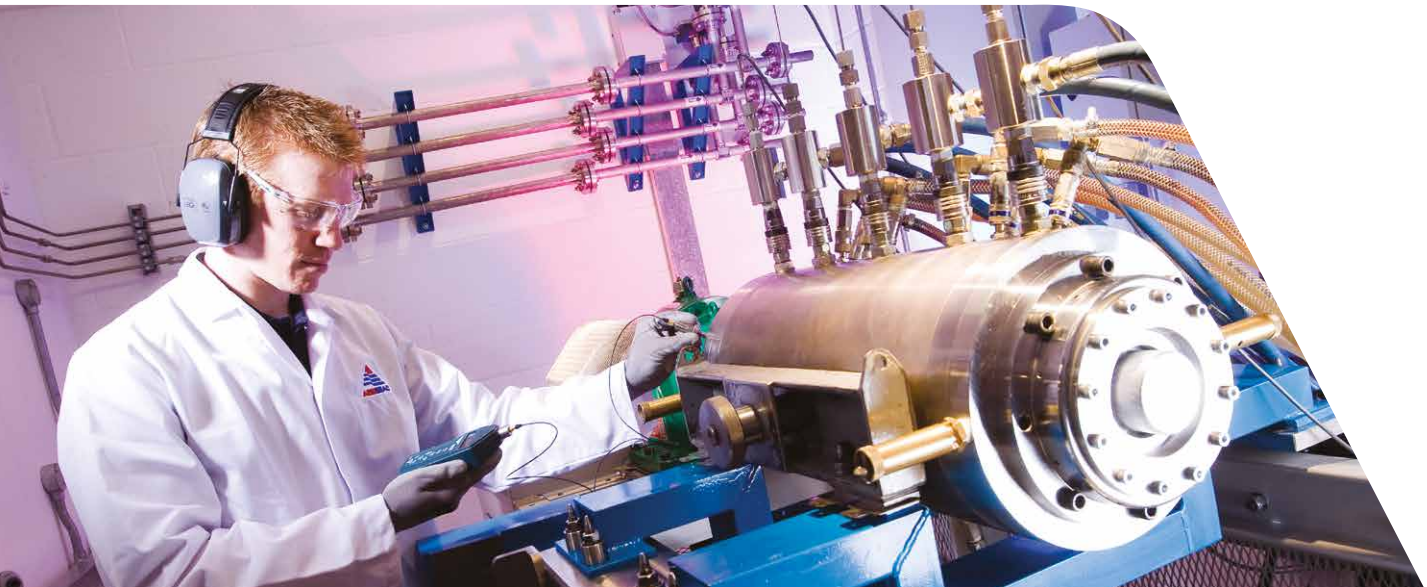
AESSEAL® Design and Testing

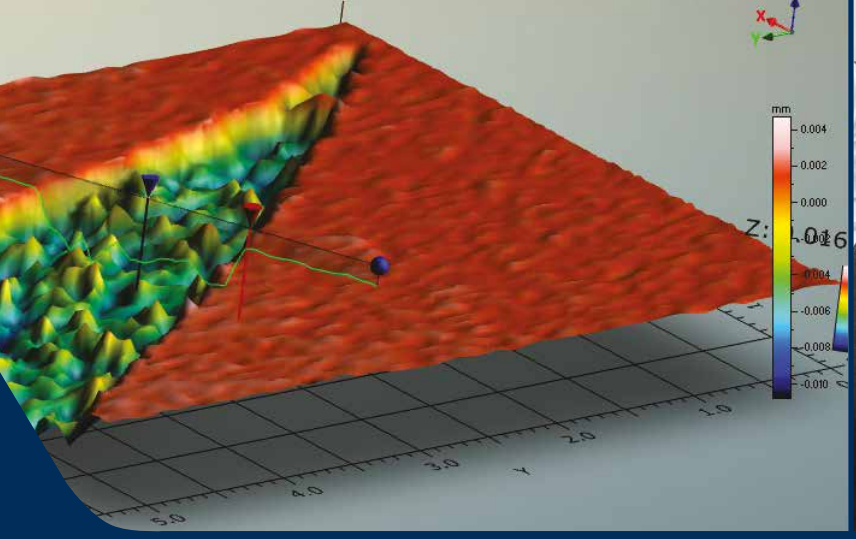
Sophisticated computational facilities and numerical tools are used at AESSEAL® to design and optimize seal performance prior to manufacture and testing. These tools include Predictive Software Code developed in-house, Finite Element Analysis (FEA) and Computational Fluid Dynamics (CFD). All compressor dry gas seals are dynamically tested as standard. The result is world-leading technology that keeps equipment running longer.



