

The Magazine from Trelleborg Sealing Solutions

in the groove

The world of seals and service



Read *in the groove*
online

FLUID POWER

Riding High

Doppelmayr ensures you reach
the summit smoothly.

INNOVATION DAYS

Accelerate Your Business Now

Meeting the demands of
an ever-changing world.



ENERGY

An Essential Element

Hydrogen is key in
transitioning to a net
zero world.



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NEWS

AWARD



Linda Muroski Named Rubber News' 2022 Executive of the Year

Since 1989, Rubber News has selected an Executive of the Year to honor worthy leaders within the rubber industry. Linda Muroski, President of Trelleborg Sealing Solutions Marketing Americas and Global Healthcare & Medical was awarded the 2022 Executive of the Year Award due to her outstanding leadership qualities and her efforts to increase diversity, collaboration, and employee satisfaction while empowering her team.



Linda joined Trelleborg in April 2016 as Business Unit President of Marketing Americas. In March 2019, her scope expanded to include BU President, Global Healthcare & Medical.

"I am honored to receive this award, and even more honored to work with the best group of colleagues I have ever worked with in my career. The team takes pride in providing our customers with solutions that help differentiate them in the market. We can only do this by working as a team, collaboratively, with our customers and internally across our organization. This collaborative spirit makes a difference, and you can see it within our team's commitment, our customer loyalty and our results as an organization," Linda states.



You can find the full article titled *Trelleborg's 'transformational' leader: Linda Muroski is Rubber News' 2022 Executive of the Year* written by Andrew Schunk on the Rubber News website.

SERVICE & SUPPORT



Trelleborg Expands Aerospace Capabilities in the APAC Region

Applying our "local presence, global reach" principles, Trelleborg Sealing Solutions has enhanced its capabilities in the APAC region so that customers can increasingly benefit from the strength and expertise of a global leader.

Quinn Collett, Director Trelleborg Sealing Solutions Aerospace Asia Pacific, says: "Our goal is to be the supply partner of first choice, working globally through our local teams, and this expansion helps deliver that promise across the region. The enhancements allow us to act quickly and reduce customers' time-to-market with more local decision-making, greater stock levels and an expanded team of experts, including engineers, project managers, quality and customer service professionals. This, along with a long heritage of aerospace expertise, will ensure that Trelleborg offers an unsurpassed level of service in the region."

Trelleborg Sealing Solutions offers a local presence through its five regional Customer Solution Centers in Singapore, China, Japan, Hong Kong and India, four warehouses, two R&D facilities and three production facilities.

NEW FACILITY



New High Performance Polymer Technology Center Opened in Colorado, US

Trelleborg Sealing Solutions celebrated the grand opening of its High Performance Polymer Technology Center on October 20, 2022. Located in Louisville, Colorado, the new facility stands alongside the existing Customer Solution Center.

It aims to accelerate development, reduce time-to-market for new products and improve manufacturing facilities' capabilities and response times. The center will also develop and refine our portfolio of high-performance plastic materials and products to support long-term innovation and device solutions to meet future requirements.

e-SHOP

New e-Shop Supports Chinese OEM and MRO Market



Trelleborg Sealing Solutions launched its Chinese Language e-Shop “Trelleborg旗舰店” on T-Mall. It provides an online platform for lower-volume customers to quickly and easily purchase a wide range of products, from reliable essentials, such as O-Rings and radial oil seals, to proven high-performance solutions, such as Turcon® Stepseal® 2K, Turcon® Glydring® T and Forsheda® V-Ring. The shopping process is quick, easy and convenient, and orders are shipped directly to the customer’s location, with the level of local service and support you would expect from Trelleborg Sealing Solutions.



Scan the QR code to learn more.

ACQUISITION

Trelleborg Acquires Minnesota Rubber & Plastics



Trelleborg signed an agreement and finalized the acquisition of the US-based company Minnesota Rubber & Plastics (MRP) in 2022. Headquartered outside Minneapolis, Minnesota, MRP is a leading manufacturer of polymer and thermoplastic components and a system provider for technically demanding applications for several fast-growing industries, such as medical equipment, water management, and food and beverage.

The acquisition furthers Trelleborg’s ambition to provide innovative custom solutions to customers by accelerating product development and strengthening research and development. MRP will help Trelleborg build a broader portfolio while leveraging its various manufacturing locations. Additionally, MRP’s Innovation Center in Plymouth, Minnesota, not only produces production samples but also sets up manufacturing processes and programs the machines that will be used to produce the parts before they move into production. The acquisition brings two strong companies together in a best-of-both approach.

IMPRINT

Trelleborg Sealing Solutions

in the groove, Edition 45, 9900142GBGT0523

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PRINTING: W. Kohlhammer, Stuttgart, Germany

IMAGES:

p. 01;02;04;05;09;14;15 Trelleborg Sealing Solutions

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p. 56;57;58;59 Trelleborg Sealing Solutions

Experience our Capabilities

Our teams of experts are exhibiting at trade shows across the globe to give you a closer look at the broad range of products, solutions and services we offer.

Aerospace Paris Air Show

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Since its first exhibition in 1909, the International Paris Air Show has constantly grown and remains the largest aerospace event in the world. The 54th annual air show will take place at the Le Bourget Parc des Expositions in June 2023, and once again will bring together the major players in the global aerospace industry, focusing on the latest technological developments and innovations.

Semiconductor 2023 SEMICON Taiwan

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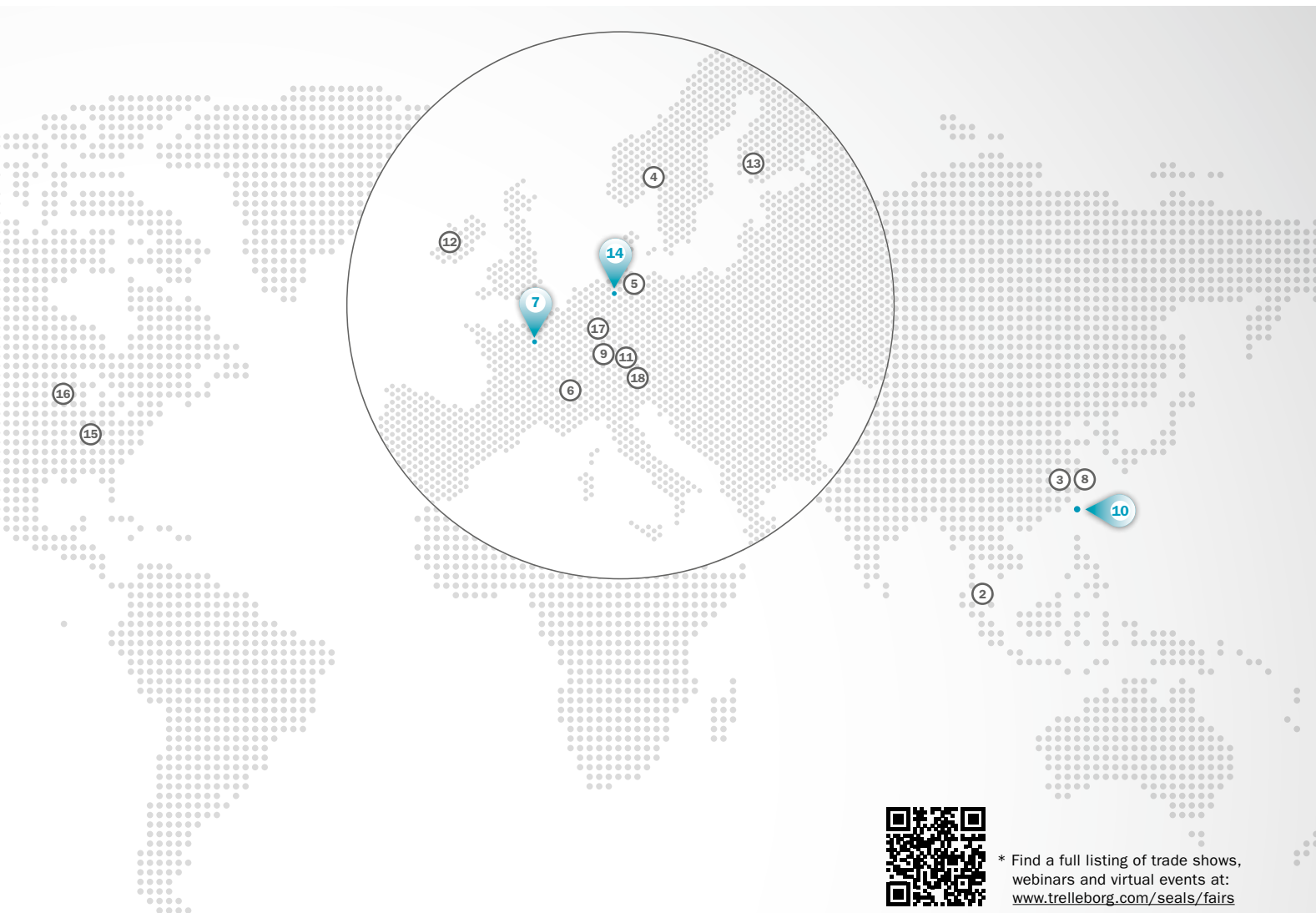
SEMICON Taiwan brings together microelectronics industry professionals from all over the world with the aim to advance technology together, or "Forward as One". Last year's show hosted 707 exhibitors in 2,450 booths, with 45,000 visitors.

