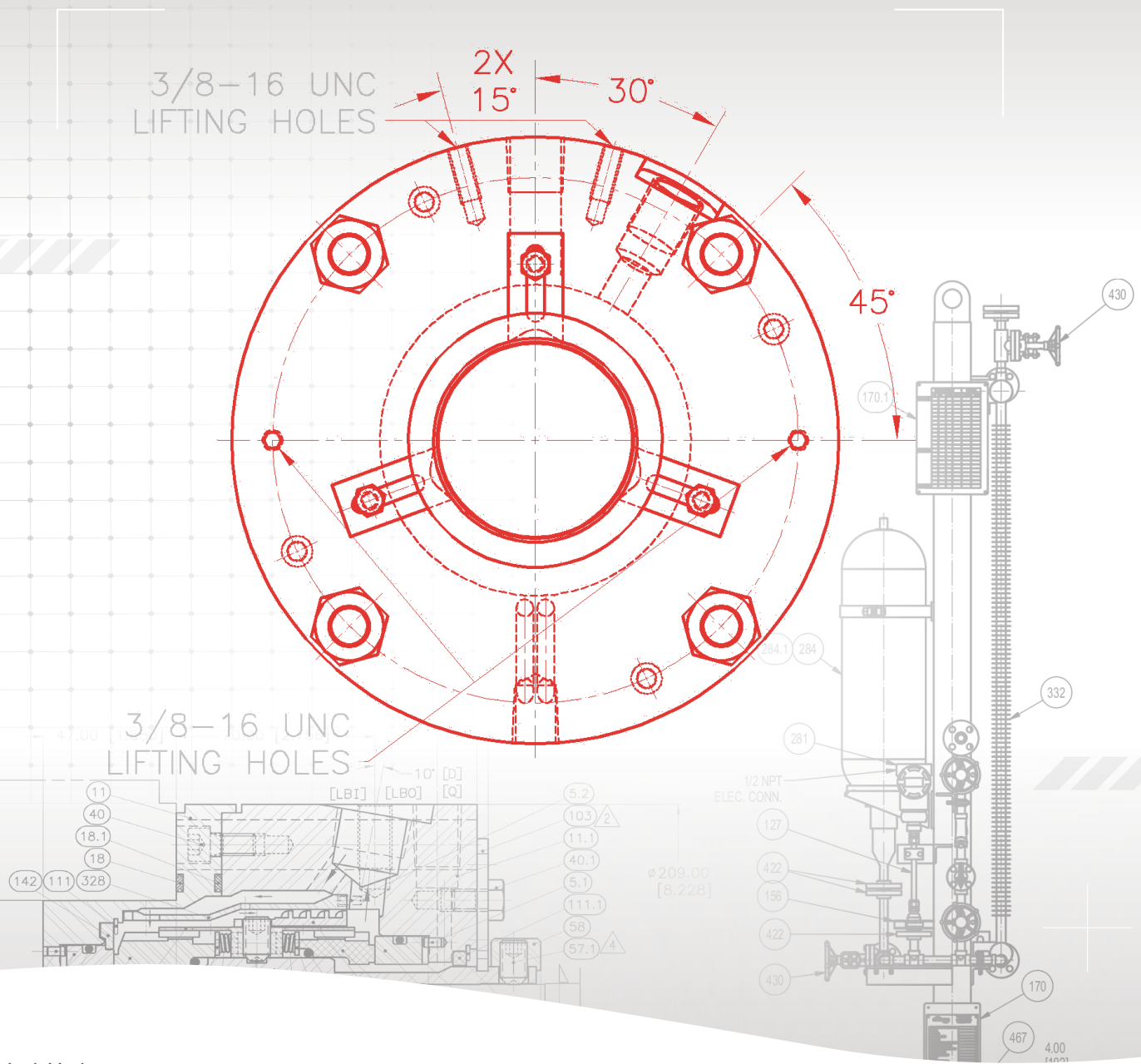


# Dual Seals on the Rise for Refineries and Petrochemical Plants





For years, single seals were the go-to option for refineries and petrochemical companies in North America, but now the industry is shifting toward preferring the use of dual seals – pressurized and unpressurized. We estimate that within 15 years, 80% of the new and upgraded hydrocarbon applications will be sealed with dual seals.