Gas flow path schematic - Tandem seal with intermediate labyrinth and separation seal

AESSEAL® compressor dry gas seal test facility





Inspection using 3D multi-sensor analysis

Advanced Face Technology

At the heart of any gas seal is the interface between the rotating and stationary sealing elements. AESSEAL® utilizes state-of-the-art laser scanning inspection technology to ensure consistent groove geometry.

Uni-directional, bi-directional and patented DualDam™ seal face technology means AESSEAL® has a design to suit the most arduous application. Laser scanning ensures sub-micron accuracy.

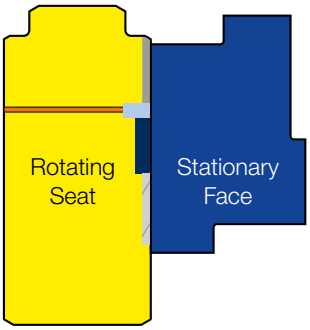
Uni-directional

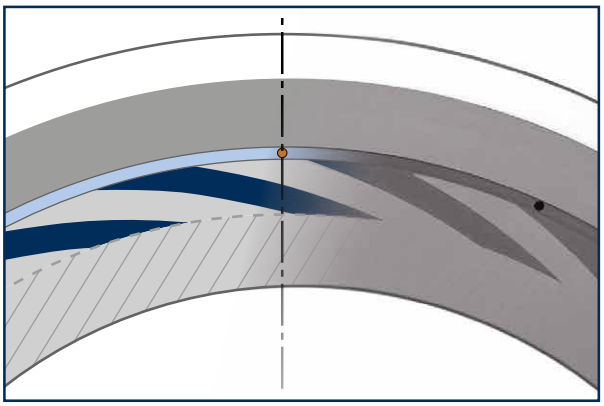
Bi-directional

DualDam™

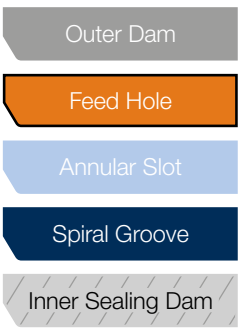
Our patented DualDam™ technology provides a more stable gas fluid film in all phases of operation to ensure a more reliable seal.

The DualDam™ gas intensifying design comprises 5 elements which combine to provide an optimum sealing interface. The design specifically addresses the period of transition between static and dynamic operation. This is the period where many dry gas seals are generally considered to be most vulnerable to a break down in the sealing interface. The 5 elements are described below.





Pictorial view of Pressure Intensifying System



During the static condition the outer sealing dam acts in conjunction with the feed holes and annular slot to provide controlled pressure decay. This allows for a pressure balance to be achieved providing a small opening force on the seal face. This opening force is known as the **hydrostatic** lift component of the separation mechanism. When conventional equipment is started there is a brief period where the seal faces will contact before sufficient **hydrodynamic** lift force is generated to separate the faces. Hydrostatic lift technology helps to eliminate this contact reducing the risk of seal failure.

