

Evaluating Critical Components of Natural Gas Compression Equipment



Your Speaker:

John Dunaway, PE
Director, OEM Sales
Cook Compression



Your Host:

David Orton
Senior Vice President, Global Business
Development & Marketing
IMW Industries

About IMW



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IMW has been manufacturing industrial machinery since 1912, and has evolved to be a leading manufacturer of natural gas compression systems, serving all major markets Globally. Equipment is currently operating mid-east to North of the Arctic Circle.

- Quality Products & Leader in CNG Compression
- Non-Lubricated Compression for Clean CNG

A variety of configurations for all applications



CLEANGAS TECHNOLOGY by IMW



COMPLETE CNG
CLEAN FUEL SOLUTION BY IMW



COMPACT CNG
CLEAN FUEL SYSTEM BY IMW



CLEAN CNG
COMPRESSORS BY IMW



INDUSTRIAL CNG
LAST MILE CNG DELIVERY BY IMW

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IMW operates as a wholly owned subsidiary of Clean Energy Fuels Corp. (NASDAQ: CLNE). Clean Energy is the largest provider of natural gas fuel for transportation in North America and a global leader in the expanding natural gas vehicle market.

Clean Energy has operations in CNG and LNG vehicle fueling, construction and operation of CNG and LNG fueling stations, biomethane production, and compressor technology.

Upcoming Webinars




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www.imw.ca/cng-webinars/

- Free Monthly Webinars
- Documented CPD Credits


More CPD Info or Board Room Attendance:

webinars@imw.ca

A photograph showing a white mobile CNG station with a green and white striped top, labeled 'Natural Gas for VEHICLES' and 'Mobile CNG Station'. Two white vans with the IMW logo are parked in front of it. A person is standing between the two vans.

A Compelling Case for CNG Vehicles
March 26, 2014

Start time: 9:00am PST / 12:00pm EST /
Duration: 1 hr
Credit: 1 hr technical, informal

A small black and white portrait of a man with glasses, wearing a suit and tie.

Guest Speaker:
Stephe Yborra
Director, Markets & Technologies Development
NGVAmerica.org

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Event Outline:
An overview of the case overall for Natural Gas Vehicles and further focus on specific strengths of CNG for regional fleets considering or currently self-fueling.

Natural Gas Vehicle Applications Include:

- ✓ Airport taxi & shuttle services
- ✓ Beverage & regional distribution
- ✓ Municipal services & maintenance
- ✓ Transit & school bus
- ✓ & several others

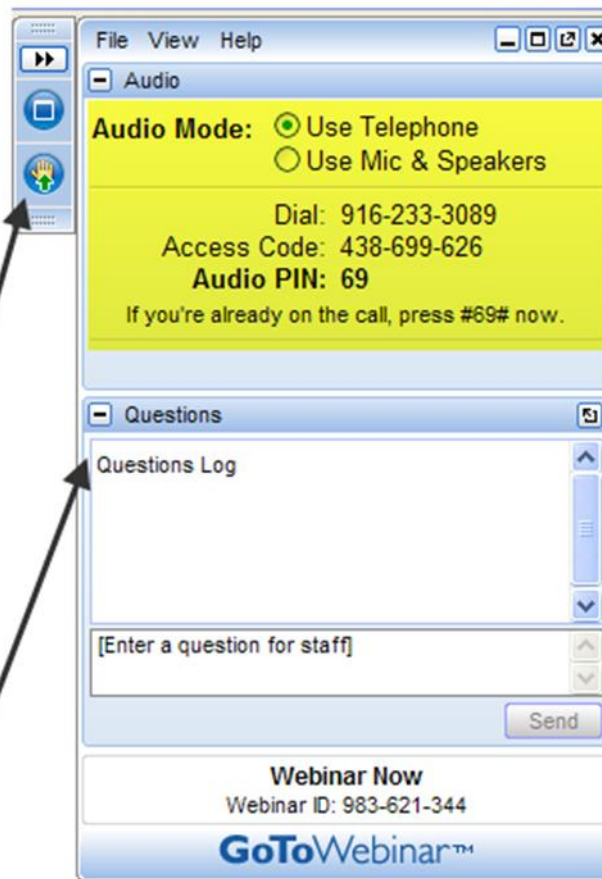
Join the Discussion!



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During the session, you can use this button to "Raise Your Hand" if you have a question.

If there are more questions than can be answered during a session, the Organizer may ask that you type in questions in the Question Log so that they may be addressed later, via email.



Cook Compression Overview



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A worldwide leader in the component design, manufacturing, monitoring and repair of the full range of reciprocating compressors for the Natural Gas, Petrochemical, EOR and Industrial markets.

- Division of Dover Corporation (NYSE: DOV)
- Broad range of compressor **valve, sealing & emissions control technologies.**
- Highly experienced **engineering team** with expertise across all compressor products and applications
- Sophisticated **Analyzers and Monitoring systems** for predictive maintenance.