Since 2010, Flowserve has seen a 7% increase in North American selections of dual seal configurations for hydrocarbon services, which now comprise about one-half of all hydrocarbon seal selections. Based on current trends, the rate of dual seal adoption is expected to accelerate over the next decade, due to factors which include:

- Increased cost of leak detection and repair (LDAR) inspections for single seals
- Expanded understanding and experience with reliable dual seals and their supportive auxiliary systems
- Tightening of emissions limits on volatile organic compounds (VOCs) and volatile hazardous air pollutants (VHAPs)
  - Expands the number of services falling under LDAR regulation
  - Decreases the ability for single seals to pass LDAR inspection

### Upward trend of dual seals

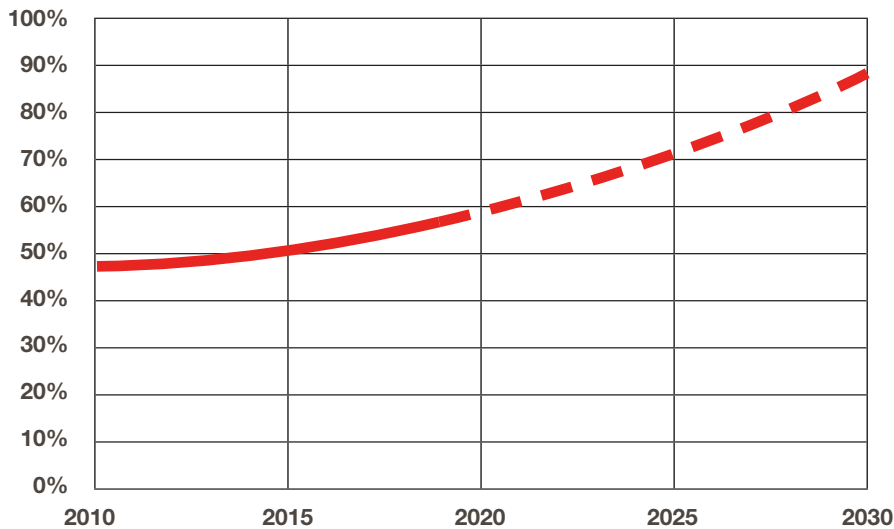


Figure 1: Forecast, percent of dual seal selections for North American hydrocarbon applications

## Unpressurized and pressurized configurations

**Dual unpressurized seals:** Dual unpressurized seals contain buffer fluid stored at or near atmospheric pressure between an inner and outer mechanical seal. Because the buffer fluid pressure is less than the seal chamber pressure, any leakage from the seal will seep into the buffer fluid. Gas leakage is vented off to vapor recovery, and liquid leakage is diluted by the buffer fluid.

**Dual pressurized seals:** In contrast, the barrier fluid in dual pressurized seals is pressurized above seal chamber pressure. Because the pressure of the barrier fluid is greater than that of the seal chamber, only the barrier fluid is consumed by the seals, and process emissions are zero.

*“Refineries in the U.S. select the simpler dual unpressurized arrangement 60% of the time; however, refineries in Europe, the Middle East and Southeast Asia are favoring dual pressurized seals by the same margin.”*

## Geography comparison

Where dual seals are determined to be required, refineries in the U.S. select the simpler dual unpressurized arrangement 60% of the time; however, refineries in Europe, the Middle East and Southeast Asia are favoring dual pressurized seals by the same margin.

North American hydrocarbon processors typically select dual seal auxiliaries that connect to their plant’s header systems, either to vent process vapors in unpressurized systems or pressurize the barrier fluid in pressurized systems. These seal auxiliary systems are generally less complex and expensive than the self-contained systems preferred by overseas refiners. Overseas refiners choose self-pressurizing auxiliary support systems for more than 60% of their dual seals compared to just 25% of self-pressurized systems selected in North America. The current trend in North America is using more self-pressurized systems, which are now selected about twice as often as they were in 2010. Flowserve forecasts that self-pressurizing system selections in North America will be comparable to those in overseas plants within 10 years.