Compressor Dry Gas Seal Manufacturing

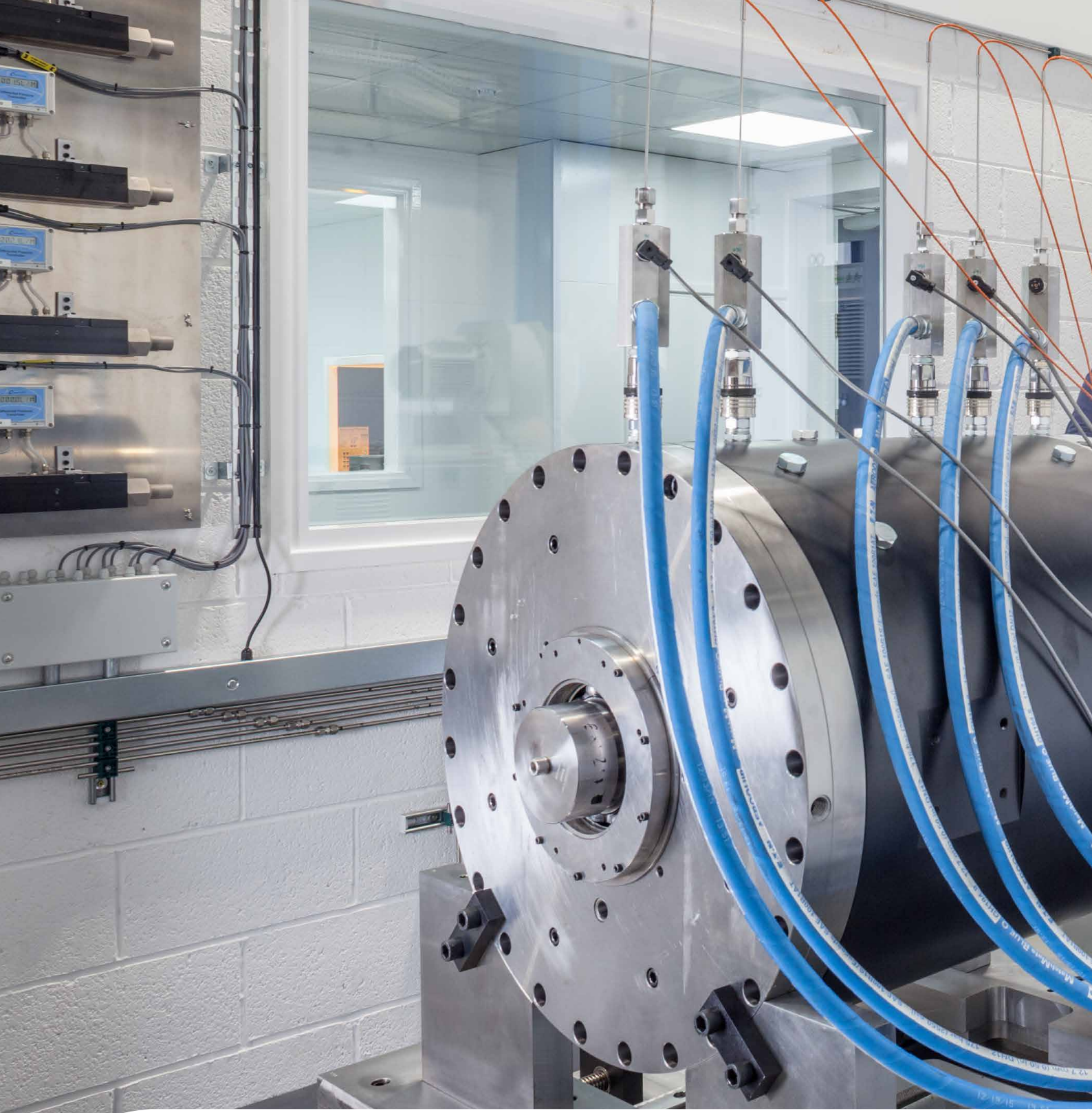
AESSEAL® has made an enormous investment in modular design which includes compressor dry gas seals. Components for our compressor dry gas seals are manufactured using the latest 9 and 11 axis machine tools.