Course Overview



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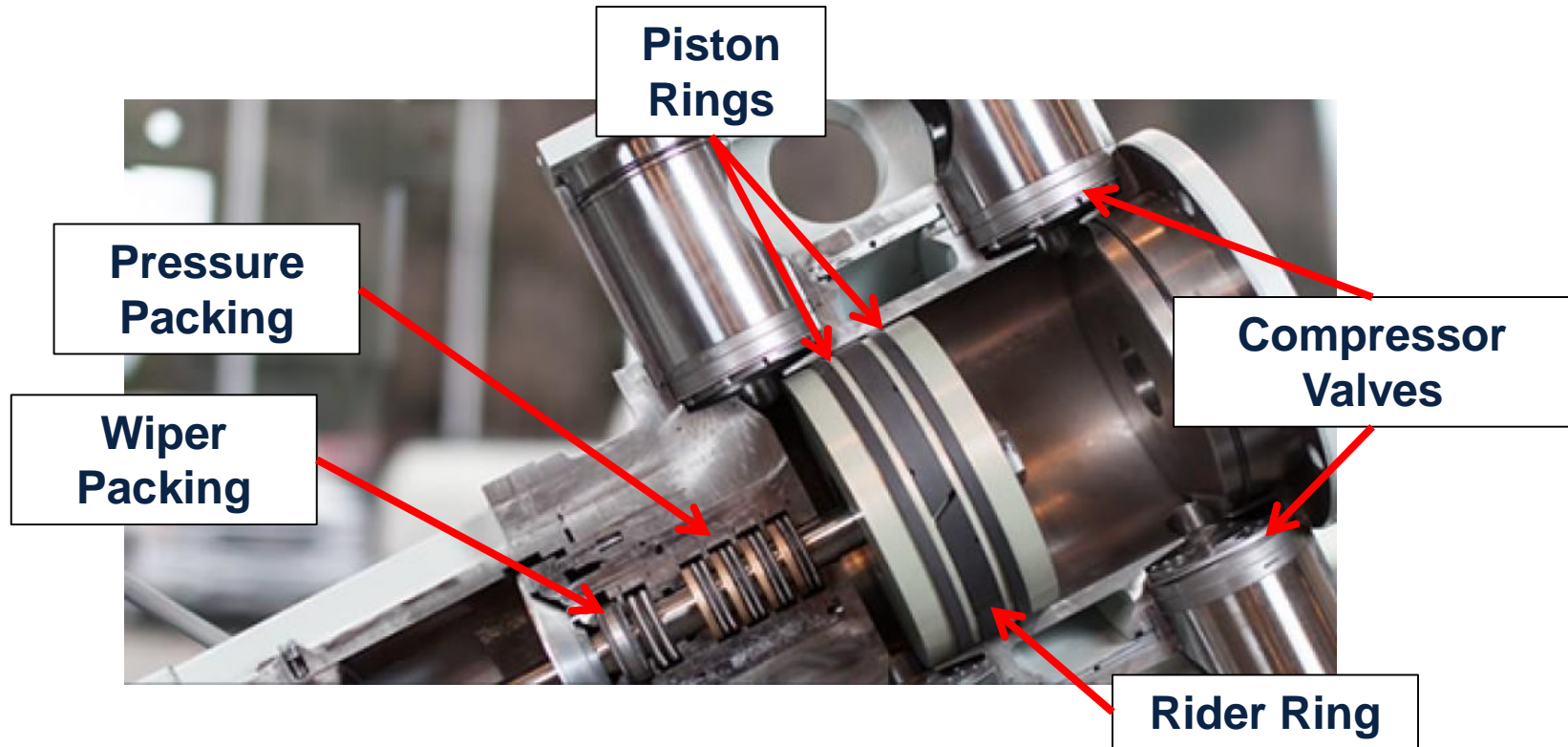
- Definition and overview of critical compressor components
- Describe the benefits and challenges surrounding non-lubricated CNG compression
- Review Cook's approach towards extending service life in non-lubricated CNG compressors
- Review IMW's standardization project and the benefit to the end customer





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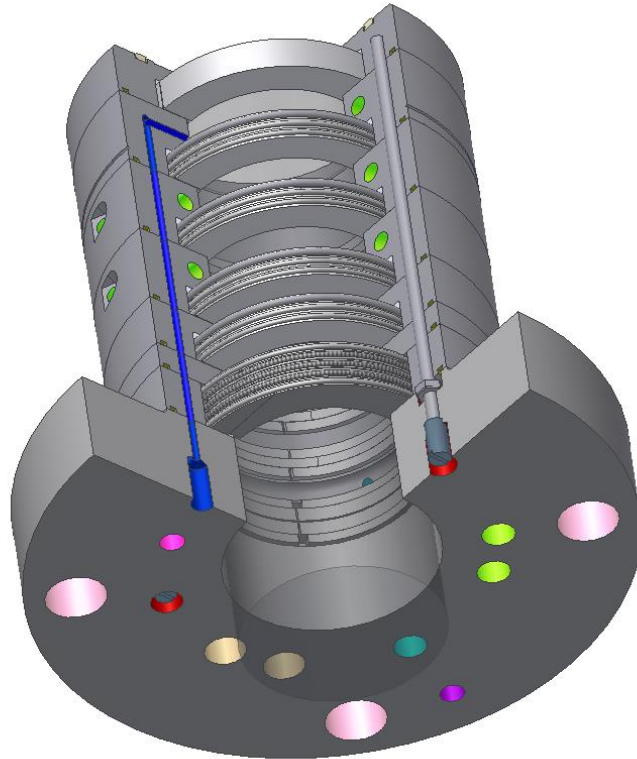
Defining Critical Components