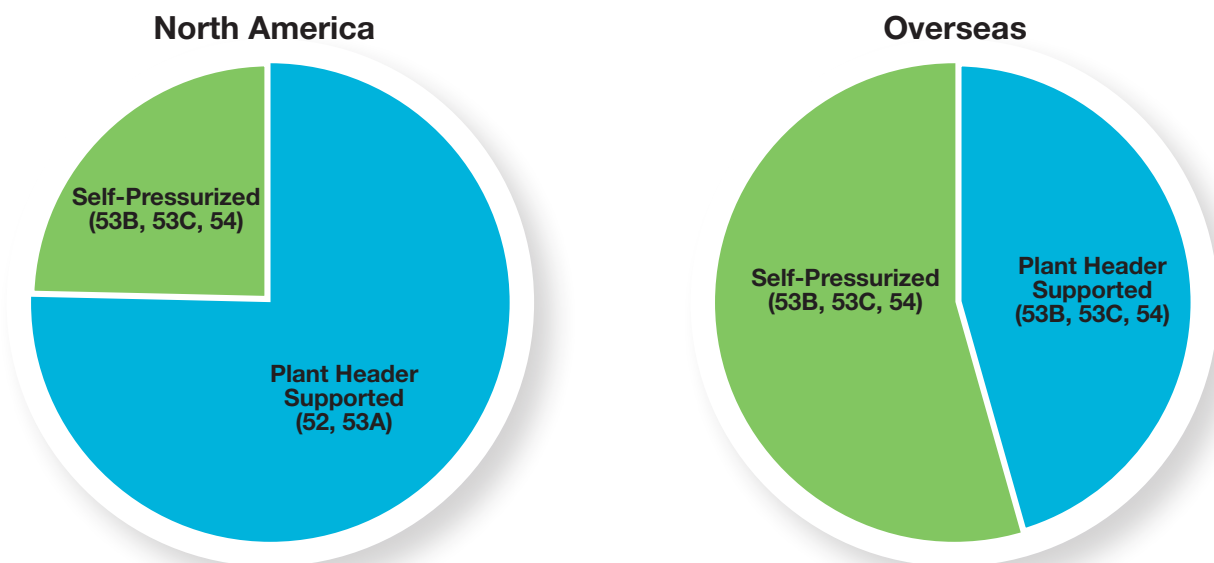


Figure 2: Comparison of dual seal auxiliary selection — North America vs. overseas