Renewable Energy & Power Generation Hydrogen Technology Expo Europe

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Bringing together professionals from throughout the hydrogen and fuel cell industry, the Hydrogen Technology Expo is focused on solutions for low-carbon hydrogen production, efficient storage, and distribution, including both stationary and mobile applications.



* Find a full listing of trade shows, webinars and virtual events at: www.trelleborg.com/seals/fairs

Trelleborg Sealing Solutions Event in 2023*

Space Tech Expo	①	Long Beach, CA, USA	May 2 – 4
Future Polymers 2023		Livestream	May 17
Lima	②	Kuala Lumpur, Malaysia	May 23 – 28
Nexus Face Seal		Online	May 25
MEDTEC China 2023	③	Suzhou, China	Jun 1 – 3
Nor-Shipping	④	Lillestrøm, Norway	Jun 6 – 9
Aircraft Interior Expo	⑤	Hamburg, Germany	Jun 6
Connect in Pharma	⑥	Geneva, Switzerland	Jun 14 – 15
Paris Air Show	⑦	Paris, France	Jun 19 – 25
CPHI&PMED China 2023	⑧	Shanghai, China	Jun 19 – 21

Trelleborg ConneX	⑨	Stuttgart, Germany	Jun 27 – 28
SEMICON Taiwan	⑩	Taipei, Taiwan	Sep 6 – 8
Agritech Supplier Summit	⑪	Augsburg, Germany	Sep 13 – 14
Medical Technology Galway	⑫	Galway, Ireland	Sep 20 – 21
SUBCONTRACTING TRADE FAIR	⑬	Tampere, Finland	Sep 26 – 28
Hydrogen Technology Expo	⑭	Bremen, Germany	Sep 27 – 28
RSI Expo & Technical Conference	⑮	Indianapolis, IN, USA	Oct 1 – 4
MD&M Minneapolis	⑯	Minneapolis, MN, USA	Oct 10 – 11
Compamed	⑰	Düsseldorf, Germany	Nov 13 – 16
Semicon Europa 2023	⑱	München, Germany	Nov 14 – 17

Engineering Resources

Find out more about the latest digital and print releases from Trelleborg Sealing Solutions.

Roto Glyd Ring®

- Low friction
- Stick-slip-free starting, no sticking
- High abrasion resistance and dimensional stability
- Simple groove design, small groove dimensions

In the Groove is Now Interactive!

In the Groove magazine is now available in iPaper format, giving you access to digitally enhanced features, such as films, interactive diagrams and clickable links to additional information.



visit:
www.trelleborg.com/seals/itg

VIRTUAL SHOWROOM – New Exhibits Explore Trelleborg's Latest Innovations

Explore our innovative products and solutions by immersing yourself in innovative sealing technology. The Trelleborg Sealing Solutions Virtual Showroom offers galleries, exhibits and in-depth information about our capabilities, services and products.

Isolast® Purefab™ JPF22 and Isolast® Purefab™ JPF40

Specifically engineered for critical semiconductor sealing applications, Isolast® PureFab™ materials demonstrate the highest purity of their kind, without compromising plasma resistance, outgassing and thermal stability.

Isolast® K-Fab™ Seal

Traditionally, flanges are sealed with an O-Ring, but as conditions in the flange become more challenging, they are subject to premature failure. The Isolast® K-Fab™ flange seal offers a solution to this.

LSR Molding Capabilities

High-precision liquid silicone rubber (LSR) parts are manufactured by injection molding techniques for many industries. Due to flexibility in design and tooling, LSR injection molding is ideal for producing complex geometries and can consolidate various functional features into a single part.

Expanded ServicePLUS

A variety of enhanced services match our customers' needs at every step of the business process, ultimately reducing total costs and throughput time. The Trelleborg ServicePLUS team works with customers to develop a custom package of services, concentrating on business activities, which typically offer the largest resource saving opportunities.



Check out our latest innovations now!
Visit www.trelleborg.com/seals/showroom

DIGITAL EVENT – INNOVATION DAYS 2022

Trelleborg Sealing Solutions held a series of events in October 2022 to bring together experts in their fields with customers and others interested in polymer and sealing technology. Hundreds of attendees joined from across the world, either in person or digitally, sharing knowledge and insider information about how sustainability is reshaping the industrial landscape.

Find out more on page 14.



TECH LIBRARY – Webinars on-demand

Trelleborg Sealing Solutions hosts a library of on-demand webinars on its website, providing an educational resource about topics relevant to sealing technology, engineered products and applications. They cover practical, targeted lessons taught by experts in their field and are available 24/7. All webinars are added to the Tech Library after their live recording, so you can still benefit even if you cannot attend live.

35+ webinars are available on a range of products and sealing topics. Watch them at:

www.trelleborg.com/en/seals/resources/technical-library/webinars



Find out about the latest literature from Trelleborg Sealing Solutions.

CATALOG – Discover Valve Stem Sealing Solutions for the Energy Market



This catalog provides a detailed overview of design considerations, installation recommendations and material selections, to make specification and ordering simple for leading valve stem solutions. Turcon® Variseal® MC is a single-acting, spring-energized primary seal used as a single seal within valve stems as an alternative to V-Stack type products and other valve stem packings. Turcon® Variseal® V-Stack Kits are commonly used in oil & gas valve stem applications to provide a single-acting, high-integrity sealing solution for higher pressures and temperatures over a long service life.

CATALOG – High Pressure and Temperature Spring Sealing with XploR™ S-Seal



XploR™ S-Seal provides reliable, bi-directional sealing for challenging applications, including casing strings and tubing hangers in wellheads, static HPHT connections, downhole tools, and subsea risers. It offers leak-tight performance even with relatively rough surface finishes at high pressures and temperatures. Integrally molded helical springs ensure high extrusion resistance, and it's easy to specify and install with a flexible and stretchable one-piece design that fits international standard O-Ring grooves.

BROCHURE – Forsheda® V-Ring: Long-Lasting and Effective Rotary Contaminant Exclusion



Effective sealing is critical to protect rotary systems from external contaminants and ensure long-lasting, efficient performance. The unique design of Forsheda® V-Ring lends itself to a wide range of applications, including wind turbines, electric motors and domestic appliances.

Find out more about Forsheda® V-Ring on page 29.

FLYERS – Isolast® PureFab™ FFKM Materials for Advanced Semiconductor Processes



Specially engineered for critical semiconductor applications, Isolast® PureFab™ FFKM materials offer the ultimate high-purity plasma sealing performance. Flyers are available for each of these materials to summarize their key benefits and applications.

Find out more about our full portfolio of Isolast® PureFab™ FFKM materials on page 50.