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Packing Case Assembly



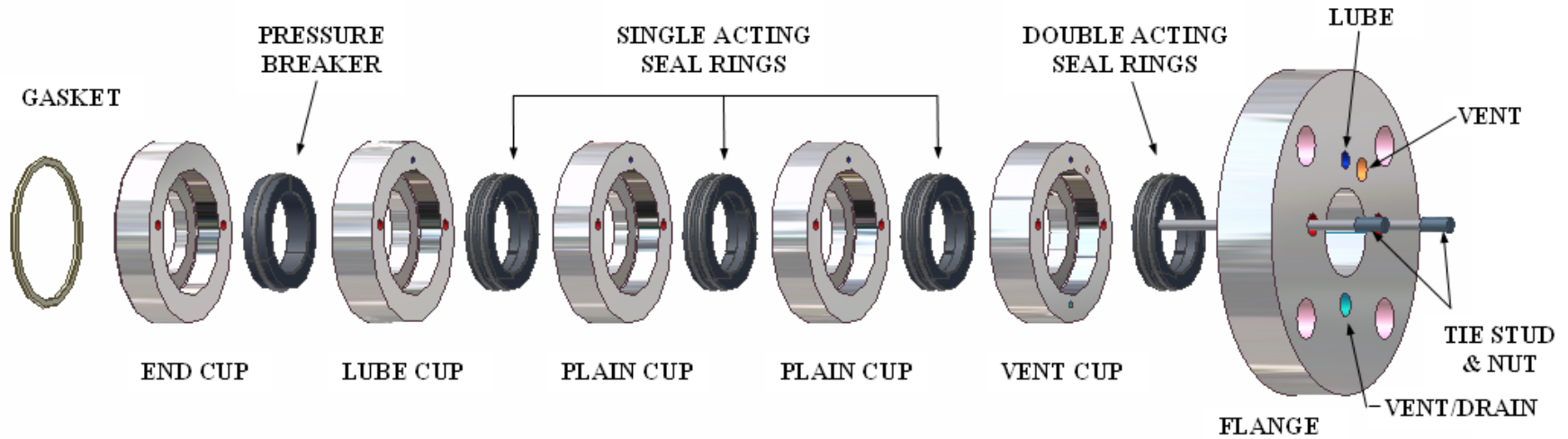
Function:

- Seals high pressure gas, prevents leakage from cylinder into frame or atmosphere
- Packing Rings seal around the rod and against packing case cup
- Sealed against cylinder with end gasket
- Rod Rings are pressure actuated seals



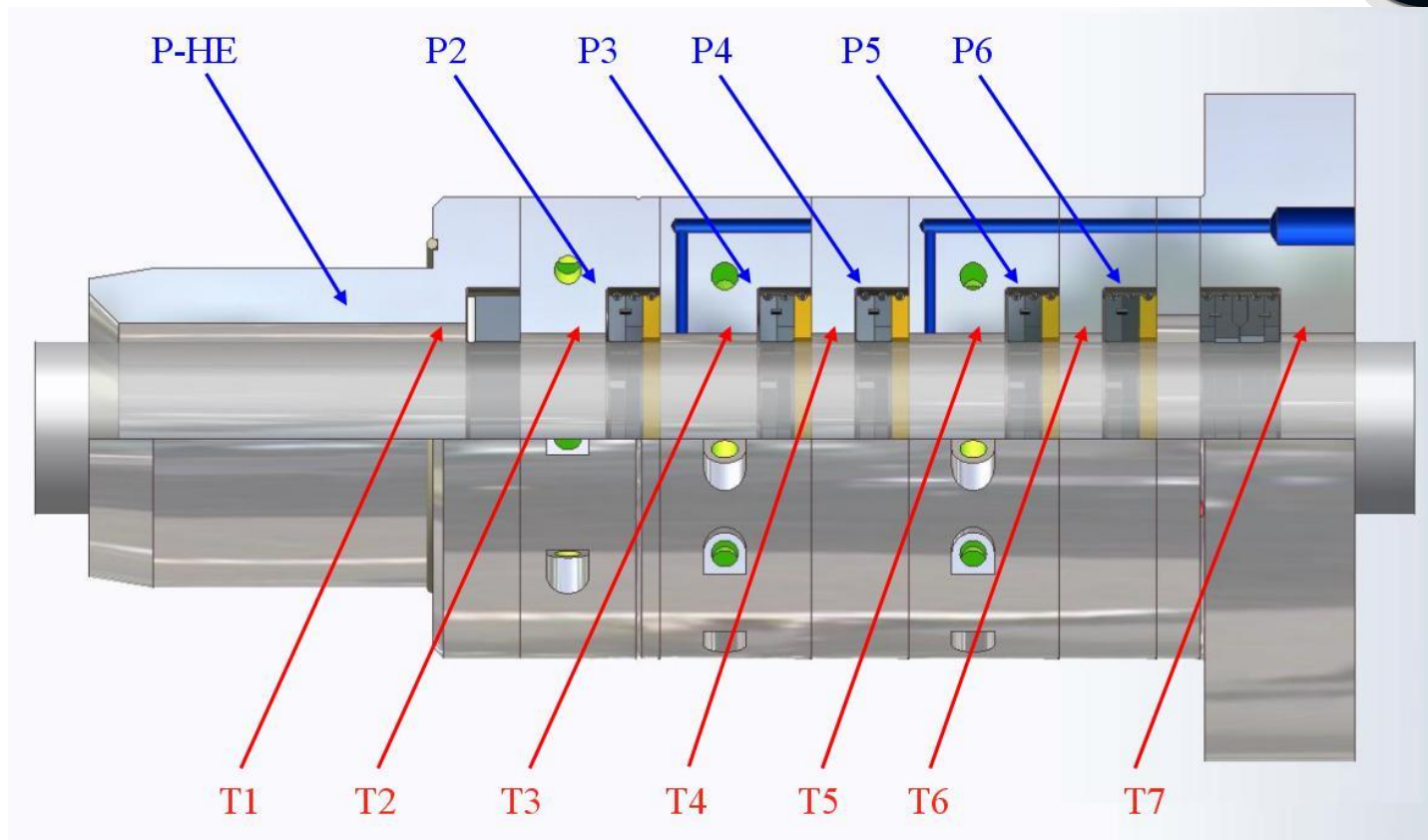
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Packing Case Assembly



PACKING CASE AND RINGS

How does it work?



