



**Type 93AX Coaxial Separation Seal**

# Engineered for Success

Reduce Risk. Reduce Downtime.  
Enhance Efficiency.



# Contents

AT A GLANCE **04**

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THE EVOLUTION OF SEPARATION SEALS **06**

---

A NEW BENCHMARK FOR  
SEPARATION SEALING **08**

---

OPERATING SCENARIOS **12**

---

HERE TO SUPPORT YOU **14**

---

ABOUT JOHN CRANE **15**

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## At a Glance

Safety, reliability and energy efficiency are critical priorities for the energy and process industries. In parallel, government and industry are looking for solutions that reduce Greenhouse Gas (GHG) emissions and limit the environmental impact of energy production and consumption. When it comes to dry gas seals, the stakes are high. Engineered to reduce the risk of leaks and contamination, coaxial separation seals help protect your most valuable assets.

Designed based on customer feedback and the expertise of teams on the ground, the Type 93AX coaxial separation seal is specifically engineered to create a safer, more reliable and more efficient dry gas sealing solution – and to deliver measurable business impact.

The Type 93AX is your route to better meet sustainability and regulatory requirements, while creating real cost savings. And it's all backed by our global service network, providing rapid response refurbishment, maintenance and repair.



SAFER



MORE RELIABLE



MORE EFFICIENT



OUR TEST DATA INDICATES UP TO 80%  
REDUCED NITROGEN CONSUMPTION



LESS ENERGY USAGE



FEWER EMISSIONS



LESS ONGOING WEAR

# The Evolution of Separation Seals

Separation seals play a critical role in maintaining uptime in rotating equipment, such as compressors. Positioned between a dry gas seal and a compressor's bearings, the separation seal's primary role is to protect the dry gas seal from bearing oil contamination. And in the case of a dry gas seal failure, they must also restrict high-pressure gas from reaching the bearings.

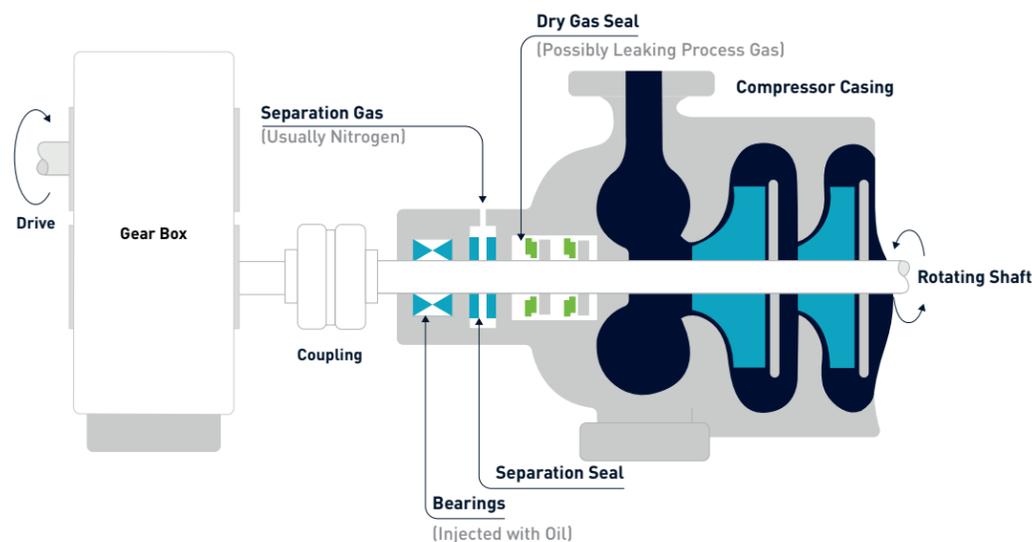


Diagram 1: Typical Compressor Installation

## From Radial to Axial

Until a few years ago, separation seals have typically been radial. While effective, both our engineers and our customers identified performance limitations. These limitations are particularly prevalent in demanding applications such as offshore oil and gas and clean energy, where high-temperature and pressure differences are common. They also require significant volumes of separation seal gas to operate, which has an impact on both running costs and efficiency.

