

# Face to Face

THE SEALING TECHNOLOGY MAGAZINE



## GAME CHANGER

One-of-a-kind flow-management technology and support help optimize your operations and exceed your expectations.

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# GAME CHANGER



A single supplier performed a pioneering rebuild on an outdated and corroded compressor, testing and commissioning it in a new refinery in Argentina — without taking it to another country or using multiple vendors.

In 2009, when Renesa, part of the Argentine MAS Energy Group, purchased an oil refinery in Pennsylvania that sat idle for more than a decade, it planned to move the compressor train to a new refinery in Argentina's Neuquen province where it would be repurposed to recycle hydrogen gas in the catalytic reformer section of the plant. Jointly owned by Renesa and Petrolera Argentina, the refinery — employing the rebuilt compressor train — now produces 7% of the gasoline sold in Argentina.

Over the 10 years of disuse, however, many components had corroded, some from being partially submerged in water and subjected to freezing and thawing cycles. Many components were outdated, and the compressor operated at 60 Hz, rather than the 50 Hz Renesa required. The latter issue was by itself a significant challenge.

Personnel at the Universidad Tecnologica Nacional in Argentina recommended Flowserve to Renesa, and after competing for the job with the compressor train's manufacturer, the company contracted to rebuild and re-rate the compressor, delivering a turn-key project within a year.

"Flowserve got the contract because we were the only company that did not need to take the compressor out of the country to make the retrofit, and Flowserve was the only company that could test the compressor dynamically in Argentina," explains Martin Gay, Flowserve general manager of seal operations in Argentina.

Many rotating components and diffusers were corroded beyond any possibility of repair. Compressor station support systems and auxiliaries were technologically obsolete, inoperable, or inadequate. Rebuilding it had to be completed by September 2011, when the refinery was to open, with commissioning in July 2012.

Flowserve pulled teams together from Mendoza, Argentina; Calgary, Alberta; and Kalamazoo, Mich., to work on the renovation, including specialists from across its Flow Solutions Group comprising rotating and seal engineers, component technology

All activities involved in the rebuilding project involved complex design and fabrication work. To accommodate the two Gaspac dry gas seals, for example, Flowserve engineers essentially custom designed the seal assemblies and housings. They also built new shafts and new diaphragms and redesigned the end pieces.

technicians, and repair and upgrade experts. Flowserve also tapped expertise from its manufacturing, foundry, and test facilities in North and South America.

## Major Undertaking

During the year time frame, this broad group accomplished many goals:

- Constructing new compressor discs and diffusers made of carbon steel, rather than iron, using 3-D laser scanning and solid modeling.
- Repairing or remanufacturing casings, guide vanes, discharge volutes, and other parts, reclaiming the original rotor and building a second.
- Installing Gaspac dry gas cartridge compressor seals with a labyrinth seal between the inner and outer seals.
- Adding a dry-gas nitrogen conditioning and control system.
- Replacing the original 60-Hz, 1,800-rpm motor operations with a 1,500-hp TEEAC 50-Hz, 1,450-rpm motor and a variable-frequency drive.
- Rebuilding the existing gearbox with new gears and shafts to compensate for the drop in frequency and to give the compressor a rated speed of 8,791 rpm.
- Replacing the old, oversized water-cooled forced lubrication system with a smaller, more efficient air-cooled one to lubricate the compressor bearings, seals, gearbox, and motor (built to API 610,



Energy company Renesa did not need to work with multiple vendors for the compressor rebuild at its Argentina refinery, and all renovation and testing was done in Argentina. Flowserve pulled teams together from Argentina, Canada, and the United States, including rotating and seal engineers, component technology technicians, and repair and upgrade experts. Flowserve also tapped expertise from its manufacturing, foundry, and test facilities in North and South America.

specifications, 10th edition).

- Building a new skid in accordance with the specifications of API 610/ISO 13709.

All of these activities brought their own challenges, and all involved complex design and fabrication work. To accommodate the two Gaspac dry gas seals, for example, Flowserve engineers essentially custom designed the seal assemblies and housings. They also built new shafts and diaphragms, and redesigned the end pieces, reverse engineering from the original compressor parts.

Throughout the process, the Flowserve team collaborated with Renesa personnel on specifying and installing state-of-the-art monitoring and control instrumentation, including programmable logic controllers, and integrating monitoring and control functions with the refinery's distributed control system.