MORE INFORMATION



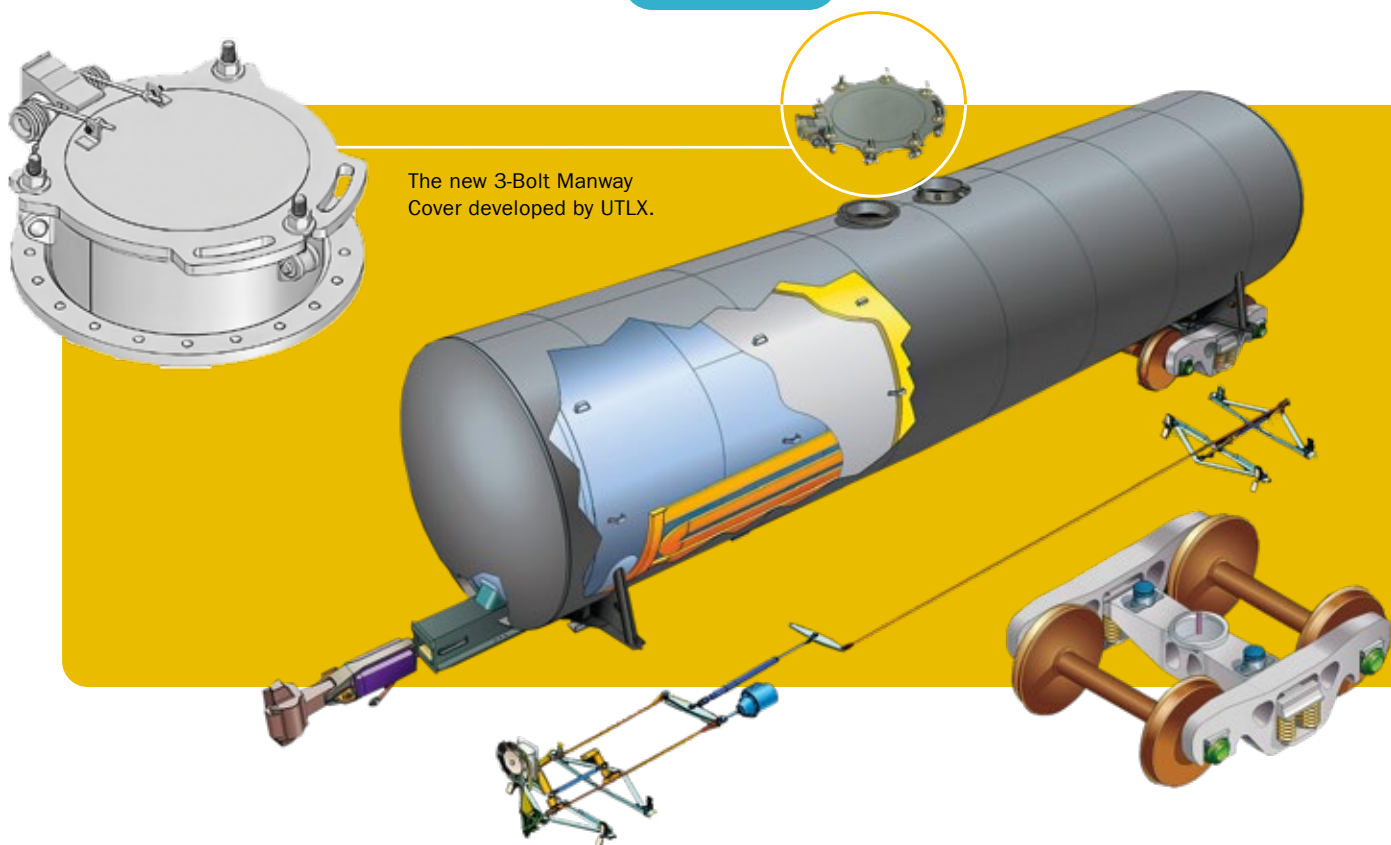
To view all Trelleborg Sealing Solutions literature, go to:
www.trelleborg.com/seals/literature

Reducing Dangerous Leaks

Union Tank Car Company's 3-Bolt Manway Cover seeks to simplify designs that have been little-changed for the best part of a century, while reducing leaks of hazardous materials.

By Patrick Gower Photos Utlx





The new 3-Bolt Manway Cover developed by UTLX.

ALMOST EVERY DAY IN THE US AND CANADA, there are instances of railroad tank cars spilling or leaking hazardous materials.

NARs occur with regularity

Spillages of hazardous material in transit are known in the industry as “non-accidental releases (NARs)” because they were not the result of a derailment or collision. Such spillages are usually caused by improperly secured or defective valves, fittings, and tank shells, according to the Association of American Railroads. There were 363 NARs from tank cars in 2019, according to the group’s most recent available data. It is a problem that Union Tank Car Company (UTLX), a railroad tank car leasing, manufacturing and repair company, set out to solve several years ago. After numerous iterations engineers came up with a newly designed 3-Bolt Manway Cover. The new cover has a simpler torque pattern relative to more common six and eight-bolt designs; however the most important element is a unique seal, designed by UTLX in collaboration with Trelleborg.

Changes take time

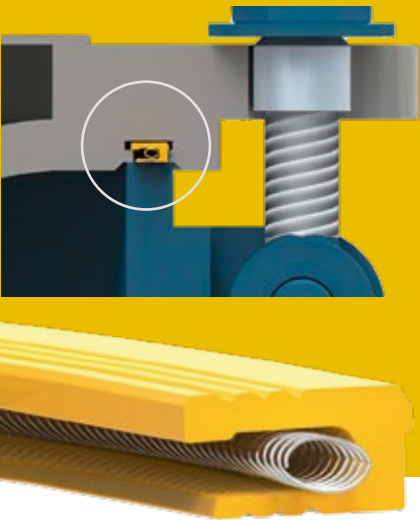
“The design uses a spring-energized elastomer seal that allows for the internal tank car pressure to help seal the manway, similar to old-fashioned pressure cookers,” says Joe Perez, Vice President of Fleet Engineering at UTLX. “It is the first of its kind in our industry.”

The design of hinged and bolted manway covers has remained largely unchanged throughout the century yet has always been among the top-ranking sources of leaks. According to Perez, the industry takes precautions in testing and approval due to the risks of rolling out premature modifications, which means that design changes take time. UTLX maintained their focus over the years to evolve their concept and deliver an acceptable solution for the good of the tank car shipping community.

“When you’re trying to bring in innovative ideas, right off the bat you’re running with something that’s going to take you a minimum of two years just to prove it.”

JOE PEREZ,
Vice President of Fleet
Engineering at UTLX





ADVANCED SEALING

Tank car manways require a seal that will ensure zero leakage over long journeys and withstand exposure to harsh chemicals in tough environments. The Trelleborg design team, in collaboration with Union Tank Car Company, met these criteria with the custom SEE® Variseal®, which features Trelleborg's proprietary Slantcoil® spring.

Details of the seal and slant coil in the UTLX 3-Bolt Manway Cover.



ABOUT UTLX

UTLX is a recognized leader within the community of builders, lessors and shippers of railroad tank cars, working closely with customers to provide practical solutions to industry needs. At the heart of its success is the more than 3,000 dedicated employees.

Owned by the Marmon Group, a Berkshire Hathaway Company, Union Tank Car Company is headquartered in Chicago, Illinois, in the US.

A new design

The design team, led by Dan Schmidt, Fleet Engineering Project Engineer at UTLX, simulated various design combinations using finite element analysis (FEA), a computerized simulation that predicts how products react to forces, including heat, pressure and fluid flow.


"Initially we sought to incorporate lessons learned from prior UTLX design concepts and prototypes, including means to reduce complexity by using fewer than eight bolts, adding a metal-to-metal contact in the assembly between the manway cover and tank car nozzle, and exploring alternative sealing options beyond the standard flat gasket," said Dan. "Central to these improvements was mitigating the primary cause of manway cover NARs, which was loose (or under-torqued) bolts."

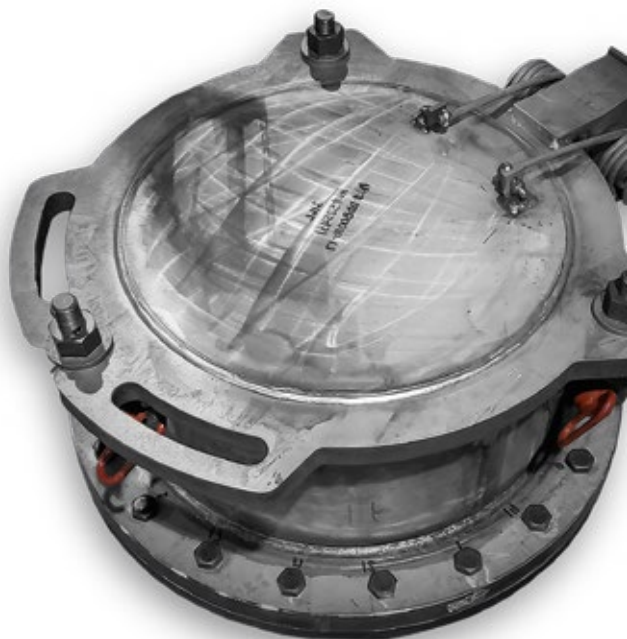
Reducing the number of bolts from eight to three simplifies the bolt torque pattern, improving functional and operational efficiency, and helps prevent the under-torquing of bolts and the over-stressing or crushing of the gasket.

Successful innovation

So far, the new design has been successful. Regulatory approval requirements include pressurization of the seal to 1.25 times that required by regulations for a duration of ten minutes without evidence of leakage or stress. The 3-Bolt Manway Cover passed that test and has now been approved for a two-year service trial, under which the product was operated in use on a select group of cars.