## From Contacting to Non-Contacting Operation

Axial non-contacting separation seals take a different approach. A film of separation gas is used between two seal faces to create a pressure barrier, which protects the bearing and dry gas seal cavity. This results in less leakage and crucially the ability to work in failure modes. Following extensive research, we made the decision to design and engineer our own coaxial separation seal that would not only surpass the performance of radial separation seals, but also outperform existing coaxial separation seals, too.

Unplanned downtime costs the global process industries an estimated £50bn annually.

Source: Deloitte

## Our Development Process

To arrive at a state-of-the-art, high-performing seal design, our engineers completed a series of incremental development stages and rigorously validated all aspects of its design. These development stages included:

### Numerical simulation of mechanical seal operation

Computational fluid dynamics (CFD), a powerful numerical simulation technique that uses sophisticated algorithms to predict and analyse flow behaviour, was essential for design evaluation before developing a prototype seal design.

### Prototype and model validation

A testing rig was created to verify evidence of adequate seal face separation and to map load capacity and leakage as a function of changing parameters. Results were vetted by a third party to ensure satisfactory agreement with the CFD analysis.

### Design of experiments

A structured method for evaluating a system, which allows multiple inputs to be altered simultaneously, establishing their impact on a chosen output. Our engineers examined control parameters such as seal film gap, groove size, face area, pilot hole quantity and more. The results enabled us to iterate rapidly while exploring innovative seal geometries and materials.

# A New Benchmark for Separation Sealing

The Type 93AX coaxial separation seal has been designed and engineered to meet real-world market needs. By listening to customers around the world, we have created a solution that addresses the challenges and performance gaps of conventional technologies while also supporting operational goals. The result is a new benchmark for separation seals:



## Performance Capabilities

100 to 225mm  
4 to 8.85"

**SIZE RANGE**

Nitrogen  
or Air

**GASES**

-25°C to 180°C  
-13°F to 356°F

**TEMPERATURE**

Compliance with API  
617 and ISO7919-3

**VIBRATION LEVELS**

Non-contacting and no  
oil migration, pressurised

**SLOW-ROLL CONDITION**

Up to 145m/s  
475 fps

**SPEED** (on inner  
balance diameter)

NACE,  
API 692

**STANDARDS**

4 Barg/58psig

Recommended operating  
pressure differential

**PRESSURE CONTROL ONLY**

2.5-4.5 Barg/36-65psig

Operating pressure  
range differential

~5% of a  
labyrinth

**CONSUMPTION**

10  
years

**DESIGN LIFETIME**

35 Barg/507psig

Non-contacting

**SEALING INTEGRITY PRESSURE AT SECONDARY VENT**

70 Barg/1015psig

Mechanical integrity

## Engineered to Protect

The Type 93AX is designed and engineered to protect your most valuable assets, from your people to your plant. It uses an inert conditioning seal gas - nitrogen, to sustain its separation seal operation, while restricting atmospheric leakage of harmful and flammable hydrocarbon process gases, such as methane. Its design reduces the risk of leaks and contamination, preventing oil migration across the pressure and temperature indexes experienced in energy and processing industries such as oil and gas, power generation and clean energy. It meets API 692 standards and operates reliably even in challenging operating conditions.



## Energy Efficiency and Sustainability

Leveraging John Crane's vast experience and expertise in mechanical sealing, the Type 93AX uses TriHex grooves to help generate a high-pressure barrier between mechanical seal faces. This significantly reduces nitrogen consumption while also helping ensure reliability in even the most challenging environments. By reducing gas consumption, the separation seal also reduces gas demand for air compressors and nitrogen generators. This is especially beneficial for offshore platforms and gas pipelines, where gas supply is limited.

Using our consumption calculator, it is also possible to predict gas leakage performance. A feature that is pivotal to integral design parameters. Leveraging AI technology, based on the theory of a neural network regression model and capable of machine learning, it provides gas leakage data to help operators proactively manage nitrogen consumption efficiently.

Our test data indicates up to 80% reduced nitrogen consumption.