The team also dynamically tested the rebuilt compressor train at a Flowserve facility in Mendoza, Argentina, with attention to quality control and assurance documentation. In addition, Flowserve staff performed precommissioning, installation, and start-up services on-site before turning the keys over to Renesa.

## A Project of Firsts

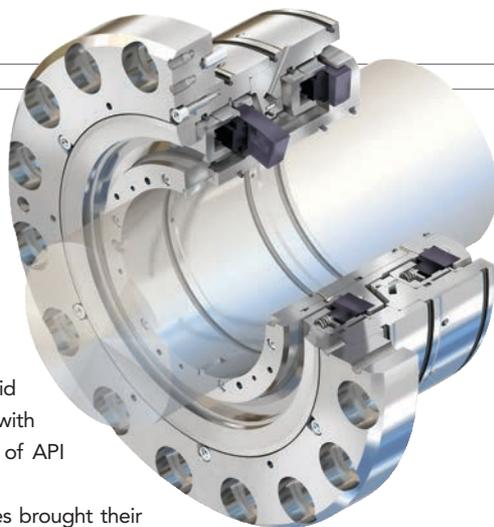
The compressor train has been operating satisfactorily for a year now, living up to Renesa's expectations.

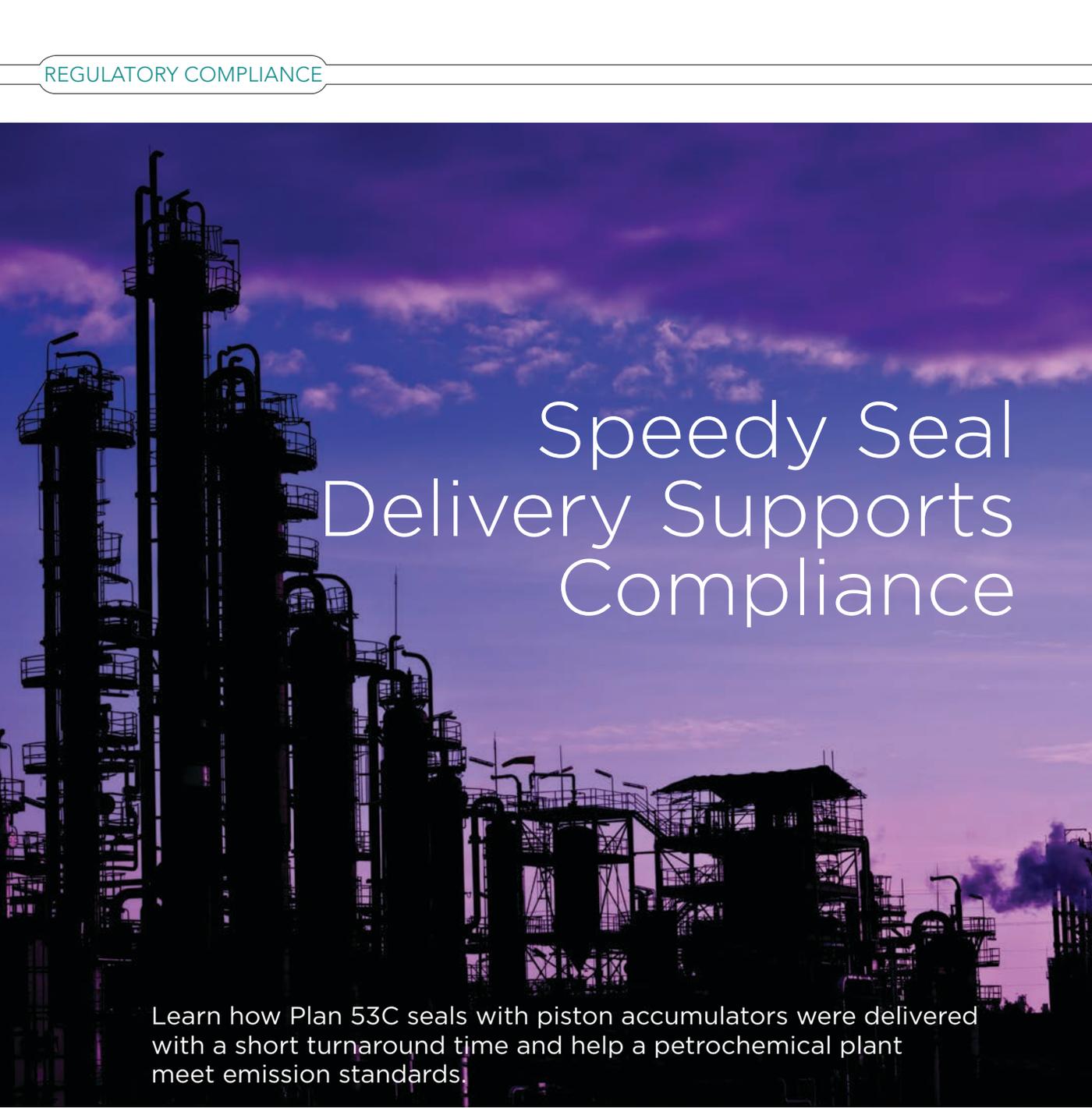
"This was a first-time project in several ways," Gay says. "It was the first time we tested a compressor in a pump test facility, which turned out to be a successful venture. We had to manufacture a special panel to test all the seals and adapt the skid compressor — it was the first time we built a compressor skid. We also designed a 12-inch discharge pipeline to take flow out of the plant. It was the first time we provided an oil lubrication system for a compressor. And it was the first time Flowserve manufactured compressor parts."

