FACE TECHNOLOGY

# Dynamic Lift

## Up-stream Pumping

5620USP | 588USP | 8620USP

**Transforming the traditional concept of sealing**

Applying gas seal spiral groove technology to wet seals

- CHEMICAL
- FOOD & BEVERAGE
- MINERALS / MINING
- OIL & GAS
- POWER GENERATION
- PULP & PAPER
- WATER / WASTEWATER

When improving the performance of mission-critical pumps, John Crane's customers face challenges, including **high heat generation, poor lubrication, abrasion and barrier system complexities**. To solve these problems, we developed a face treatment, called Dynamic Lift Up-stream Pumping, as part of our suite of seal face technology options for rotating equipment. Drawing upon our pioneering gas seal innovations in the 1960s and 1970s, John Crane engineered the Dynamic Lift Up-stream Pumping concept for liquid services and launched this face treatment three decades ago. Today, we answer operators' toughest challenges, improving seal and pump reliability, preventing unplanned downtime and reducing operating costs across a broad range of process industries.

ONLY FROM
**JOHN CRANE**

# Three Decades of Dynamic Lift with Up-stream Pumping for Mechanical Seals

*Reducing Costs / Reducing Leakage / Improving Pump Reliability*

**John Crane's unique, engineered, non-contacting Dynamic Lift Up-stream Pumping seal face technology borrows from gas seal designs to deliver a breakthrough in liquid sealing technology. This allows operators to:**

- *Improve mechanical seal life*
- *Increase mean time between repair (MTBR)*
- *Reduce seal leakage to atmosphere when compared to a pressurized dual seal*
- *Allow a clean inboard face fluid interface, even with dirty product*
- *Deliver a simple support system ensuring face lubrication without the cost of a pressurized barrier system*
- *Prevent solid build-up with slurries, scaling fluids or solids in suspension*
- *Eliminate seal face flush to dissipate seal heat, reducing water usage*
- *Address low water supply pressure challenges*
- *Reduce power consumption and heat generation due to non-contacting technology*

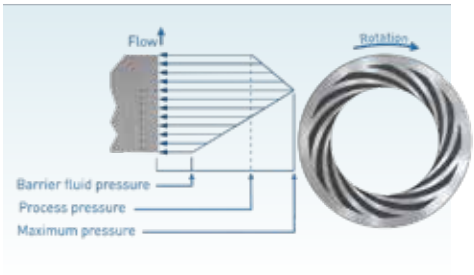
## Why are Face Treatments So Important?

Face material selection is critical to the performance of the mechanical seal. Every mechanical seal application experiences challenges, often including poor lubrication. Poor lubricating process can damage seal faces leading to increased leakage, unplanned downtime and even catastrophic equipment failure. That's why our experts have developed a suite of seal face technologies—including Dynamic Lift Up-stream Pumping—that can address the most difficult sealing problems and optimize the performance of rotating equipment in all process industries.

## Starting with Game-changing Technology

In the 1960s and 1970s, John Crane's patents for centrifugal compressor mechanical seal designs pioneered the use of non-contacting spiral groove face technology in gas compression applications. These new gas seals revolutionized centrifugal compressor shaft sealing by delivering a step change in compressor reliability and operating costs.

### SPIRAL GROOVE TECHNOLOGY




## Applying Spiral Groove Technology to Pumps

By the 1980s, John Crane engineers started working with these faces on mechanical seals for pumps, applying that same game-changing innovation to "actively lift" the faces of wet seals. The results were impressive, and the potential for improving pump performance in key process industries was promising. John Crane engineers kept working and launched the T8000 Dynamic Lift Up-stream Pumping seal in 1989. Now—almost three decades later—John Crane remains the only seal company to offer this innovation for pumps.

## Three Decades Prove Value

Today, John Crane customers who have applied Dynamic Lift Up-stream Pumping face technology have experienced seal life improvements from just two to three months up to five years in some instances. Plus, with the right seal support system and piping plan, reliability issues due to poor water quality are virtually eliminated. With hundreds of installations in the last few decades, John Crane is the best—and only—expert in applying the concept of active lift to mechanical seals for pumps.

## How Does it Work?

Mechanical seals require a narrow gap between faces to allow a lubricating film to work; the gap must also be optimized to eliminate leakage. The lubricating film thickness is measured in microns. Debris in process fluids can create deposits, damage faces and cause hang-up. Ultimately, seal life is shortened, and the MTBR of the pump is not acceptable.

The basic concept of John Crane's solution is that the conventional seal is replaced by a low-volume, high-pressure "pump"—the Dynamic Lift Up-stream Pumping seal. This "pump" propels a minute quantity of buffer liquid along the path normally sealed by the mechanical seal faces and into the product side. Because the product side is at a higher pressure than the buffer liquid, this seal is said to pump "Up-stream."