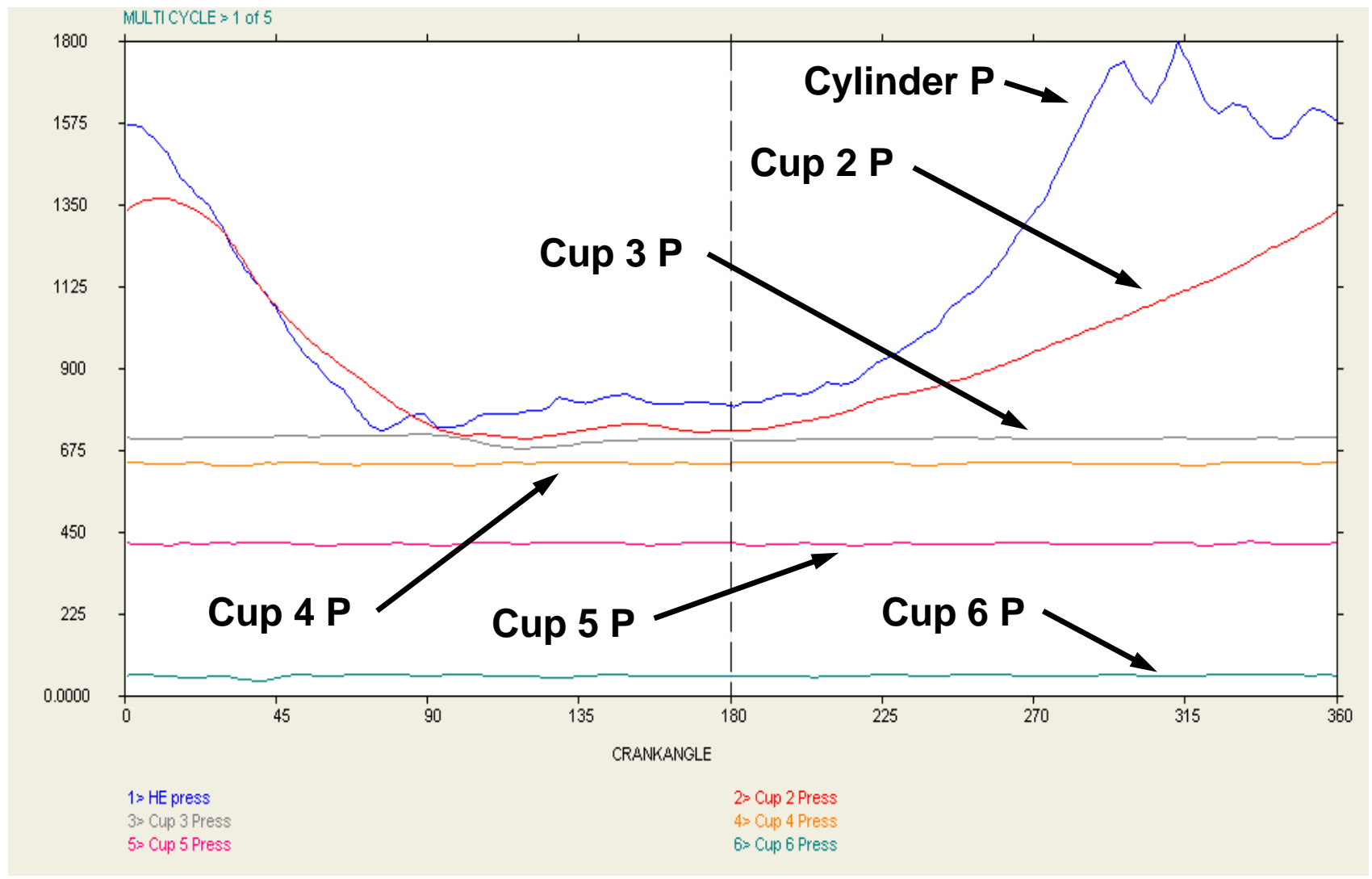
INSTRUMENTED PACKING CASE

Monitors and record what is happening inside the packing case

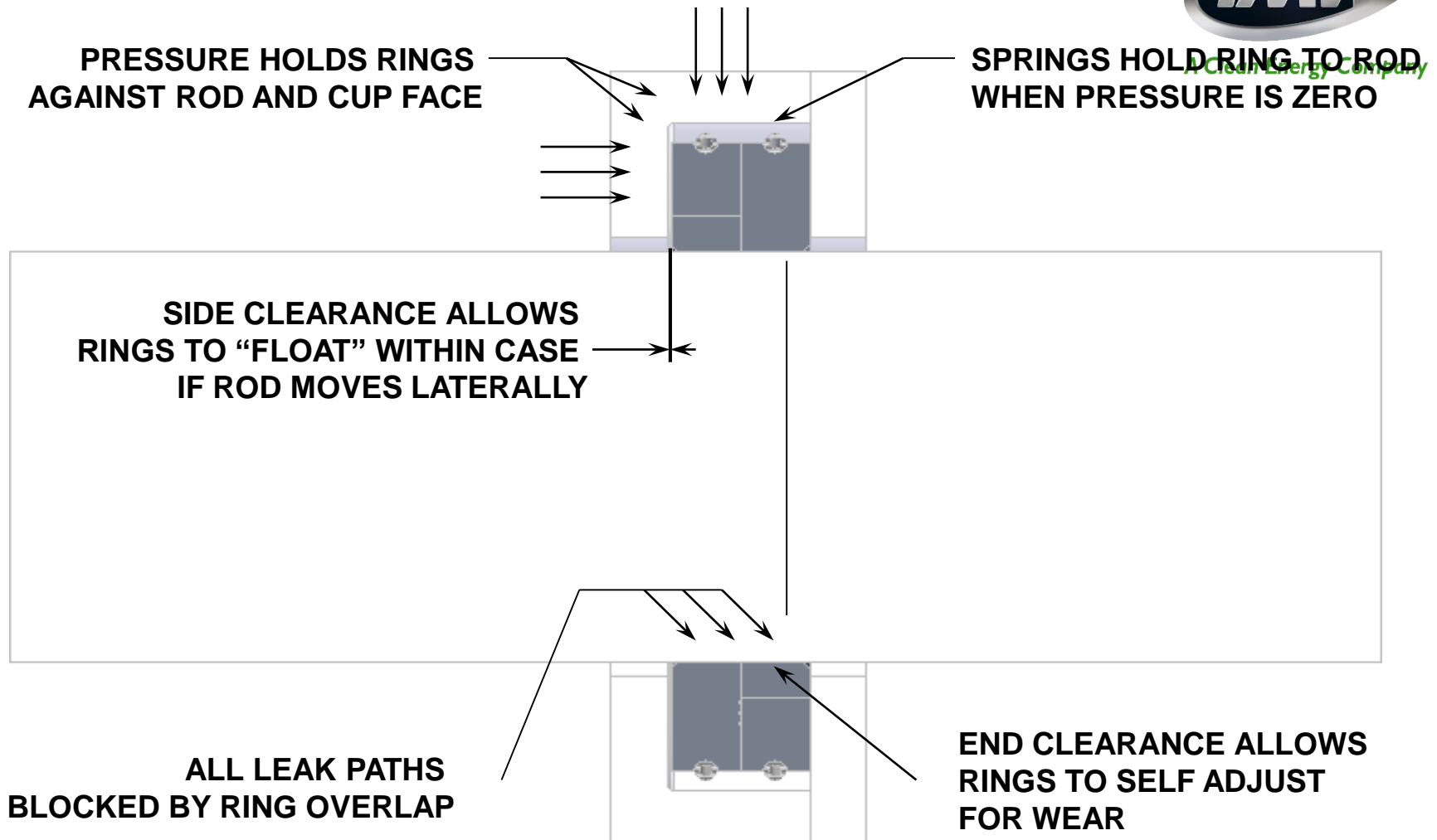
Title



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Packing Rings – How They Work

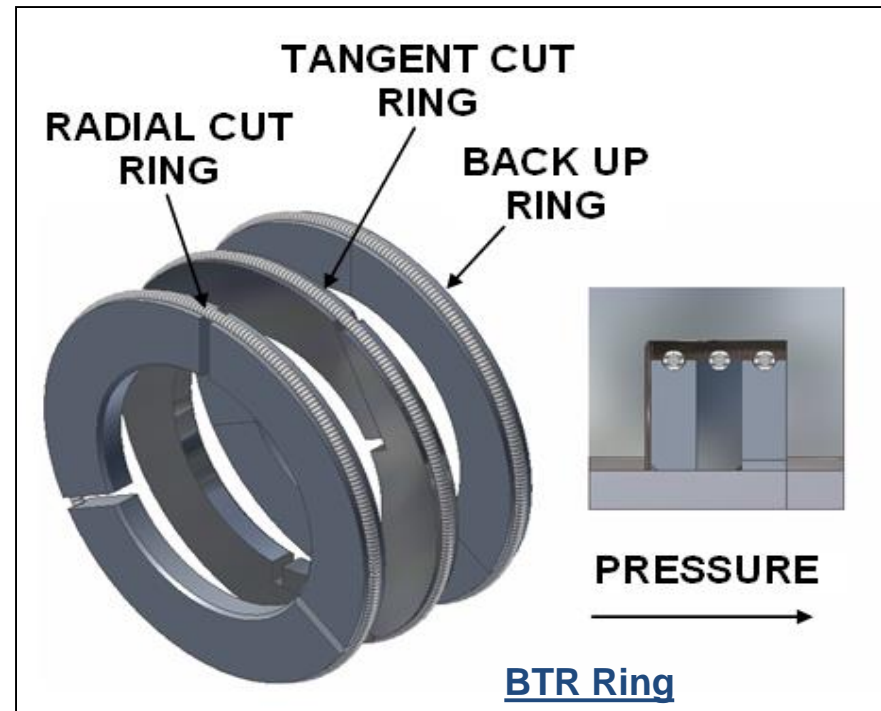


Standard Packing Rings



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- Most common ring is BTR style
- The Radial and Butt-tangent, and rings are typically made from filled-PTFE
- Back Up rings are typically bronze or PEEK
- Single-Acting, only seal in one direction
- Must be installed with letters on face of rings facing pressure source