"This was the first time any company has undertaken this degree of rebuilding on a compressor," he notes.

Very important for the customer, Gay adds, is that "Flowserve provided one global solution for the project, and Renesa did not need to work with multiple vendors."

For more information, visit [www.flowserve.com](http://www.flowserve.com).





# Speedy Seal Delivery Supports Compliance

Learn how Plan 53C seals with piston accumulators were delivered with a short turnaround time and help a petrochemical plant meet emission standards.

A manufacturer of chemicals, fuels, and polymers needed to upgrade process lines at its Houston petrochemical plant to comply with emissions regulations. This meant changing out single seals for dual seals at multiple points on lines carrying propane, ethylene, propylene, and similar hydrocarbons.

This installation was not routine. First, the company's leaders wanted to install the seals starting at the beginning of February 2013, although the funds would not be allocated until after January 1. This short turnaround of about one month for project completion was a major challenge.

Second, the pump pressure varied during operation, rising high enough that barrier pressure could not reliably be maintained between the seals. Those two characteristics — variable and high pressures — are textbook examples of why the API Plan 53C seal support system was developed for this customer. The Flowserve seal systems the petrochemical customer selected manage the pressure differentials with piston accumulators built as part of the seal assembly.

The extremely short turnaround was the work of cooperation among the Flowserve operations and sales staffs and the customer's engineers.

## An API Plan 53C seal support system manages the pressure differentials with piston accumulators built as part of the seal assembly.

“We knew the order would be coming in,” says Jeff Hiemstra, general manager, Systems-North America at Flowserve. “So we began to manufacture and source components that have long lead times in order to begin making the seals as soon as the paperwork came in. By getting everything lined up ahead of time, we were able to meet our customer’s expectations.”

Flowserve shipped eight systems within four weeks and another nine systems four weeks later. Normal turn-around would be eight weeks or more.

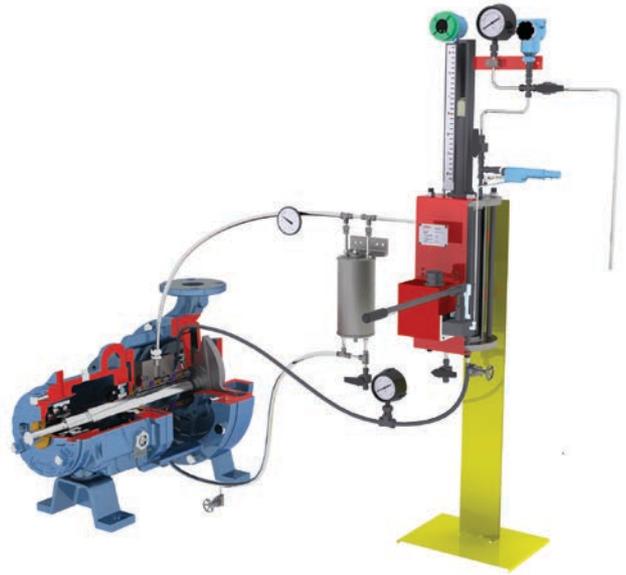
Many parts have to be special ordered, Hiemstra explains, because customers often request specific brands of pressure valves, temperature indicators, level switches, and other components — and some components have lead times of eight to 10 weeks. “This is not a device we can build in advance,” he elaborates. “That’s why knowing a customer’s needs ahead of time makes it possible for us to support them effectively.”