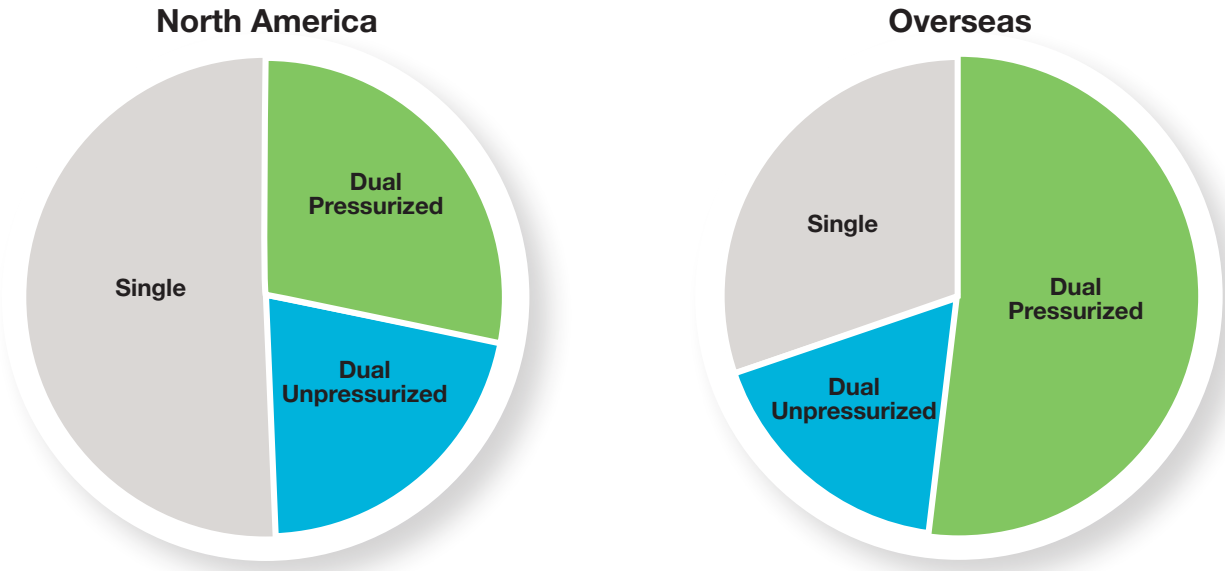
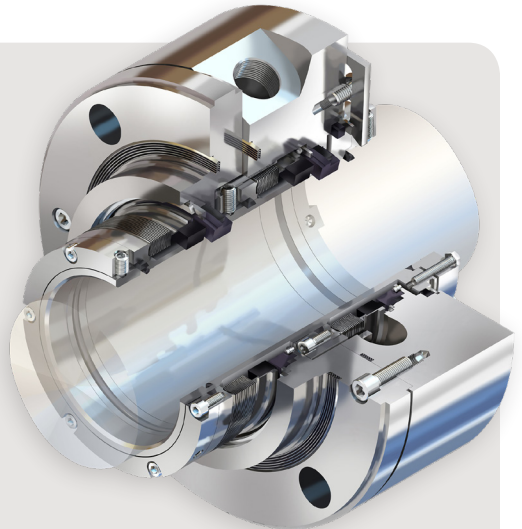
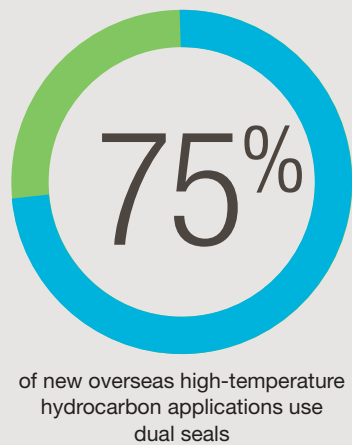
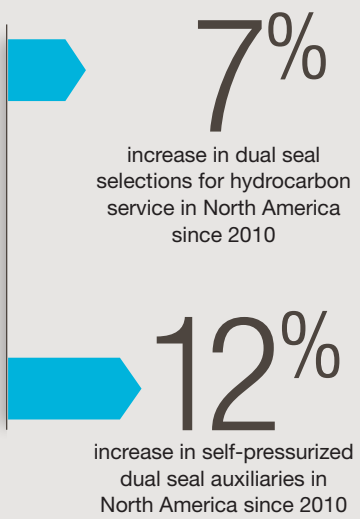


Figure 3: Comparison of seal selections for high-temperature hydrocarbon applications — North America vs. overseas

Another significant regional difference is found when examining seal selections for high-temperature hydrocarbon services. North American refiners are selecting dual seals about one-half the time, whereas overseas refiners select dual seals about three-quarters of the time. While this is a significant gap, North American refiners are trending toward using more dual seals for these services.

**SNAPSHOT: Dual pressurized seals are on the rise\***



BXHHSB from Flowserve has dual sealing capability at extreme temperatures for refinery and petrochemical services.

\*Based on Flowserve sales

## Advantages of investing in dual pressurized seals

The growing interest in dual pressurized seals for refinery and petrochemical applications is directly related to the benefits they offer compared to single seals and dual unpressurized seals. These include:



**Zero emissions.** Dual pressurized seals can prevent emissions from leaking into the atmosphere, which is vital in refinery and petrochemical operations. Aside from the environmental benefits, eliminating leaks can

help refineries and petrochemical plants stay compliant with strict government regulations and reduce or even eliminate EPA and LDAR fines.