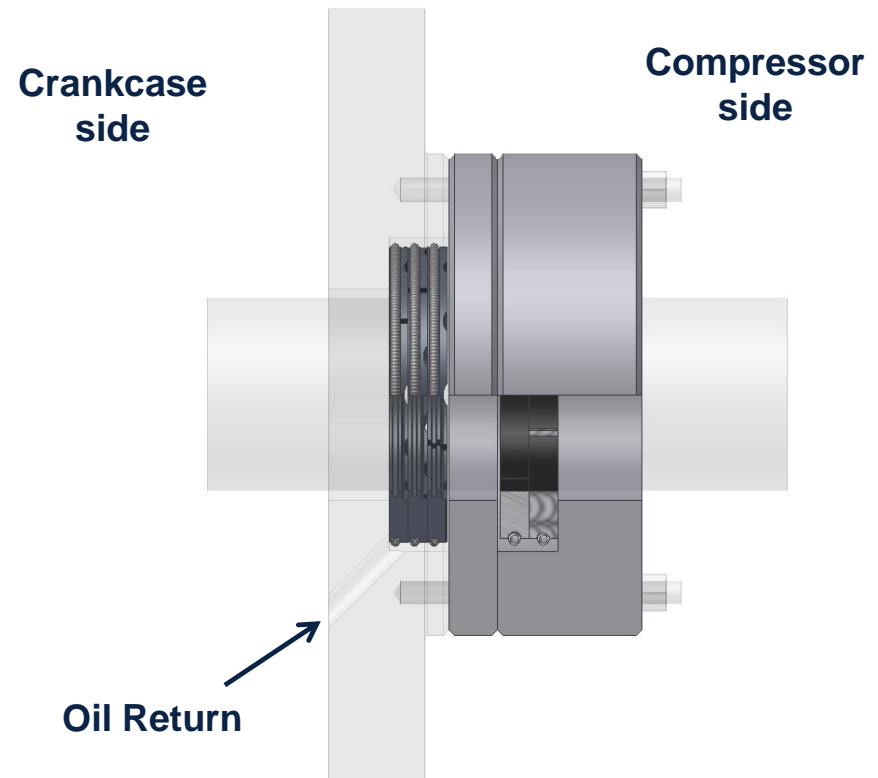


Wiper Rings



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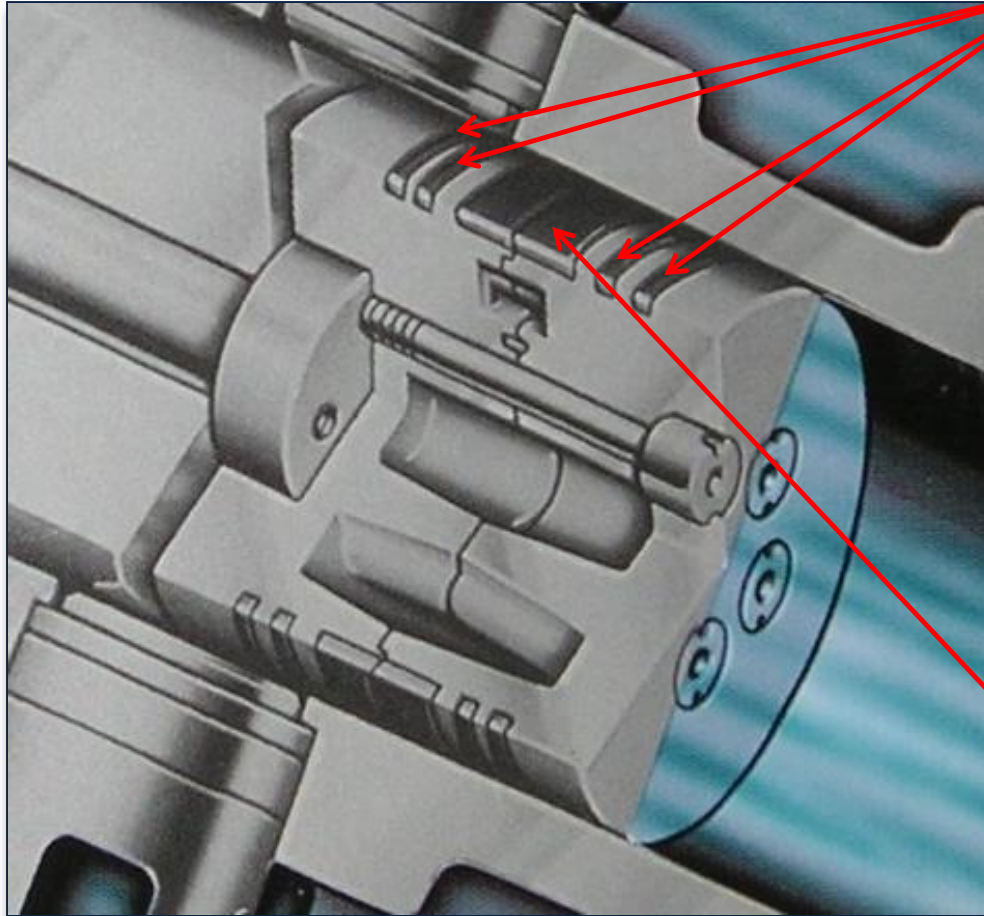
- The purpose of wiper rings is to keep the crankcase oil in the crankcase by “wiping” it off the rod
- Special edge geometry and high spring tension allow wiper ring to shear oil film off rod