### Managing the Seal Pressure

Process fluids must not leak into the atmosphere, so the seal must be very tight, especially when fluids are being pumped at 400 or 500 psi. The dual seal design accomplishes this by ensuring that the pressure of the barrier fluid between the two seals always is maintained at a higher pressure than that in the seal chambers.

Setting a high barrier pressure with a Plan 53B system, however, creates problems for the seal design and the facility’s infrastructure, according to Hiemstra. In some pressurized seal-system applications, pressure within the seal chamber varies, making it difficult to set the pressure for the barrier fluid reservoir. The Plan 53C tackles this challenge.

In the Flowserve seal system, barrier fluid is pressurized through a piston accumulator so that its pressure is



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amplified to maintain seal pressure — in this application, to 15% greater than the pressure in the stuffing box. As a source of pressure to maintain that constant differential, the piston assembly takes a stream of process fluid in a direct line from the pump stuffing box, rather than using an external accumulator. This design ensures sufficient barrier pressure is available between the seals. In this application, the differential pressure for the inboard and outboard seal is 15% higher than the seal chamber pressure.

Pressure in the outbound seal chamber may be affected by the inevitable slight leakage of barrier fluid. Part of the piston accumulator’s job is to move in its cylinder to allow for that loss. The piston assembly also contains cooling coils on the barrier fluid side that remove heat from the pressurized fluid, an important part of the Plan 53C’s job.

The Plan 53C system and seals have now been in service at the facility for months and have proven to help ensure that the plant meets emission standards.

“This project is a good example of what can happen when sales and operations people and the customer all talk to put in place a plan that meets the customer’s needs and expectations,” says Hiemstra.

For more information, visit [www.flowserve.com](http://www.flowserve.com).



# Unique Test Facility is Revolutionary

A first-of-its-kind, fast-performing test facility in the United States allows customers to watch as high-pressure, high-speed tests on compressor seals are conducted.

A new Flowserve test facility for compressor seals is cutting turnaround times for high-speed, high-pressure tests in half and enabling emergency tests to be done within 24 hours. The facility, in Kalamazoo, Mich., is still being built, but results from the first test bay already are demonstrating the company's commitment to "exceed customer expectations and offer the flexibility and capabilities that they need," according to Jason Jerz, project engineer at Flowserve.

Previously, compressor seals to be tested at high speeds and pressures had to be sent to the company's Dortmund, Germany, location. However, the first test bay with new capabilities has been operating since April 2013. A second came online in July, and the third will be in service by year end.

The first bay with new capabilities is an upgrade of one of the older testers. The second is a complete rebuild of another older test bay — "everything including the plumbing," Jerz says. The third is new and is being built in an expansion of the building.

## Enhanced Capabilities

The first two test bays will have parallel capabilities: testing at pressures approaching 600 bar (8,700 psig) now and exceeding 900 bar (13,000 psi) by the end of the year; speeds greater than 28,000 rpm, up from 23,000 in the older testers. The facilities each have about 100 measurement channels for data acquisition, an increase from 12.

The third tester will perform tests exceeding 55,000 rpm when it enters service and exceed 75,000 rpm in the future and at pressures of greater than 250 bar (3,600 psi). It also has about 100 measurement channels. The older testers were hand operated; all three new ones are fully automated except for very difficult tests that require human judgment.

These pressures and speeds are common requirements in industries such as oil and gas drilling and pumping, pharmaceutical manufacturing, and turbo expanders. "High operating speeds are especially valuable when you need a lot of flow in not much space," says Michael Spaid, project engineer at Flowserve.

This supply gas panel is made of thick-wall tubing that operates in the first tester. The gas supply panel works directly with the control panel and is the brains and backbone to the entire tester. It also enables Flowserve to accomplish fast setups and improved response times for customers.

“During the design phase of the project, we worked to improve functionality and safety and to lower costs,” he adds. “For example, we designed one PLC-controlled operating panel for our pressure supply. We have also removed all of the flexible tubing under high pressure, since these lines break down over time and become hazardous, using our 3-D software to develop tubing runs before the installation.”

The new panel, Spaid continues, “allows us to quickly change tester setups with common instrumentation for pressure, temperature, and flow monitoring. We also designed an improved floor-mounted rail system with hydraulic means of installation and removal to reduce cycle times. This also has helped reduce daily wear and tear on the tester.

“In addition, we incorporated additional water jacketed cooling areas into the tester, which will help in heat removal, improving tester performance as our testing pressures increase from customer applications,” he explains.