Seals are assembled in our dedicated assembly area. Our seal face lapping facilities can accommodate seal faces up to 500mm diameter. All components are individually balanced prior to assembly into the finished seal. You can trust AESSEAL® to deliver on time as every seal is project managed through the process of manufacture and testing.

> The quality of the four supplied seals was excellent. A full witnessed API test was completed at AESSEAL's facility in the UK.

Senior reliability engineer, Chemical industry

www.aesseal.com/gas-seal



Compressor Dry Gas Seal Testing

We have the capability to test compressor dry gas seals in all sizes. Seals are dynamically tested to API requirements. Test reports and a full certification pack is supplied with each seal.

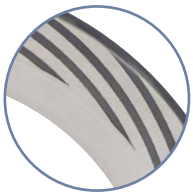
AESSEAL® welcome customers to witness the testing of their seals at the state of the art test facility. The company provides a dedicated workspace to all customers to continue working while the tests are on-going. Alternatively the tests can be witnessed remotely via the internet.

AESSEAL® recognise that spare compressor dry gas seals may be stored for considerable time prior to installation and provide a seal health checking service. This service dynamically tests the seal giving confidence that there will be a reliable startup of the compressor.

In addition AESSEAL® can provide complete repair and refurbishment of compressor dry gas seals. Seals returned are thoroughly inspected before being repaired and tested. The seals are then returned to the customer with a full documentation and certification pack.

www.aesseal.com/en/services

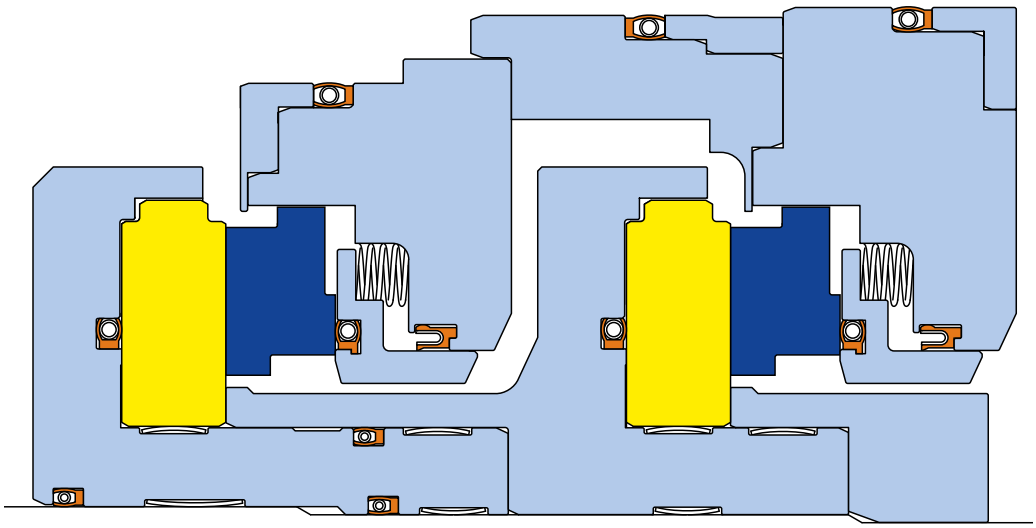
Compressor Dry Gas Seals



CCS™ — Conventional Compressor Seal

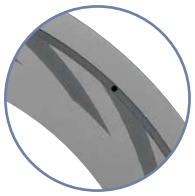
The CCS™ is a compressor dry gas seal that utilizes proven spiral groove lift technology to provide reliable compressor sealing across a wide range of operational duties. This seal is ideally suited for the retrofitting of wet compressor seals and the replacement of existing dry gas seal products.