## Keeping Costs Under Control

The Type 93AX reduces both your operating and maintenance costs. Lower gas demand reduces running costs, while its zero-touch functionality results in extended lifespan with less need for refurbishment or replacement. It also requires less maintenance, extending both MTBR and MTBF. And if the compressor suffers a separation gas failure or dry gas seal gas failure, it has two additional operating modes to ensure it can keep running – avoiding any costly unplanned downtime.

## Lowering Emissions

Industry is striving to reduce GHG emissions and to meet government targets. For example, the UK is aiming to achieve net zero emissions for scopes 1 and 2 (direct and indirect emissions) by 2040. With high-pressure capabilities, combined with minimal leakage, the Type 93AX helps support these sustainability goals. It is also suitable for clean energy applications, including hydrogen and Carbon Capture, Utilisation and Storage (CCUS). And in the event of a dry gas seal failure, the coaxial separation seal can act as a back-up seal, increasing compressor safety and reducing the release of harmful gases into the atmosphere.

## Compatibility Covered

The Type 93AX is compatible with our range of high-quality dry gas seals, including high-pressure tandem and double seal systems, and is available for both upgrades and retrofits.



# Operating Scenarios

For energy and process industries, equipment failure is responsible for 42% of unplanned downtime.

Source: Deloitte

## Avoiding Failure. Even in Failure Scenarios.

Our seals are used in critical applications where failure isn't an option. But that doesn't mean compressors always run optimally. The Type 93AX coaxial separation seal is designed to work, even in the event of multiple failure scenarios. Consequently, there is a reduced risk of unplanned compressor shutdown and unscheduled maintenance.

### Standard Operation

Under normal working conditions, the separation seal behaves as you'd expect. It protects the dry gas seal from the bearing oil with gas in the Inner Diameter (ID) directed towards the secondary vent. Separation gas is injected from the back of the face, creating the lift-off force required to separate the face and seal. This results in a high-stiffness film with high exit gas velocity.

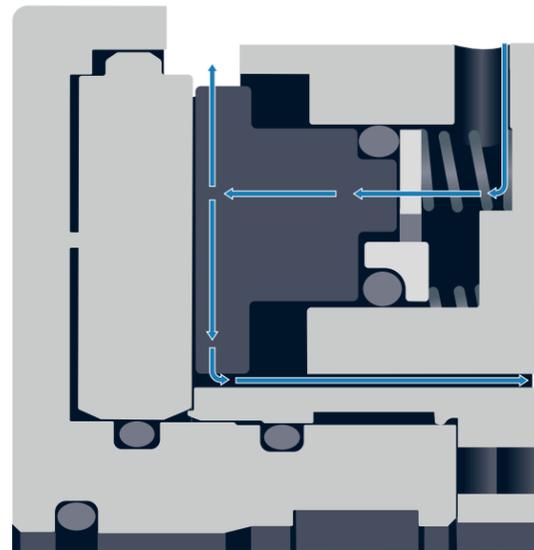


Diagram 2: Standard Operation

### Separation Gas Failure

In the event of a separation gas failure, the seal is designed to maintain its non-contacting operation during dynamic conditions and stop oil migration in both static and dynamic conditions. Low-pressure gas is drawn from either the remaining gas on the inlet line or from the dry gas seal side to create flow towards the bearing side. The gap is sufficient to ensure a non-contacting regime in the speed range and to prevent oil migration.