### What the Tests Entail

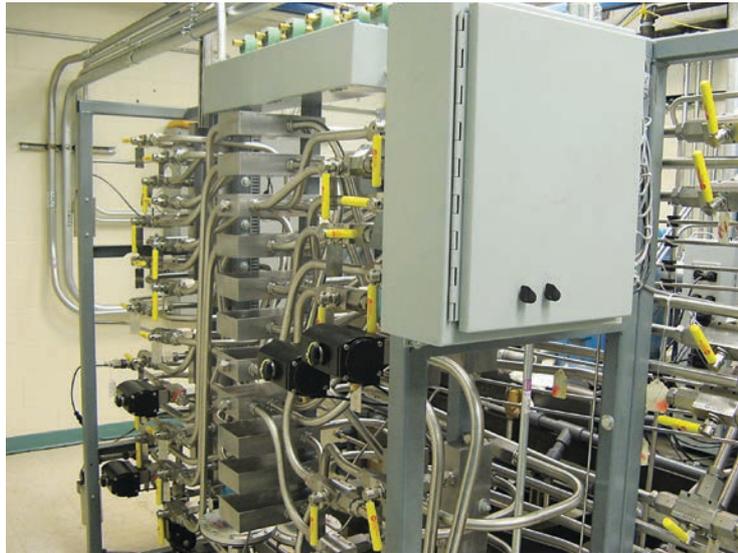
Compressor seals typically undergo a sequence consisting of tests of low pressure, static pressure, and dynamic pressure at speeds of, for example, 50% and then 125% of their expected operating speeds. Hysteresis is also tested — whether stationary parts travel smoothly axially — as is balance, which can contribute to machine vibration. Spin testing at high rpms ensures that ceramic seal faces do not fracture.

In addition, customers may request tests of pressure drops across orifices, high and low pressures on each half of a seal, high and low temperatures, vibration from each half, pressures on each side of a seal face, the separation of seal flows, and other parameters.

The test bays can generate reports automatically, detailing the data acquired through the measurement channels, in a variety of formats including graphs and raw data. Customers can also request reports prepared by hand.

About one-fourth of customers visit the facility when their seals are being tested to witness the process or have an inspector do so, and these individuals may want interim hand-written reports they can discuss with testing personnel.

“We encourage them to visit,” Jerz says. To help make customers welcome, the facility has a high-speed wireless



network so customers can work while they are monitoring tests of their seals, and the facility will soon have a dedicated witness area for them. “Having customers witness their tests is a good learning experience for us. It helps us stay current on customer needs.”

### Early Successes

The upgraded and completely rebuilt testers already are proving their mettle, Spaid says. The upgraded tester has been in operation more than five months. Already, the backlog for testing has dropped from six weeks to two. And now the facility can handle emergencies as quickly as within 24 hours.

“In one case, an oil and gas drilling company realized that the pressures their seal would be subjected to were higher than they had previously thought, and we were able to run the tests over a weekend so they could continue with installing it on an off-shore platform on Monday,” Spaid says. “In another instance, a compressor manufacturer specified that their customer wanted testing done in the United States, and we were able to accommodate them.”

In addition, within a three-week period shortly after the first two testers entered service, Flowserve was able to tell four customers it could perform tests in Kalamazoo that previously would have required the seals to be sent to the Dortmund facility. “This enabled us to give them a much quicker turnaround,” Jerz says.

“We see this as a continuous improvement project,” he adds. “We want to meet our customers’ needs as those needs grow and change.”

And, Jerz points out, “there’s no other test facility like this in the world.”

For more information, visit [www.flowserve.com](http://www.flowserve.com).



*Your seal faces may look like this after just 200 hours in hot water service*

*Flowserve's exclusive\* UNCD® diamond coated seal faces show no wear or damage after 4,000 hours in the same service conditions*



Utilizing Advanced Diamond Technologies' Ultrananocrystalline diamond coatings, Flowserve provides plant operators an exclusive sealing solution for low lubricity fluids. Flowserve's fine grain UNCD® coated mechanical seal faces offer lower friction than other seal face materials while maintaining a smooth surface topography that allows UNCD diamond coated seal faces to run opposite softer seal face materials. This unique capability to pair a diamond coated seal face with any traditional seal face material gives Flowserve the opportunity to select the optimum seal face material combination to suit specific application needs.



\* Flowserve technology agreement with Advanced Diamond Technologies, Inc. (ADT)



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