- Supplied in 410 stainless steel as standard with exotic alloy options on request
- Available with Silicon Carbide seats as standard. Tungsten Carbide and Silicon Nitride seats available on request. Mating faces available in Carbon and synthetic diamond coated Silicon Carbide
- 'O' ring and spring energized polymer versions available
- Designs available as single, double, tandem or tandem with intermediate labyrinth, for increased integrity
- Fully shrouded seats adopted as standard
- Bi-directional seal designs also available



Separation Seals

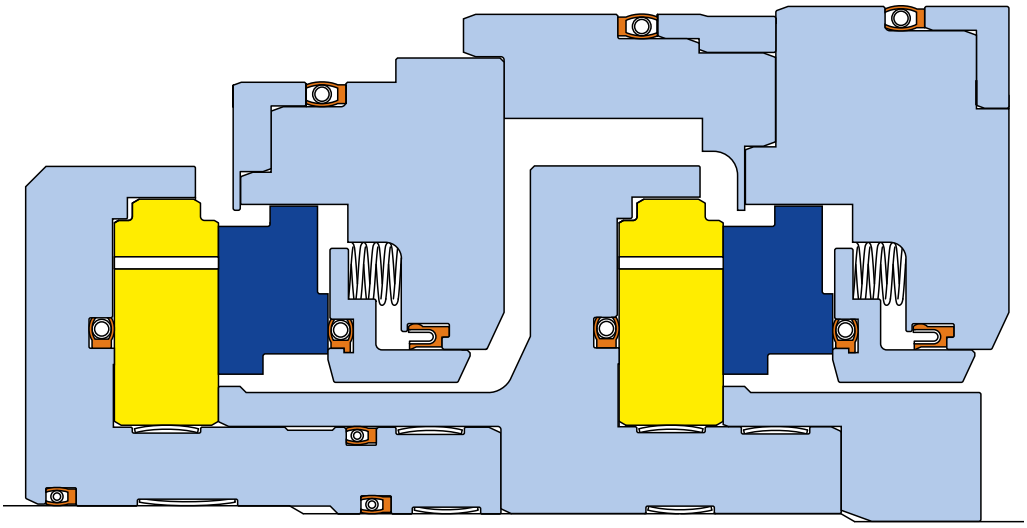
AESSEAL® offers both labyrinth and dual bush non-contacting separation seals, supplied individually or as an integral part of the gas seal cartridge. This device provides a positively pressurised chamber protecting the dry gas seal from potential bearing oil migration and preventing gas ingress to the bearing chamber.

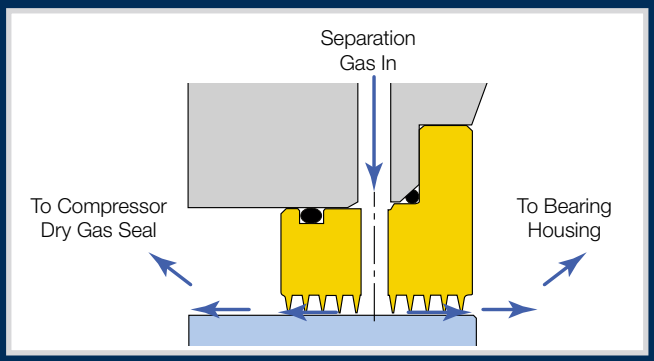


HHCS™ — Hydrostatic and Hydrodynamic Compressor Seal

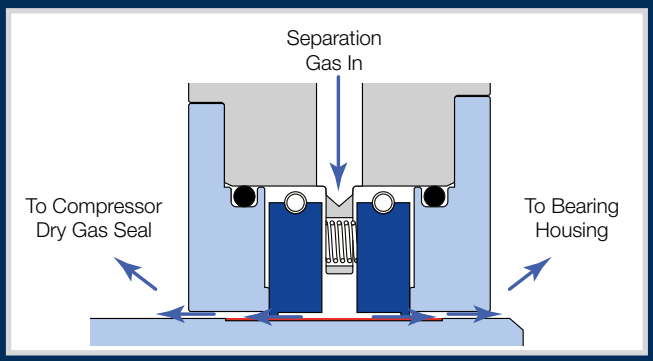
The HHCS™ is a compressor dry gas seal that utilizes patented DualDam™ hydrostatic and hydrodynamic face technology that provides lift even under static conditions. This unique action provides zero face contact under starting, stopping and slow roll conditions.