"When you're trying to bring in innovative ideas, right off the bat you're running with something that's going to take you a minimum of two years just to prove it," concludes Joe Perez. "But in the long run we want this to become our standard design with it installed on a good proportion of our 100,000 tank cars, and we think many others will benefit from it too. We're bringing forward a new innovation that will help reduce the industrywide issue of NARs."

UTLX expects that the new 3-Bolt Manway Cover will be generally available to the rail industry in 2024. 



A prototype of a UTLX 3-Bolt Manway Cover.



ADVANCED
TECHNOLOGIES

MANUFACTURING
CAPABILITIES

CUSTOMIZED
SOLUTIONS


Watch the sessions

All presentation recordings from the
Innovation Day are available at:
[www.trelleborg.com/en/seals/resources/
technical-library/tech-talks](http://www.trelleborg.com/en/seals/resources/technical-library/tech-talks)



INNOVATION DAYS 2022

Accelerate Your Business Now



The imperative to meet the demands of a constantly changing world with a focus on sustainability is reshaping the industrial environment. This challenge and arising opportunities were key themes of Trelleborg Sealing Solutions Innovation Days, a series of events in October 2022 for customers and anyone interested in polymer and sealing technology.

By Natalie Hesping

THE NUMBERS

- 365** guests and approximately 350 virtual participants joined in our first ever interactive hybrid Innovation Days
- 65** technical presentations and keynotes, and five panel discussions shaped the agenda under the conference motto, *Accelerate your Business Now*
- 3** key themes, *Advanced Technologies*, *Manufacturing Capabilities* and *Customized Solutions*, were addressed in sessions on industry trends and sealing and polymer technology

HOSTED BY JANINE MEHNER, Tech Moderator and Journalist, together with Prof. Dr. Konrad Saur, Vice President Innovation & Technology at Trelleborg Sealing Solutions, the Innovation Days featured inspirational keynote speakers, lively panel discussions and technical presentations. Sixty Trelleborg experts and several selected guest speakers shared their knowledge with hundreds of attendees from across Europe either digitally or in person in Stuttgart, Germany.

Reflecting how the Covid pandemic has reshaped the ways we travel and communicate, guests primarily from German-speaking regions took the opportunity to meet industry peers in person at the Wagenhallen in Stuttgart, a unique historical event venue with a suburban industrial atmosphere. Many more attended Trelleborg's first interactive hybrid event day which saw the full program broadcast to numerous people from across the European continent. →



Welcome session (from left): Janine Mehner, Tech Moderator, **Jürgen Bosch**, BU President Marketing Europe, **Linda Muroski**, President Global Healthcare & Medical and Marketing Americas, **Prof. Dr. Konrad Saur**, Vice President Innovation & Technology

Featured segments

From fluid power and semiconductor, to the new energy and healthcare and medical industries, the Innovation Days provided customers with information on the full range of Trelleborg Sealing Solutions capabilities. The event addressed guests' interests in technical and commercial matters and demonstrated Trelleborg's ability to serve as a reliable partner for customized solutions and individual application development. Comprising various segments in one event offered the opportunity to learn from each other and share best practices from other industries.

Session highlights included:

- **Advanced technologies**, including Multicomponent Technology, iCast™ LSR processing and additive manufacturing
- **Manufacturing capabilities** and innovative material processing, including high-performance plastics, composite technologies and Isolast® FFKM
- Pioneering developments supporting the **energy transition**, electrification and hydrogen technologies
- Insights into our state-of-the-art **R&D** capabilities

- **Customized solutions** and applications, for example in the fields of healthcare and medical, food and beverage processing, semiconductor manufacturing and many more sectors
- **ServicePLUS**, our 'total solution' program of value-added services to enhance every step of the value chain

What made the Innovation Days 2022 valuable for you?

"After challenging times due to the worldwide pandemic, welcoming hundreds of customers was most valuable for me. The conference program allowed for conversations and opened great opportunities to speak to customers, partners and prospects in person."

JÜRGEN BOSCH, BU President Marketing Europe



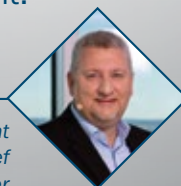
Guest speakers

From megatrends shaping the industrial workplace, to hands-on tips to cope with disruption and mental load, and practical use cases and brain-friendly presentation skills, our guest speakers covered a variety of challenges and opportunities we all face today. In addition to developing the professional and technical knowledge of attendees, the speaker program offered opportunities to hear inspirational leaders share their insights around personal development topics. →

Why did Trelleborg choose a hybrid event format?

“With meeting habits having changed rapidly in the past few years, our idea was to make both options available – to connect with customers in person but also digitally via an interactive event platform. The hybrid event was a first attempt to also bring both worlds together at once. In addition, with the awareness of sustainability being top of mind, our goal was to help reduce emissions at the same time. A win-win for customers and the environment.”

PROF. DR. KONRAD SAUR, Vice President
Innovation & Technology and Chief
Sustainability Officer



Jule Bosch Future Scientist &
Innovation Consultant

*Lost in Transformation – Understanding
change & designing the future*



Kim Dalum CEO and Founder Dalum
Beverage Equipment

*Skol to a Sustainable Beer – Helping
craft brewers reduce carbon emissions*



Falko Geisler Analytical Chemical
Engineer ATU GmbH

*The Future of Semiconductor
Technology – The challenge of
ultratrace chemical analysis*



Volker Busch Neuroscientist,
Psychologist and Author

*Just Do It – Change as
the engine of life*



Ákos Gerold Consultant and Brain-
Friendly Presentations Skills Trainer

*Drive Decisions – Speak the brain's
secret language*




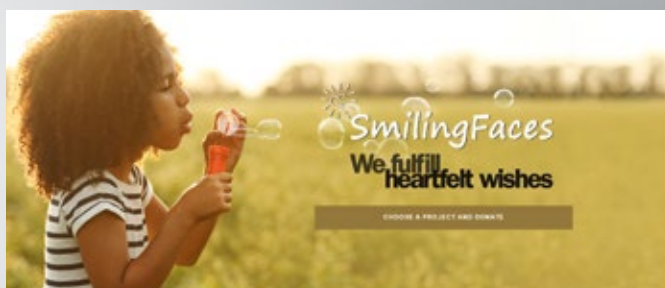


Hosted at a unique historical venue, highlights of the Innovation Days included a variety of guest speakers, tours of our R&D and logistics facilities, and numerous networking opportunities.

Protecting the Essential

Alongside technical presentations on sustainable solutions, innovative packaging and supply chain measures, the entire Innovation Days program focused on reducing our ecological footprint, in line with the Trelleborg Group initiative 'Protecting the Essential' which aims to reduce our emissions to net zero by 2035.

All guests received a bag of "social coins" to spend on selected local charity projects in Stuttgart with either a social or sustainability impact. Based on how attendees chose to use their social coins, Trelleborg Sealing Solutions donated over €20,000 to a selection of initiatives and bought certificates for the equivalent of 126,558 tons of CO₂ emissions. 



SELECTED SPONSORED PROJECTS

- Education initiative focusing on the energy transition – Crossing Borders Stuttgart
- Curbing the littering of our planet – The CleanUp Network
- Sustainable living and travel – STUVUS University Stuttgart
- Bee conservation project – Bienenschutz Stuttgart
- Table soccer for people with disabilities – Lebenshilfe Stuttgart
- Laughter at the children's hospital – Olgäle Stuttgart
- Friendship and activities for disadvantaged children – KÄPSELE
- Help for homeless, elderly and families – Helfende Hände Stuttgart

For details on all charity projects,
please visit: touch.tss-smilingfaces.com





COVER
STORY

Riding High



Magnificent views, fresh powdered snow, the warming après ski drinks; it's hard to resist the charm of the slopes. A collaboration between Trelleborg Sealing Solutions and Doppelmayr, a specialist ropeway engineering company, ensures you reach the top of the mountain smoothly.

By Sophie Hudson and Meghan Cloud Braunger

SKI RESORTS AND PASSENGERS PLACE THEIR TRUST IN DOPPELMAYR ski lift solutions to safely take them to the top of mountains, enhancing their winter sports experience. Transporting four to 15 passengers per cabin, detachable gondola ski lifts move up and down mountains by means of a steel wire monocable system, reaching speeds of up to seven meters per second.

A key part of a monocable system is the ski lift clamp and clamping cylinder. Located within the terminal housing alongside the bull-wheel, a large wheel that drives the cable movement, the clamping cylinder is a thin, 5-meter-long hydraulic cylinder. It provides the important function of tightening and loosening the main pulley, to manage tension on the cable and provide smooth performance of the system.



The monocable system is supported by a hydraulic cylinder that manages tension on the cable and smooths movement.