**Greater reliability.** Dual pressurized seals provide enhanced equipment reliability in many hydrocarbon applications because the pressurized barrier fluid between the two

seals makes the seal less dependent on the pump-process fluid. This enhanced reliability also leads to greater productivity, as pumps using dual pressurized seals are more likely to survive common process upsets.



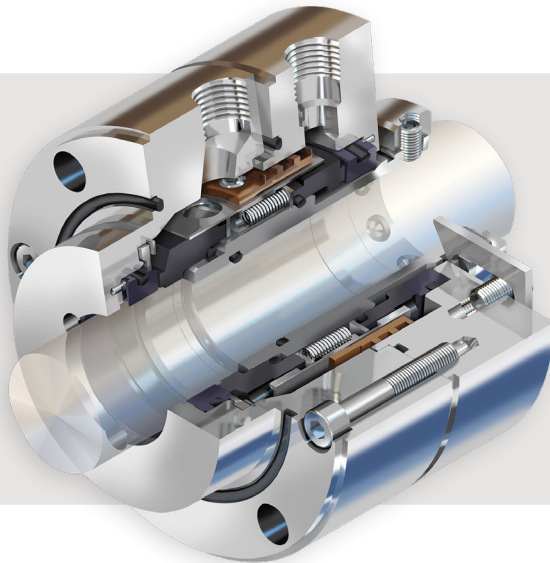
**Increased safety.** Dual pressurized seals reduce exposure to toxic and flammable fluids, creating safer environments for plant employees.

**Cost savings.** Because these seals operate on a small volume of cool, clean barrier fluid, expensive process side flush fluids are rarely required, which greatly reduces operating costs.

When pressurized dual seals are paired with a self-pressurized auxiliary system utilizing air cooling, utility costs can also be further reduced by the elimination of cooling water requirements.



Given their ability to prevent emissions from escaping into the atmosphere, dual pressurized seals are commonly used for applications containing VOCs, high-temperature and high-pressure applications, and applications involving viscous fluids and slurries.



*The QB2B seal from Flowserve is the typical pressurized dual seal selection for most refinery applications under 176°C (350°F). Pressurized dual seals are often configured in a near 'mirror image' to optimize barrier fluid circulation to both the inner and outer seals.*

## Trends driving dual pressurized seal adoption

Why are more U.S. refineries and petrochemical plants replacing single and dual unpressurized seals with dual pressurized seals? Several factors have led to higher adoption rates, including:

### Tightening environmental regulations

As local, national and global environmental regulations become stricter, refineries and petrochemical plants are increasingly turning to their equipment to help them remain compliant.

For example, in California, the EPA is cutting back on what is an acceptable amount of leakage for VOCs and VHAPs from 1000 to 100 ppm. The long-term expectation is that governments will eventually set zero-emission limits for most hydrocarbon pumps containing VOCs or VHAPs.

Non-compliance with these limits can result in steep fines and expensive repair costs. Because dual pressurized seals prevent all emissions from escaping into the atmosphere, they are **exempt from LDAR guidelines** and don't have to be inspected.

### A shift toward self-contained auxiliary systems

Typically, dual pressurized seals are pressurized with nitrogen or another inert gas via a plant-wide header system, but there is a growing trend in favor of using independent, self-contained auxiliary systems to pressurize the seal. With a stand-alone