- Unique, patented DualDam™ compressor dry gas seal technology offers robust protection for the sealing surfaces during start-up, coastdown, slow roll and upset conditions
- Supplied in 410 stainless steel as standard with exotic alloy options on request
- Available with Silicon Carbide seats as standard. Silicon Nitride seats available on request. Mating faces available in Carbon and synthetic diamond coated Silicon Carbide
- Capable of withstanding unintentional reverse rotation
- 'O' ring and spring energized polymer versions available
- Designs available as tandem or tandem with intermediate labyrinth for increased integrity
- Fully shrouded seats adopted as standard
- Bi-directional seal designs also available



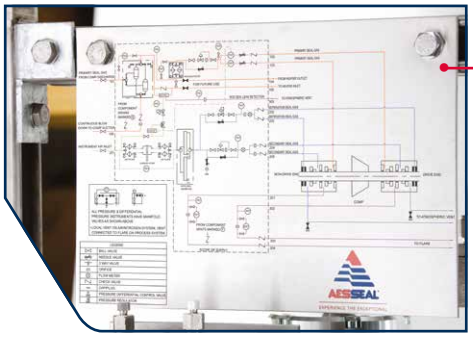


Labyrinth separation seal



Dual bush non-contacting separation seal

Compressor Dry Gas Seal Systems



Colour coded P&ID for ease of identification

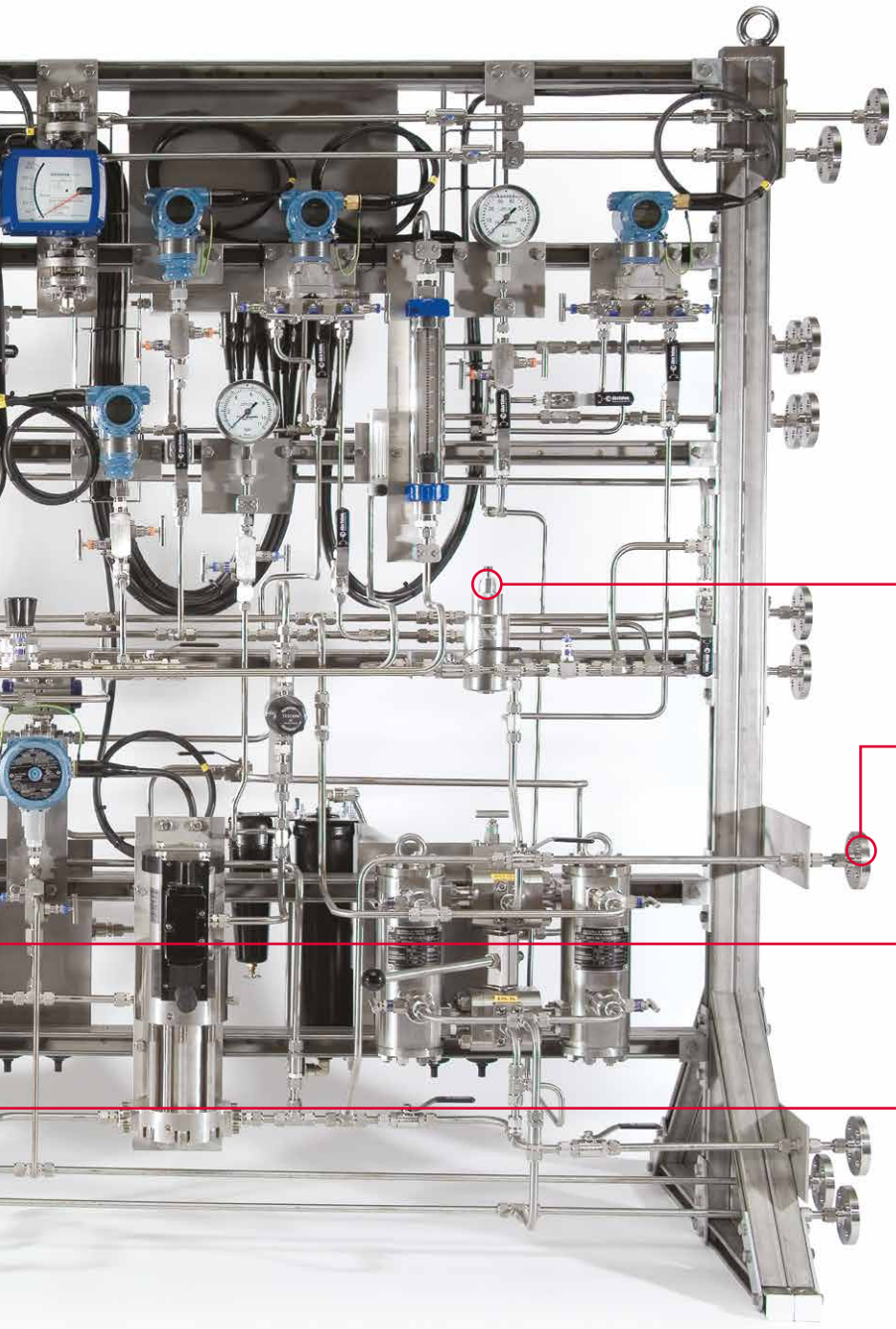
User friendly operation with gauges at eye level and accessible instruments and controls