DID YOU KNOW?

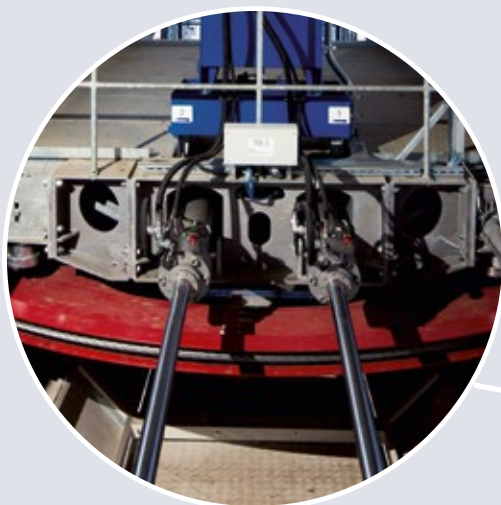
- The first ski lift was built in 1908 by Robert Winterhalder in the Black Forest in Germany
- The northernmost ski lift is near Tromsø, Norway and the southernmost is near Ushuaia, Argentina
- In the French Alps, you can ride the Vanoise Express, a double-decker, glass-bottomed gondola that fits 200 people and travels 380 meters above the valley floor
- The world's longest ski lift is in the German Alps and transports passengers 4.5 km to the top of the Zugspitze Mountain.

The force of friction

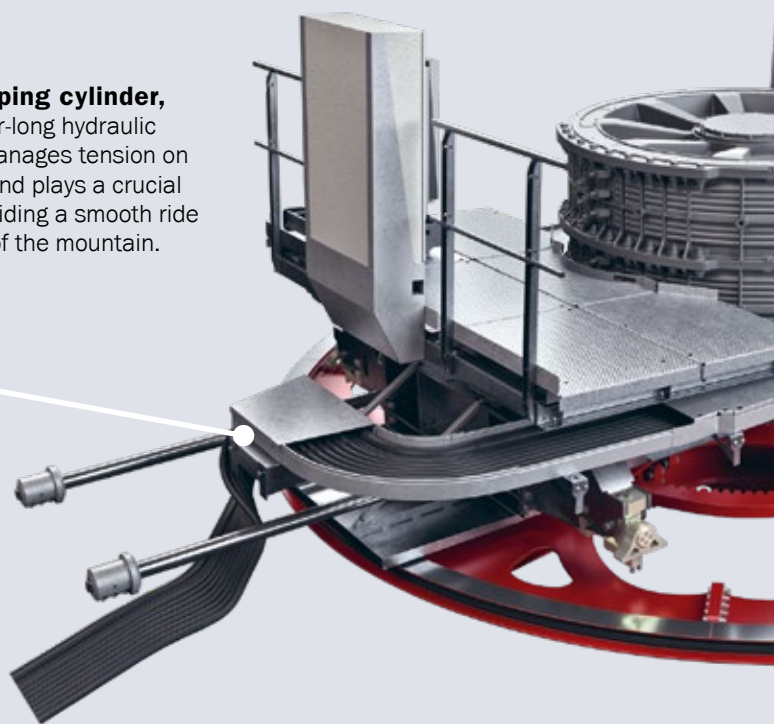
Within the clamping cylinder, friction can result in a phenomenon known as stick-slip; a spontaneous stop-start jerking motion that prevents the piston and rod from operating smoothly. This causes the cylinder to vibrate and creates unwanted noise throughout the system.

The right sealing and bearing system can optimize the operation of the clamping cylinder using a lubrication management solution that prevents stick-slip under all working conditions. This technology adjusts the lubrication conditions of each of the single sealing elements within a seal configuration to reduce the load.

For Doppelmayr, this is key. Any noise or vibrations felt through the monocable system need to be mitigated, with a high-performance sealing and bearing configuration combined with Lubrication Management Technology. →



The clamping cylinder, a five-meter-long hydraulic cylinder, manages tension on the cable and plays a crucial role in providing a smooth ride to the top of the mountain.



Wear rings

Turcite® and Zurcon® Slydring®



Piston seal

Turcon® Glyd Ring® Hz



Rod sealing system

Turcon® Stepseal® V LM
Zurcon® U-Cup RU9
Zurcon® Scraper DA22



Sealing challenges in hydraulic cylinders

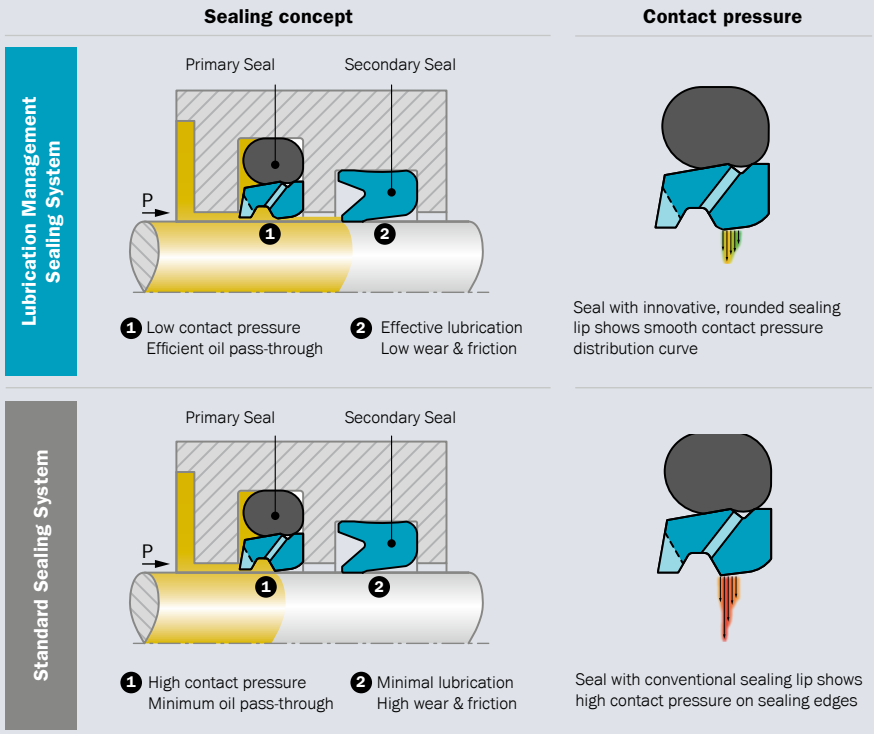
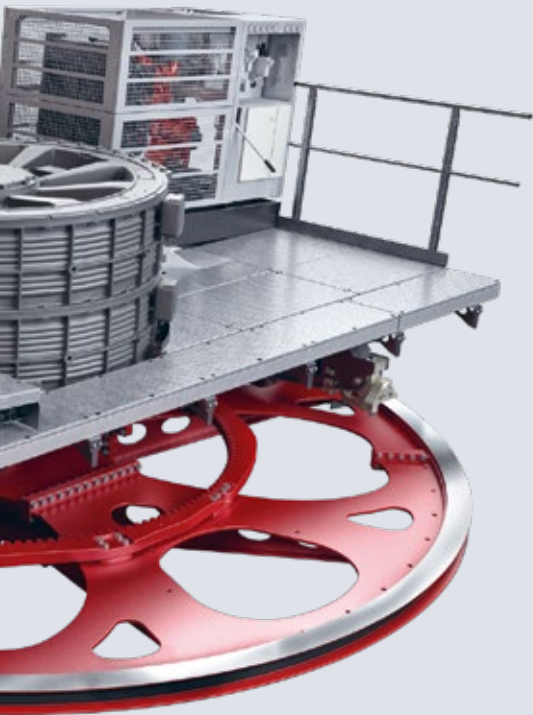
Best practice in demanding fluid power sealing applications is to have both a primary and a secondary seal within the hydraulic cylinder. The primary seal provides the sealing requirements for the system, and the secondary seal acts as a backup should the primary seal fail, providing automatic redundancy when needed.

Holger Jordan, Global Technical Manager Fluid Power, explains a common challenge in hydraulic cylinders: “Because the secondary sealing element runs under dry conditions, friction can be an issue. The more effective the primary seal is in preventing lubricant from leaking out of the hydraulic system, the drier the running conditions of the secondary seal will be. This can result in stick-slip and increased wear of the material, which shortens the life of the seal.”

Smooth moving

Trelleborg's Lubrication Management Technology transforms hydraulic systems by adjusting the lubrication conditions of all single sealing elements within the system to optimize performance and maximize lifetime. To facilitate lubrication management, new innovative seal designs incorporate rounded sealing edges to give a neutral or inverse contact pressure.