## Principles of Active Lift Operation Solve the Problem

A Dynamic Lift Up-stream Pumping seal operates on the principle of hydrostatic and hydrodynamic force balances. The spiral groove pattern serves the purpose of a pressure-

## LIFE EXTENDING RESULTS:

**When facing processing challenges like high heat generation, poor lubrication, itermittent dry-running conditions, abrasion and barrier system complexities, Dynamic Lift helps you dramatically improve seal life MTBR depending on unique application conditions. Potential results are shown below:**

**3 MONTHS** MTBR **BEFORE DYNAMIC LIFT**

**5 YEARS** MTBR **AFTER DYNAMIC LIFT**

### PULP & PAPER

- Black liquor—especially the evaporator area
- White liquor
- Green liquor
- Hot condensate at the paper machines
- Stock
- Coatings

### POWER GENERATION

- Flue gas desulfurization
- Water condensate
- Sea water
- Recirculation
- Lime slurry feed
- Sludge

# OVERCOME HIGH HEAT GENERATION, LOW-LUBRICITY, INTERMITTENT DRY-RUNNING CONDITIONS, ABRASION AND BARRIER SYSTEM COMPLEXITIES

generating system, directing barrier fluid toward the outside diameter (OD), meeting the resistance of the sealing dam and increasing pressure. This causes the flexibly mounted face to actively "lift," setting the sealing gap. In this non-contacting mode, liquid is pumped from a low-pressure region to a high-pressure region.

**Active lift at a seal interface offers several advantages over the traditional dual-pressurized seal approach:**

- *The technology is non-contacting and, therefore, the usual pressure velocity (PV) limitations do not apply*
- *The sealing environment within the seal chamber is cleaner, resulting from positive flow of clean fluid*
- *Reduced power requirements and environmental contamination*
- *Self-regulating and tolerant to process pressure variations*
- *Ability to handle slurries, scaling liquids, abrasives and products with poor lubricity*

## SEALING BASICS

*A narrow gap must be maintained to allow a lubricating film to exist, while minimizing the rate of leakage.*

*A typical seal face film thickness is 10-50 µ-in [0.25 - 1.27 µm].*

*Most seal faces are produced with a finished flatness of 2 helium light bands. This corresponds to 23.2 µ-in [0.6 µm].*

*A typical piece of paper is 5,000 µ-in [127 µm] thick.*

## DUAL PRESSURIZED

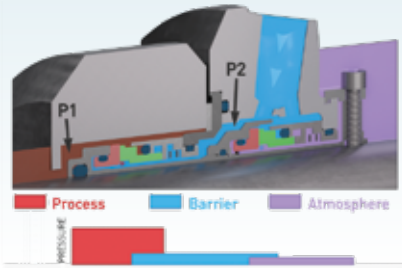
**Dual Pressurized: P2 > P1**

*Barrier fluid is NOT contaminated by process but does require external pressurization, which increases cost.*

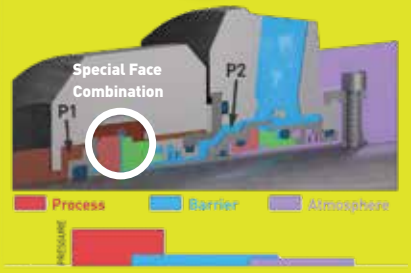

## DUAL UNPRESSURIZED

**Dual Unpressurized: P1 > P2**

*Buffer fluid is contaminated by process, which ultimately leaks to the atmosphere.*




## DYNAMIC LIFT
UP-STREAM PUMPING




**Simple low-cost support system** delivers the benefits of a dual pressurized seal, **replacing more complex, expensive support systems**

Dynamic Lift Up-stream pumping technology combines the benefits of a dual-pressurized and unpressurized seal into one solution, providing the environmental protection of a double-seal arrangement with the inherent safety of a tandem-seal arrangement.

*Up-stream Pumping active lift pushes the low-pressure buffer fluid into the higher-pressure process fluid, hence taking advantage of both pressurized and unpressurized concepts.*

### SUITABLE FOR:

- Chemical process liquids
- Volatile organic compounds (VOCs)
- Poor lubricity fluids
- Sour services ($H_2S$)
- Foul water
- Abrasives

### MINERALS / MINING

- Slurry
- Abrasive liquid slurries
- Corrosive fluids
- Filtrate

### CHEMICAL

- Low-viscosity mildly corrosive chemicals
- Corrosive chemicals
- Caustics
- Non-flashing low temperature hydrocarbons
- Process water
- Mild acids
- High-viscosity slurry

### OIL & GAS

- High sand content in crude oil and water
- 85% crude oil + 15% produced water
- Effluent oily water
- Sour water + gas
- Desulfated seawater + produced water
- Deaerated sea water + produced water
- Caustic solutions
- Desalter water

### WATER / WASTEWATER

- Clarifications
- Treatments
- Sludge

Let John Crane's engineering experts recommend a seal face treatment to solve your most demanding challenges. Together, we will work with you to keep your mission-critical operations up and running with support and guidance from our experienced team. Visit **www.johncrane.com** and request a quote or consultation with one of our seal face engineering experts today!

"UP-STREAM PUMPING: NEW DEVELOPMENTS IN MECHANICAL SEAL DESIGN" by Afzal Ali with support from Gordon S. Buck and Doug Volden (all John Crane employees). Presented and published in the proceedings of the 6th International Pump Users Symposium, April 1989, Turbomachinery Laboratory, Department of Mechanical Engineering, Texas A&M University, College Station, Texas.

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United States of America
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United Kingdom
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Fax: 44-1753-224224

**Latin America**
Brazil
Tel: 55-11-3371-2500
Fax: 55-11-3371-2599

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United Arab Emirates
Tel: 971-481-27800
Fax: 971-488-62830

**Asia Pacific**
Singapore
Tel: 65-6518-1800
Fax: 65-6518-1803