High quality compressor dry gas seal support systems engineered to customer requirements for all seal configurations and applications.

Each AESSEAL® gas conditioning system contains the key API modules plus various enhancements derived from our own field experience, to ensure the highest degree of compressor dry gas seal reliability and longevity.

For every application AESSEAL® performs a detailed phase analysis in-house to determine the required level of gas conditioning.

Patent pending TriStage™ prefiltration system



- Compliance with pressure equipment directive PED 97/23 EC
- Modular technology means a streamlined ordering process
- Zero clearance fittings on all control valves
- Connections available for additional gas conditioning
- Nitrogen generation system can be engineered for any application
- Patent pending TriStage™ prefiltration system

Typical features of AESSEAL® compressor dry gas seal support systems include:

- NACE compliance
- Patent pending TriStage™ prefiltration — removes bulk liquids up to 20 times more effectively than most coalescent filters
- Superior gas filtration — more stringent than API requirements
- Pressure booster — ensures continuity of seal gas under all transient conditions
- High purity nitrogen generation — removes reliance on plant nitrogen
- Heater system — provides dew point control
- Designed by engineers with extensive field experience — ergonomic, coherent layout with easy maintenance of all key components without taking the system off-line

Dry Gas Seal Refurbishment

In recent years, the global demand for engineered compressor dry gas seal repair has outstripped supply. This has led to a rapid rise in both costs and lead-times for repairs.

AESSEAL® has helped to fill this gap. We have successfully repaired a substantial number of compressor dry gas seals from other OEMs, delivering a high quality of repair, often with substantially reduced costs and lead-times. AESSEAL® has invested heavily in test facilities and equipment to demonstrate the quality of repair on every compressor dry gas seal.

Features of our gas seal refurbishment service include:

- Pre-repair inspection report
- Dynamic test specifications
- Tabulated dynamic test results and graphical representation of the data captured during all tests
- Full set of installation details
- Spin, balance and dynamic test certification
- Full traceability of all materials used
- Post test inspection reports
- Test regime to API or customer's specific requirements
- Inspection using 3D multi-sensor analysis
- Single, tandem or dual seal arrangements
- Polymer or 'O' Ring seal types
- Computerized face analysis
- Full warranty provided

Reference lists and competitive quotes provided on request. Please contact DGS-Services@aesseal.co.uk

Dry Gas Seal Research and Development Test Facilities

Computer-controlled test bays can be programmed to validate seal designs to any pre-determined cyclic pressure, temperature and shaft speed configuration. Visit our YouTube channel to see a series of videos on our dry gas seal refurbishment process.