Holger explains how this works: “In this sealing arrangement the primary seal still takes the pressure load in the hydraulic system but it is lubricated much better, so it has an easier life in terms of friction and wear. This lowers contact pressure against the rod, which allows just enough lubricant to enter the hydraulic system to efficiently lubricate the piston rod, reducing friction and wear. The secondary seal is no longer running dry, and thereby operates under better conditions. In case pressure builds up, the seals have a built-in ventilation function.”



Interactive Exhibit

Go to www.trelleborg.com/seals/showroom
to visit the interactive exhibit in the Virtual Showroom.

Simulating the solution

Central to creating the concept and solution for Doppelmayr was Finite Element Analysis (FEA). This method of simulation tests the behavior of the clamping cylinder under pre-agreed set conditions in a virtual environment, to understand the demands on the cylinder and enable Trelleborg to create a custom solution.

Developed for engineers by engineers, FEA simulation provides a way to understand structural and mechanical challenges and allows for optimization of components as part of the design process. This removes the need for the creation of multiple prototypes, speeding up the overall process.

Holger concludes: "Once we're happy with a solution we identify using FEA, we conduct a series of in-house tests to ensure this meets customer requirements. By collaborating with customers in the design, development and validation phases, we help reduce development time while improving overall equipment performance longevity."



ABOUT DOPPELMAYR

As quality, technology and market leader in ropeway engineering, Doppelmayr operates in 50 countries worldwide. To date, the Group has built more than 15,400 installations for customers in 96 nations.

With Doppelmayr, customers receive top quality in modern design, user-friendly solutions and optimum service, from the initial idea to the completed project and beyond.

www.doppelmayr.com

Driving on Hydrogen

Zero emissions is the new present and the future of passenger transportation. Vehicles powered with conventional combustion engines are being phased out. Hydrogen is proving to be one option for long-haul travel.

By Meghan Cloud Braunger



CHECK OUT
THE FILM SERIES :

**"Let's Talk
Hydrogen"**




THE TRANSITION TO VEHICLES POWERED BY ALTERNATIVE SOURCES IS ACCELERATING.

Hydrogen is considered the fuel of the future in cases where battery electric vehicles are less attractive. “Long-haul heavy trucks are a great example” says Axel Weimann, Global Segment Director Automotive. “Hydrogen enables quicker refueling, a higher payload and extends the distance between refueling stops.”

Innovative solutions required

Hydrogen has very special properties and requires innovative, tailor-made sealing solutions. “A lot of know-how goes into developing the optimum sealing solutions for hydrogen applications. Solving these challenges is a combination of the right material and the right design, as well as other considerations, like counter surfaces,” explains Axel. “We are in close collaboration with our customers to help develop the sealing technology for their hydrogen applications, since we know hydrogen is a crucial component of the future energy mix.”

Learn more about our sealing materials for hydrogen applications in the next edition of *in the groove*! 



THE NEED FOR FREEZE

Understand the refueling process and the opportunities and challenges this offers.



NOTHING IS ETERNAL

Sealing components optimized to hydrogen systems are critical in extending fuel cell electric vehicle (FCEV) lifetime.



EXPLODING SEALS

Why it is important to select seals that perform under extremely high pressures.



Not just cars and trucks

Hydrogen isn't only relevant for the automotive industry, it's also a key energy source for other segments.

Find out more on page 34.



JULE BOSCH,
Innovation Consultant, Founder & Author

Lost In Transformation:

Understanding The Future And
Designing Change



IMAGINE YOU ARE IN ANCIENT GREECE to visit the Oracle of Delphi. You're still you from today but have traveled back through time to make a wish. A wish you know will come true by the time you're back in the present day. What would you wish for? What would be the one thing you would like to change about the world's future? Think about this for a

BIOGRAPHY

Jule Bosch

Jule Bosch has been a consultant for companies in innovation and strategy processes for more than 10 years. She has received awards for her entrepreneurial projects, including from the German Federal Government (Land of Ideas) and the German Federal Ministry of Economics (Culture and Creative Pilot).

She is the author of 'ÖKonomie', a non-fiction book dealing with future-proof business models published by Campus Verlag, as well as a much sought-after keynote speaker at international events and conferences.

moment. It's a little like asking people at the end of their lives what they would have done differently if they could relive everything, only with a more societal perspective.

Questions like these help us figure out what is most important — in our personal lives, as well as for humanity in general. Throughout time, humans have tried to find ways to influence the future beneficently or at least predict it, so that we can prepare for things to come. Things like droughts, floods, or pandemics. Though what's funny about it is that we might have dramatically changed our lifestyles from hunter-gatherers to farmers to modern city people. However, the things we fear the most have stayed the same: natural disasters. The difference from ancient times is that today's disasters are, at least for the most part, self-made.

So, let's get back to your wish for a second. What would you have wished for when you went to see the Oracle of Delphi? World peace? That we stop global warming before it's too late? Or something comparably small like, let's say, a million dollars in your bank account? Whatever it is, I have good news! All these wishes can come true, and we don't have to rely on chance, magic, or even time travel to make them happen. How so? Let's find out by diving right into the art and science of



futurology! And, dear techies, don't worry — we'll get to how this connects to technology and process innovation along the way.

Two kinds of change: no need to swear at the weather (wo)man!

When we break change down to its very core, we arrive at two basic types. There is change that we have no power over at all, even if we try. Phenomena like the weather belong to this type of change. We can complain, protest or even swear at the weather (wo)man, but it will be rainy or sunny regardless. The future, however, belongs to another genre of change, let's call it 'type-two-change' in that the moment we talk about it, it develops in a new direction. Stock market dynamics, for example, belong to this group of type-two-change. The moment people like Elon Musk or a large group of small-scale investors spit out their thoughts on social media, stocks might drastically change course.

“Let's not wait for the future to happen to us. Let's actively create it!”

JULE BOSCH,
Innovation Consultant, Founder & Author

Society and culture are made up of smaller and larger actions by people and organizations that are always trying to adapt to their surrounding world (which is also made up of the actions of other people and organizations). The sum of these actions and the way they influence each other are the fuel for the world's constantly changing nature. The result: a hypercomplex system made up of impulses, some of which will continue (long-term trends such as ever smarter machines) and some won't (like digitizing every aspect of life). But linear deductions from the here and now are almost impossible; in the end, things tend to turn out differently than we expected. Especially when it comes to developments that might evolve 10, 20, or even 50 to 100 years from now. Even the greatest minds tend to fall into this futurology trap. The automobile, at the time of its emergence, was regarded as a fad not worth investing in by many because of the huge importance of horses back then. Very similar voices predicted the fading away of the internet roughly 100 years later.

A rollercoaster headed into the unknown

The impossibility of straightforward predictions dramatically contradicts our human drive to prepare and plan for the future. What is especially relevant for tech companies is that the rate of change and innovation in technology right now is not only hard to predict but is rapidly accelerating at the same time. In his book, *The Age of Spiritual Machines*, computer scientist and futurologist Ray Kurzweil puts it this way: “An analysis of the history of technology shows that technological change is exponential, contrary to the common-sense ‘intuitive linear’ view. So, we won't experience 100 years of progress in the 21st century — it will be more like 20,000 years of progress (at today's rate).”

The nature of science is that some scientists are already arguing against Kurzweilian observations and they find that the rate of change has come to a halt or even started to decline. What we can state for sure is this: change is and has always been the only constant, and the rate at which technology is changing right now is certainly faster than it used to be. For many of us, it feels like a rollercoaster headed into the unknown. We are ‘lost in transformation’... but all is not lost!

Though planning and predicting with certainty is very relevant, there is more to business success than ‘Excel’-ing (pun intended) in these competencies, attributed to the left cerebral hemisphere.

Before we dive into the next steps of your future design journey, let's sum up what we have learned so far:

- The human instinct to prepare and plan for the future obliterates our openness and curiosity for the unexpected.
- Clear predictions about the future are almost impossible. Nevertheless, even the most intelligent people fall into the trap of trying to predict all kinds of things all the time.
- Now, as ever, change is the only constant, which leaves us emotionally and physically ‘lost in transformation’.
- We might not be able to predict the future, but we can influence it by designing our actions in new and innovative ways, as well as the narratives around them. →

Four aspects are of fundamental importance to the way the tech industry should go about research and development, designing corporate culture, training employees, and how to work together with clients and customers:

1. DESIGNING FOR CHANGE: We must 'plan' for short- and long-term future changes in our products and processes, but without knowing what kind of change will be coming. That is why we have to make room for potential changes in the design that require a whole new way of looking at innovation. Rather than developing innovations via a finite process with a beginning (kick-off) and end (entering the market), we have to regard innovation as a never-ending project open to changes along the way and at unexpected times. One of the main drivers

of this need for 'along the way' adaptation is, for example, the rapid developments going on in the material sector. Most sustainable materials or processes might not be ready for industrial-scale use right now, but they will be. For your product, this might possibly be 10 years from now. But maybe, looking at exponential innovation, you should prepare for this to happen in just one to two years! This takes us directly to the next principle for future-proof business success.