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Piston Rings and Riders



Piston Rings

- Piston rings stop or reduce the flow of gas between a piston and cylinder
- Rider rings keep pistons from contacting the cylinder wall

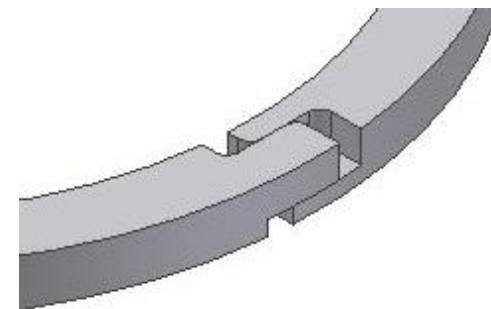
Rider Ring

Piston Rings and Riders



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- Typically Angle Cut, one piece or two piece
- Seal joints and multi-piece rings used in higher stages to reduce blow-by
- Side notches on riders prevent pressure loading under the ring
- Filled PTFE or PEEK materials





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Non-Lubricated CNG Compression

Benefits	Challenges
<ul style="list-style-type: none"> Oil carry-over into engine has adverse affect on performance. Removing oil from the compressor eliminates this concern. 	<ul style="list-style-type: none"> Elimination of lubrication increases heat at sealing surface and can reduce life of rings if not properly accounted for
<ul style="list-style-type: none"> Reduced operational cost due to reduced oil consumption 	<ul style="list-style-type: none"> Space constraints limit the available design envelope
<ul style="list-style-type: none"> Reduced capital and operating expenses from elimination of equipment required to deliver and handle compressor oil 	<ul style="list-style-type: none"> High linear piston speed and high pressure at upper stages increases heat at sealing surfaces
	<ul style="list-style-type: none"> Close-coupled frames create challenges for wiper seals



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Non-Lube CNG Design Approach

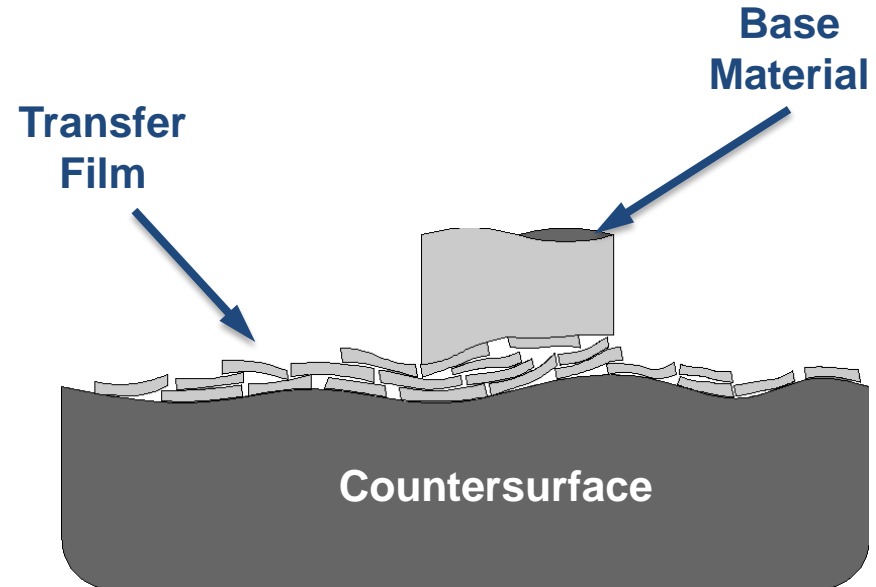
- A combination of upgraded materials and proper seal design is the key to extending service life
- Material selection – must select a material that performs in the absence of oil
- Product design – Heat and oil carryover are the enemies of ring life. We must select designs that minimize these factors.
- Application Experience – Knowing which technologies best fit non-lube CNG applications



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Material Selection

- Challenge: Selecting wear materials to survive in the absence of oil
- Transfer film is the key to non-lube material performance
- Materials developed through extensive lab and field testing
- Oil carryover washes away transfer film and accelerates wear