- Shaft Speeds up to 45,000 rpm
- Pressures up to 5,000 psig (350 barg)
- Dedicated test equipment for every seal
- Witness tests can be viewed via weblink

AESSEAL®
ENVIRONMENTAL TECHNOLOGY

EcoGuard – Zero Emission Double Seal Technology

EcoGuard™ has been developed as a simple and effective way to eliminate emissions from gas compressor drivetrains that use dry gas sealing technology. It can be easily retrofitted to existing equipment or installed on new systems.

The EcoGuard™ system captures gas that would typically be flared and boosts it for reinjection into the compressor, preventing its release into the atmosphere. The system ensures that high-pressure, clean gas remains in the compressor at all times, keeping the gas seal clean and eliminating the need for venting. Its advanced design includes integrated bearings, magnetic coupling, and patented drivetrain cooling technology, enabling five years of continuous operation without leakage of harmful gases into the atmosphere.

EcoGuard™ offers three key Emission Reduction modes of operation:

- **Zero Emission Sealing**
- **Vent Recovery**
- **Mass Venting Avoidance**

EcoGuard™ can be added to existing Dry Gas Seal support systems to function as a Seal gas Booster.

During normal operation, gas is taken from the compressor's discharge, conditioned, and supplied at a higher pressure to the seals. However, during maintenance or standby, pressure drops can interrupt the gas supply, putting seals at risk of damage or failure. EcoGuard can ensure a clean, uninterrupted supply of seal gas to the seals allowing for continued, safe operation.

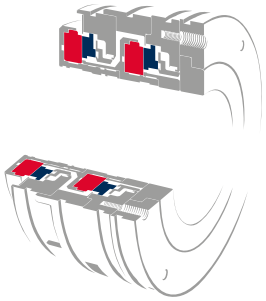
NET ZERO

For more information check out the brochure

Specialist Training

Dry Gas Seals: Understanding their design, installation, and operation to improve reliability.

Being sustainable, it is important to ensure that these skills are kept up-to-date.



Developing Your Team's Skills

To operate industrial plants both safely and efficiently, you need highly skilled, well-trained and knowledgeable personnel.

With the introduction of new technology, production processes, the need for increased plant availability, and the global awareness of manufacturing processes being sustainable, it is important to ensure that these skills are kept up-to-date.

AESSEAL® provides specialist training courses that are specifically designed to help your staff develop their knowledge and understanding of mechanical seals, dry gas seals and support systems.

These courses are designed for companies that are aiming to:

- Understand the technology associated with dry gas seals
- Maximize rotating equipment reliability
- Helps to identify and prevent dry gas seal operational issues
- Improve site efficiency

Dry Gas Seals: The Need for Specialist Training

Dry gas seals are considered by many to be at the top of the mechanical seal technology ladder and operate in a different manner to the more common wet mechanical seals. It is therefore important that if you operate this kind of seal your operators understand the differences between dry gas and the more traditional wet mechanical seals.

To book, please contact: **training@aesseal.co.uk**
or go to **www.aesseal.com/customer-training**

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For further information and safe operating limits contact our technical specialists at the locations below.

THE QUEEN'S AWARDS FOR ENTERPRISE: INNOVATION 2021

THE QUEEN'S AWARDS FOR ENTERPRISE: SUSTAINABLE DEVELOPMENT 2022

AESSEAL plc is certified to:
ISO 9001, ISO 14001, ISO/IEC 20000, ISO/IEC 27001, ISO/TS 29001, ISO 37001, ISO 45001 & ISO 50001

Use double mechanical seals with hazardous products.

Always take safety precautions:

WARNING

- **Guard your equipment**
- **Wear protective clothing**

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