2. NEXT LEVEL KPIs: Agile project management is key to fast adaptation. What is often lost when employees are trying to unlearn old and learn new ways of communicating and decision-making is the emotional and philosophical layer of agile. If nothing is ever finished, final individual results cannot be the basis for evaluating success. The KPI of a corporate culture driving a company's success in an ever-changing world is not so much the amount of implemented requirements, but rather the amount of fun that teams

experience in their work, as well as the grade of psychological safety on which they can count. Today more than ever, results are a byproduct of a positive and supportive corporate culture, which leads us directly to the skills needed in an ever-changing business environment.


3. VISIONARIES WANTED: If we agree that, as a business, we want to be the ones who actively design an industry's future instead of reacting to what others have already set out to change, we have to look out for employees with a drive to create and

a vision of what they want to see the company achieve. Yes, of course, purpose is something ingrained in a company, but it's the employees who drive it forward. And purpose is not something that can simply be stamped onto somebody's job description; they must choose it themselves.

4. SUCCESS NEEDS NEW CONNECTIONS: Last but not least, the shared vision of the company and its employees also carries on to customers. While business of the past rested on a transactional relationship between producer and customer with a clear hierarchy of one working for the other, we see more and more of these relationships

turning into a transformative pact to bring about a version of the future all of the involved parties find fruitful. This might also include companies usually seen as competition. The industrial age made us gain enormous amounts of efficiency by departmentalizing industries, companies and societies. In today's world, all of our success is put at risk by the results of our collective past actions, like climate change, environmental degradation and even the unwanted collateral damage that comes from headless (digital) innovation. It's all of us together who can create an economy that provides meaningful products and fulfilling jobs. To achieve this, we must leave the departments behind and start forming new purposeful connections.

Understanding the future and designing change

If it is impossible to make long-term predictions about the future, maybe we should work on creating it in the first place — as individuals, as well as businesses. As stated before, the future is made up of individual and collective actions that, in their connections and interdependencies, drive the complex web of future changes. Whoever designs the actions, as well as the narratives and discourses around these actions, will be able to influence the future. And businesses that acknowledge their active part in the process of future creation will be able to work towards a future that secures their own success. Not in a completely controlled way, but at least in a proactive and potentially quite creative way! Because in the end, the future will happen, whether we like it or not — even if we decide not to do anything at all. Only then will it be shaped not by us but by everyone else. So, let's not wait for the future to happen to us. Let's actively create it! 

Simply Stated

Forsheda® V-Ring protects rotary applications in a wide range of different industries. Find out what gives this simple-looking seal its unique and surprising performance features.

By Jan Sklucki



60 years of expertise

Designed in the 1960s, Forsheda® V-Ring was first produced in its namesake locality of Forsheda, Sweden — a town with just 1,500 inhabitants. From these humble beginnings, the product is now in use around the world, protecting rotary systems against dirt, dust, and liquid. So what's its secret?

Though the design is similar, manufacturing and material technologies have advanced, as has the engineering and our understanding of the physics behind how it works. Indeed, considering this is an 'only rubber' component, Forsheda® V-Ring has a remarkable amount of design and consideration behind it.

Measure twice, cut once

So, how is a seemingly simple seal so effective in heavily contaminated environments? Part of its performance relies on a carefully engineered geometry. As rotational speed increases, the sealing lip's unique design allows it to lift off slightly, 'flinging' away any foreign particles from the outside of the seal. By lowering contact pressure with the countersurface, friction is also reduced, lessening heat generation and wear and extending service life.

The flexible sealing lip is then supported by a hinge-shaped profile that helps maintain light contact with the sealing surface.

Single-piece construction

Keeps the seal in position with its own tension, stretching to fit the shaft

Sharp lip edge

Flexes against the sealing surface to provide a wide contact surface with low pressure and friction

Unique lip design

Acts as a check valve during grease purging

Hinge profile

Enables light but continuous contact against the sealing surface, compensating for significant misalignment, eccentricity, ovality or shaft run-out

Lip lift-off technology

Creates a 'slinger' action at high speeds to remove excess droplets and reduce wear on the lip

UV and ozone resistant

Resists the harmful effects of ultraviolet radiation and ozone



FORSHEDA® V-RING

Retains lubricants while effectively excluding contaminants. Forsheda® V-Ring is usually specified either as a primary seal for bearings or a secondary seal for another seal that cannot manage hostile environments.

Visit the [Latest Innovations](#) page to learn more about the Forsheda® V-Ring.

Features and Benefits

- Reduced wear at high rotational speeds from lip lift-off technology to extend seal life
- Temperature resistant from -100 °C to +250 °C/ -148 °F to +482 °F depending on material choice
- Permits axial movement or angular and radial misalignment
- Simple installation – stretches onto the shaft or seating
- No special machining is required to close tolerances
- Versatile enough for several fields of application
- Optional splicing allows any size diameter
- Suitable for partially submerged applications

These two structures permit Forsheda® V-Ring to compensate for shaft misalignment, eccentricity, and run-out. The final stage of manufacturing adds further optimization. The sealing lip's edge is precision cut to a calculated angle that gives a more effective seal and deflects even fine abrasive particles away from the contact area.


Material world

Its simple construction also brings other benefits. By manufacturing from only a single piece of elastomer without fabric or metal reinforcement, Forsheda® V-Ring can be stretched directly onto the shaft, making it quick and easy to replace. To reduce downtime, they can be installed over flanges, pulleys, and bearing housings without disassembly where the hardware allows this. For large-sized applications,

Forsheda® V-Ring can also be supplied cut and then vulcanized in situ.

In addition to abrasive attack, the seal must also be able to resist the chemical environment in which it operates. This is where Trelleborg's expertise in specification and its broad portfolio of materials play an indispensable role, balancing performance characteristics like wear resistance and chemical stability to maximize service life.

Service and support

The performance of Forsheda® V-Ring is continuously being tested, with in-house and real-world applications combined for an accurate and reliable picture. Engineering and development teams are on hand to assist with specification and customization to ensure an optimal solution is provided. 

Materials for all weathers

Trelleborg Sealing Solutions has one of the largest portfolios of materials on the market and unparalleled local support to help when selecting the optimal material for your application. Local engineering and support teams can assist with customizing the final product, logistics, and any special requirements.

- Ethylene propylene (EPDM)
- Fluoroelastomer (FKM)
- Silicone rubber (VQM)
- Ethylene acrylic elastomer (AEM)
- JPF20 nitrile (NBR)
- Hydro nitrile (HNBR)
- Chloroprene (CR)

Forsheda® V-Ring is available in a range of profiles to support a wide variety of applications and hardware designs.





Once Upon a Time...

The history of rubber is lined with chances and a series of innovative inventors who have laid the foundations for modern-day products in everything from spacesuits to designer sports shoes.

By Paul Ravenscroft

RIGHTLY HAILED AS A “WONDER MATERIAL” IN THE MIDDLE OF THE TWENTIETH CENTURY, synthetic rubber, i.e. plastic, was commended as lighter, stronger and cheaper than alternative materials for consumer goods, and rapidly became ubiquitous. Plastic played a major supporting role in the creation of a consumer culture epitomized by single-use, throwaway everyday items, like drinking straws and shopping bags. However, today’s increased focus on reducing the consumption of single-use plastics has driven a transition toward alternative sustainable materials which, in combination with an increased focus on sustainability, is being mirrored in the industrial polymer sector as well. The inherent qualities of engineered plastics mean they retain a critical role in the global economy as essential components in airplanes, automobiles and medical equipment. But businesses large and small are also seeking viable alternative materials and production processes to reduce their environmental impact. Trelleborg strives to be a sustainability leader in its industry through a range of targeted initiatives.

Polymers for Tomorrow

Historically, Trelleborg’s polymer-based solutions were largely fossil-based due to the unique sealing and damping properties of, above all, synthetic rubber or plastics. Even if it remains a technological challenge to easily recycle synthetic polymers, Trelleborg intends to gradually make the solutions offered clearly more sustainable, primarily by increasing the share of recycled/recyclable or bio-based material in polymer-based products. This aims to further strengthen Trelleborg’s role as the sustainability leader in its industry. A waste initiative is for example already under way in Trelleborg’s manufacturing facility in Livorno, Italy, where metal scrap is pressed into 900 briquettes and sold onward. Resource efficiency and a circular approach are becoming an increasingly integrated part of the company’s DNA.