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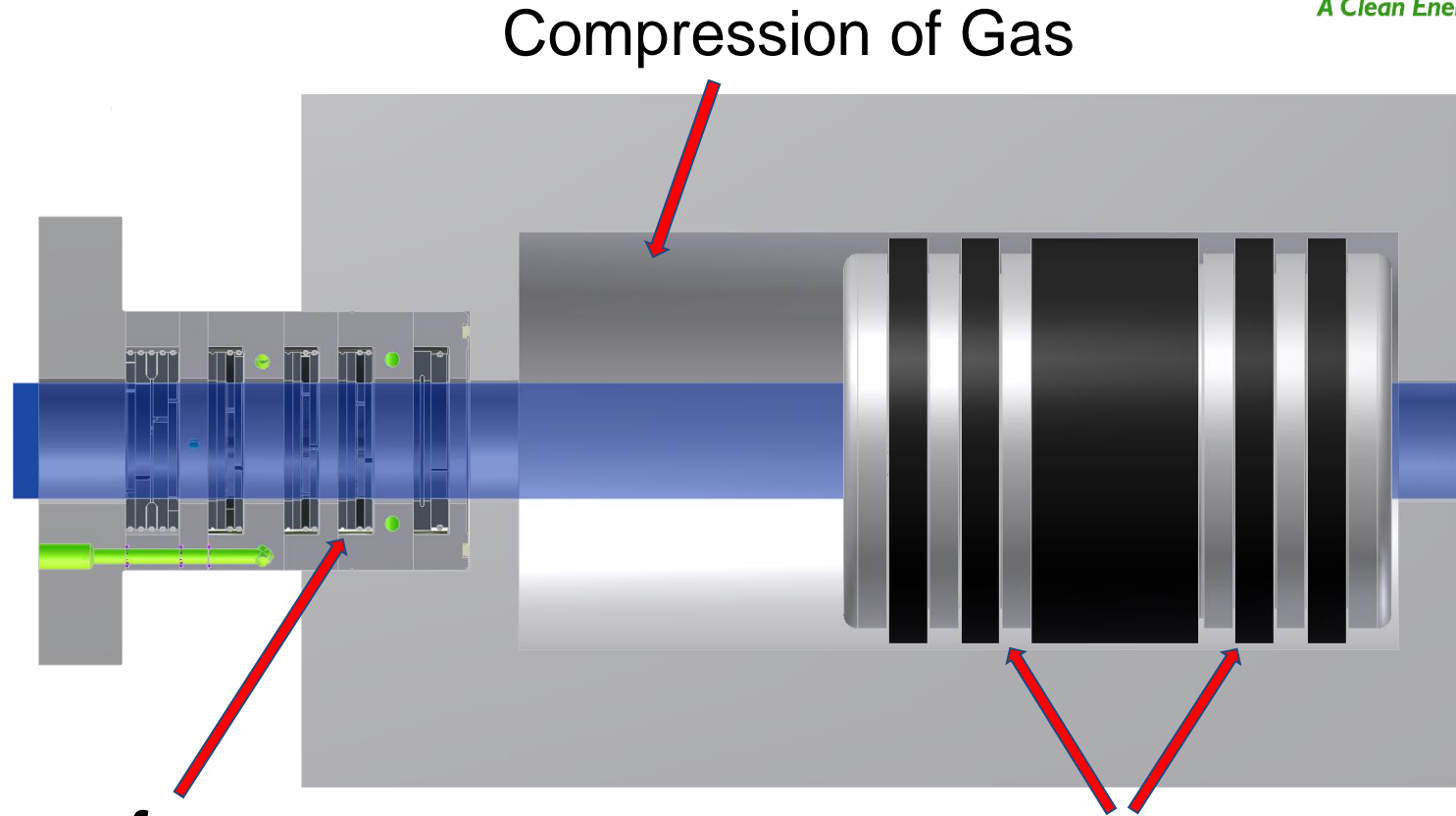
Material Selection

- Common materials for Non-lube CNG piston rings and rod rings include the following
 - Carbon-filled PTFE
 - Polyimide-filled PTFE
 - Filled PEEK (high pressure)
 - PTFE with proprietary fillers
- Cleanliness is key when performing maintenance
- All sealing surfaces should be cleaned with de-natured alcohol to remove all contaminants

Problem: Sources of Heat in Compressor



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**Friction of
Rod Rings**

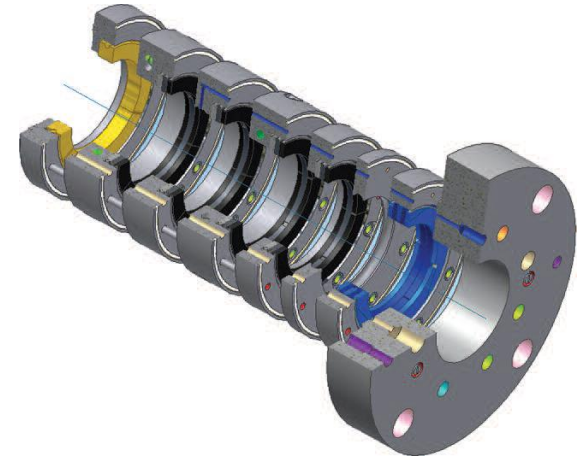
**Friction of Piston Rings and
Wear Bands**

IMW Standard Compressors



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- Cook and IMW are working on standard designs that will include **best available technology** for non-lube CNG compressors
- Packing includes **upgraded seal designs** with carefully selected materials that optimize performance over a range of operating conditions
- Piston rings will use joint designs and materials that minimize wear and blow-by
- Designs configurations have been condensed to a **minimal number of parts**



Key Takeaways



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- **High service life** can be achieved in non-lube CNG compressors when the proper considerations are taken
- **Heat and oil carryover** are the enemies of service life, especially in non-lube applications
- To maximize life, use the a **combination of product designs and wear materials** designed to reduce heat generation, limit oil carryover and minimize wear rates
- Take **proper cleanliness precautions** during maintenance to promote material transfer film development
- **Standardized IMW compressors** will utilize best available technology with a goal of achieving high service life, low lead times and high spares availability



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Questions?

Contact Us!



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Questions?

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Request For Information

With a simple mission to provide quality alternative energy products, on-time delivery, and dependable after-sales service, IMW commits to building long-term relationships by satisfying each customer.

This commitment is evident in all of our products, which can be found fueling vehicles and industrial gas generators in harsh climates around the world. These climates span the chilly northern city of Barrow, Alaska to the hot climates of remote Pakistan, Peru, and Qatar.

Contact us today to discover how IMW can partner with your organization.

Full Name: (required) *

Company Name: (required) *

Email: (required) *

Phone Number:

City:

Country:

How Can We Help You?

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