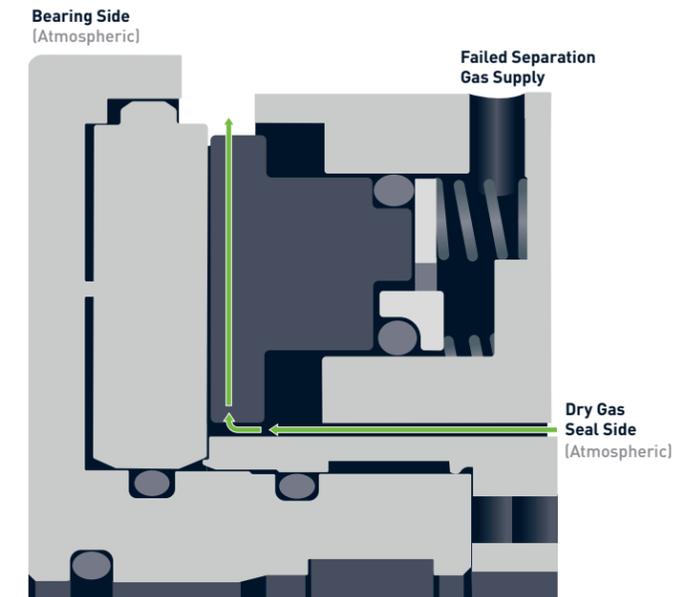


Diagram 3: Separation Gas Failure

### Dry Gas Seal Failure

If the compressor experiences a dry gas seal failure, the seal is designed to create a controlled flow of high-pressure gas towards the bearing side. This maintains a positive restriction in this catastrophic event and prevents extreme leakage of pressurised gas into the atmosphere. The gap is sufficient to prevent separation seal failure by ensuring a non-contacting regime up to 35 Barg and maintains mechanical integrity up to 70 Barg.

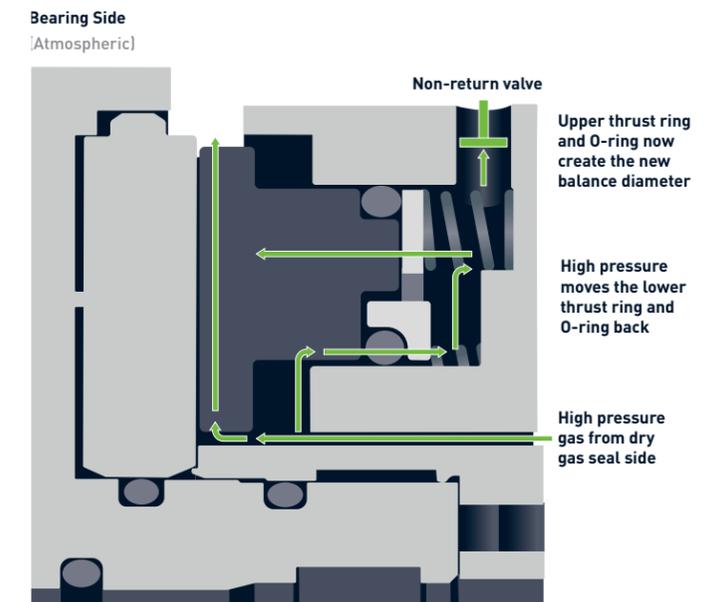


Diagram 4: Dry Gas Seal Failure



## Here to Support You

All our dry gas seals and separation seals can be serviced locally at our global network of Global Turbo Service Centres. These teams enable you to increase both uptime and productivity.

Our highly trained turbomachinery service engineers travel globally to support compressor manufacturers and dry gas seal end-users on-site. They implement dry gas seal change-outs, start-ups and other

turbomachinery services during planned shutdowns and unplanned breakdowns in the infrequent event of a site emergency.

Our service engineers can work with you to offer customised compressor seal upgrades to help you reduce nitrogen consumption without the need to buy a new nitrogen package – lowering OPEX and CAPEX, while improving compressor reliability.

## About John Crane

John Crane is a global leader in mission-critical technologies for the energy and process industries and an innovator in rotating equipment, encompassing mechanical seals, couplings, filtration systems and cutting-edge asset management and digital diagnostics solutions. Blending a rich legacy of innovation with a commitment to service excellence, we've enabled our customers' reliable and sustainable operations for over a century. While recognising the role

of traditional energy, we are pioneering solutions that enable cleaner alternatives, crafting a vision for a sustainable energy future. Our extensive global presence underscores our promise to customers, with over 200 facilities, including manufacturing, sales and service, in more than 50 countries. With over £1.1 billion in revenue in 2024, we are an integral pillar of Smiths Group plc, a FTSE 100 listed industrial technology company dedicated to engineering a better future. Visit [www.smiths.com](http://www.smiths.com) for more.



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