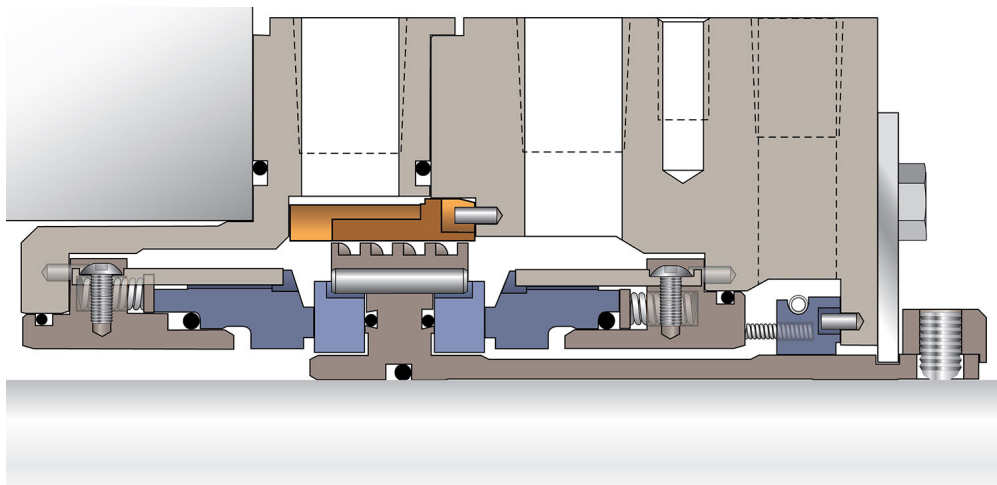
system, refineries and petrochemical plants can generate pressure for the seal locally, eliminating the need to integrate it into a larger delivery system. The primary driver of this trend is the **reduced integration cost** in tying the seal into utilities that may not be present or may not have the needed capacity to support large populations of dual seals.

Flowserve has seen a significant increase in self-contained support system sales. Two decades ago, self-contained systems accounted for 10% of the company's support system sales. Today, that figure fluctuates between 50 and 70% annually.

### A preference to reduce utility costs

Many U.S. refineries and petrochemical plants are moving away from external flush systems because of the growing demand to **reduce water and electricity consumption**. Utility costs can significantly impact a plant's total operating expenses, as plants can use two to three gallons of finished product per minute, per seal, every day of the year.

This demand to reduce utility use is even higher in regions such as the Middle East, where water for cooling is less abundant and transporting cooling water to refineries and petrochemical plants can be quite costly. In these areas, there is a growing interest in support systems that utilize air-cooling technologies.



*The HSH seal from Flowserve is applied in high-speed, high-torque and high-pressure dual seal applications. Pressurized dual seals have unique features to handle pressures from both directions across the inner seal.*

## Long-term cost savings outweigh startup costs

Historically in the U.S., new dual pressurized seals cost about three times that of single seals, but their long-term operational savings make these seals an economically viable solution. Plants can recoup purchase costs through fewer environmental fines, lower utility costs and lower inspection costs. Plants can also mitigate integration costs by using self-contained auxiliary systems that do not have to be integrated into the plant's fluid utilities.

*In addition to lower total lifecycle costs, dual pressurized seals often lead to more reliable, more productive and longer-lasting systems.*

	Single Seal With External Flush (Plan 32)		Dual Seals	
Initial Cost	1x	Seal Only	3x	Seal + Auxiliary
Installation	1x		3x	
Operating Cost	10x	Flush Fluid	0.4x	Cooling Water (not always required)
Maintenance Cost	0.1x	Inspections	0.1x	Replacement Barrier Oil
<b>Total First Year Cost</b>	<b>12.1x</b>		<b>6.5x</b>	

Figure 4: Cost savings analysis of single seal vs. dual seal systems

## Final thoughts

Forward-thinking refinery and petrochemical operations in the U.S. are realizing what their European, Middle Eastern and Southeast Asian counterparts have known for some time: that dual pressurized seals can make their operations safer and more cost-effective while increasing the reliability and productivity of their rotating equipment.

It's only a matter of time before stricter environmental regulations, rising operating costs and higher demands on equipment reliability make dual pressurized seals the new normal around the globe.

## Flowserve can help

Is your plant considering dual seal configurations for hydrocarbon services? If so, we can help.

Please contact your local Flowserve sales representative to learn how we can help. Contact details can be found at [Flowserve.com](http://Flowserve.com).



## About the author

### **Jack Vasko**

Jack Vasko has been with Flowserve for more than 12 years in roles of increasing responsibility. He obtained his BSME from Georgia Tech in 2005 and started at Flowserve shortly thereafter as project sales engineer. Jack has been the product manager for engineered seals for Flowserve since 2011, specializing in strategic partnerships, external training and product positioning.

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Flowserve Corporation  
5215 North O'Connor Blvd.  
Suite 2300  
Irving, Texas 75039-5421 USA  
Telephone: +1 937 890 5839

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