To achieve this, Trelleborg has initiated a development group – Polymers for Tomorrow – to work in accordance with the principles of circularity. The aim is to systematically increase the use of recycled/recyclable, bio-based and completely new, more sustainable raw materials. The development group identifies strategic collaborations with suppliers and other initiatives to improve sustainability.

So far, eight materials have been identified by the *Polymers for Tomorrow* group as areas for action:

- Process oils
- Nitrile butadiene rubber (NBR)
- Ethylene propylene diene rubber (EPDM)
- Fluoroelastomers (FKM)/perfluoroelastomers (FFKM)
- Textiles
- Thermoplastics (PTFE)
- Polyurethane (PU)
- Carbon Black and other fillers

“We are committed to meet the targets of the Paris Agreement and are set to make the biggest possible difference in our CO₂ footprint,” says Ulrika Wedberg, Vice President Sustainability at Trelleborg. “Our solutions in themselves have a positive impact on the sustainability of society as they, for example, save energy and reduce CO₂ emissions, eliminate noise and vibrations, seal in demanding environments to avoid leaks of water, oil, gas or hazardous chemicals, and dramatically extend the lifecycle of our customers’ products.”

“In addition, reducing Trelleborg’s dependence on fossil-based materials is a journey worth making. I think we’re all becoming more sensitive and aware that this is something we need to do. CO₂ and circularity are in focus for us and for our customers, and focus is what leads to solutions.”

Trelleborg’s focus on sustainability is not new and the company is regularly recognized for the sustainability of its activity. Most recently Tenneco, a major supplier to the automotive industry, commended Trelleborg as one of only three suppliers to achieve a high sustainability rating and an advanced ESG management system. Indeed, sustainability is a strategic priority for Trelleborg. The Group will present new climate targets in 2023 for the period extending to 2030 in dialog with the Science Based Targets Initiative, following the 1.5 °C scenario for Scope 1 and 2 and the well below 2 °C scenario for Scope 3 of the Paris Agreement.

Trelleborg’s strategic approach to improve its sustainability

To understand its environmental impact, Trelleborg measures its total carbon footprint using the Greenhouse Gas Protocol (GHGP) global standard which divides emissions into three groups or “scopes”:

Scope 1 – emissions created as a direct result of own operations

Direct emissions from Trelleborg owned and controlled resources are mainly natural gas-driven boilers that produce steam for different manufacturing processes.
Direct energy → direct emissions

Scope 2 – indirect emissions from the generation of purchased energy from a utility provider

For Trelleborg, these indirect emissions are caused by bought energy, mainly electricity, to run manufacturing processes, and purchased energy for heating or cooling of buildings.
Indirect energy → indirect emissions

Scope 3 – all indirect emissions – not included in scope 2 – which occur in the value chain of a company, including both upstream and downstream emissions

MORE INFORMATION



Scan the QR code to learn more about how Trelleborg is #ProtectingtheEssential



Photovoltaic panels significantly reduce CO₂ emissions at our manufacturing facility in Malta.

Delivering Scope 1 emissions reductions


- Trelleborg has long highlighted the link between energy consumption and climate impact in its production. The reduction of energy consumption is achieved through a systematic approach to identify potential savings and “energy thieves”, including training, energy inspections, local energy teams, measuring and analysis.

Delivering Scope 2 emissions reductions

- Local solar panel projects are ongoing for supplying part of the energy needs of some facilities. For instance, Trelleborg’s manufacturing facility in Malta has used photovoltaic (PV) power since 2013, taking advantage of the island’s sunny climate. Today the PV array generates around 1,245 MWh of power from about 2,500 panels, reducing the facility’s CO₂ emissions by an estimated 810 tons.

Delivering Scope 3 emissions reductions

- Emissions from purchased goods and services, mainly from raw materials, represent the largest part of Trelleborg’s Scope 3 emissions along the value chain. Scope 3 emissions are at least five to six times higher than the existing emissions in Scope 1+2, thus significant in terms of the total emission picture for the company.
- Trelleborg is proactive in reducing emissions, not only from its own production but also along its whole value chain. To significantly reduce supplier-related emissions Trelleborg has established channels for dialog on emission reductions with selected suppliers of polymers and transport services on annual questionnaires through the Climate Disclosure Project (CDP) Supply Chain.

The outcome of energy consumption for 2022 was a 28 percent decrease in emission intensity which reflects the ongoing efficiency enhancements in energy use, with the largest driver of improvement coming from the increased purchase of renewable electricity under Scope 2. 

Hydrogen – an Essential Element





The transition to a net zero world has become an accepted necessity over the last decade if we are to avoid catastrophic global warming devastating the environment.

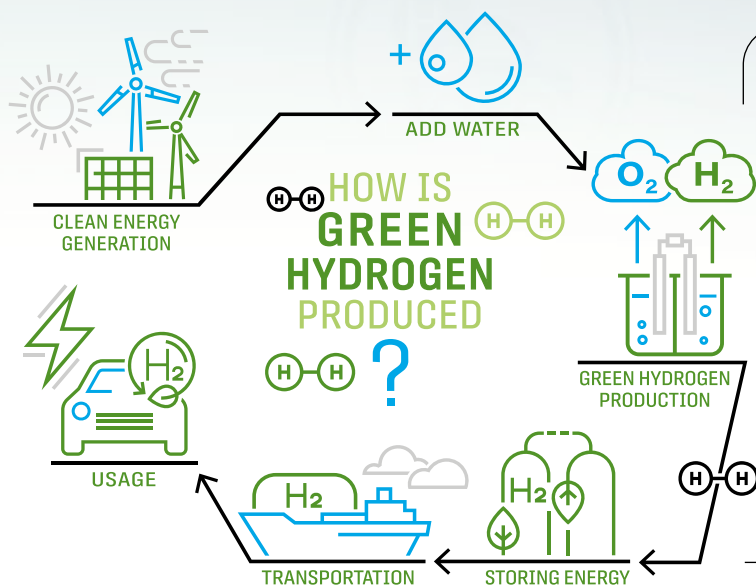
By Paul Ravenscroft

THE CHALLENGE IS ACCEPTED by most countries; but how we wean ourselves off fossil fuels, while meeting the growing demands for energy, remains an open debate. And achieving the dramatic transition by the goal of 2050 entails making critical decisions as quickly as possible if we are to limit warming to anything near the +1.5 °C target.

Renewables like solar, wind, and hydro, and nuclear power, will undoubtedly increase their role in the energy mix, and – for certain applications – hydrogen in one form or another will play a part as we move away from a

world addicted to fossil fuels. To give the challenge some context, to reach net zero electricity production will need to double by 2050, yet today over 60% of electricity is generated from fossil fuels. Hydrogen – a colorless and odorless gas – is envisaged to do a significant part of the heavy lifting.

James Simpson, Global Segment Director Energy, says: “The world is changing. Our energy mix is currently heavily dominated by fossil fuels, with over 65% of energy coming from natural gas and coal. Yet the goal is to be carbon neutral by 2050 based on renewables, and hydrogen has a major role to play in the transition.” →



“Hydrogen is undoubtedly a significant component in the energy transition, and Trelleborg is developing its knowledge, expertise, materials, and applications to be the sealing partner of choice as its deployment becomes widespread as a fuel source and a store for electricity.”

JAMES SIMPSON,
Global Segment Director Energy

The opportunities

Hydrogen offers two fundamental possibilities as a route to decarbonization.

Firstly **hydrogen itself can be used as a fuel source**. Currently there is global consumption of around 80 megatons of hydrogen a year, mainly as an input to industrial processes, particularly the manufacture of chemicals. But estimates anticipate that demand will rise to 350 megatons as the world's economy starts to utilize hydrogen more widely. The vast potential for hydrogen fuel is in three areas:

- As a heat source for industry, a notoriously difficult sector to decarbonize
- In the production of e-fuels, where hydrogen is refined with other chemicals to produce, for example, e-ethanol or e-ammonia, or synthetic fuels for commercial and industrial transport
- Hydrogen blended with natural gas as a domestic heating solution

Secondly **hydrogen has the potential to supercharge the deployment of renewables due to its ability to store energy like a battery**. Some countries have already achieved the milestone of periodically providing half of their energy from renewables. But the issue remains that when the supply of wind and solar power generated exceeds the demands of a grid network, there are no viable mechanisms to store the surplus energy. During peak production up to a fifth of potential renewable energy goes to waste. Equally there is no solar energy at night or wind power generated when the weather is calm.

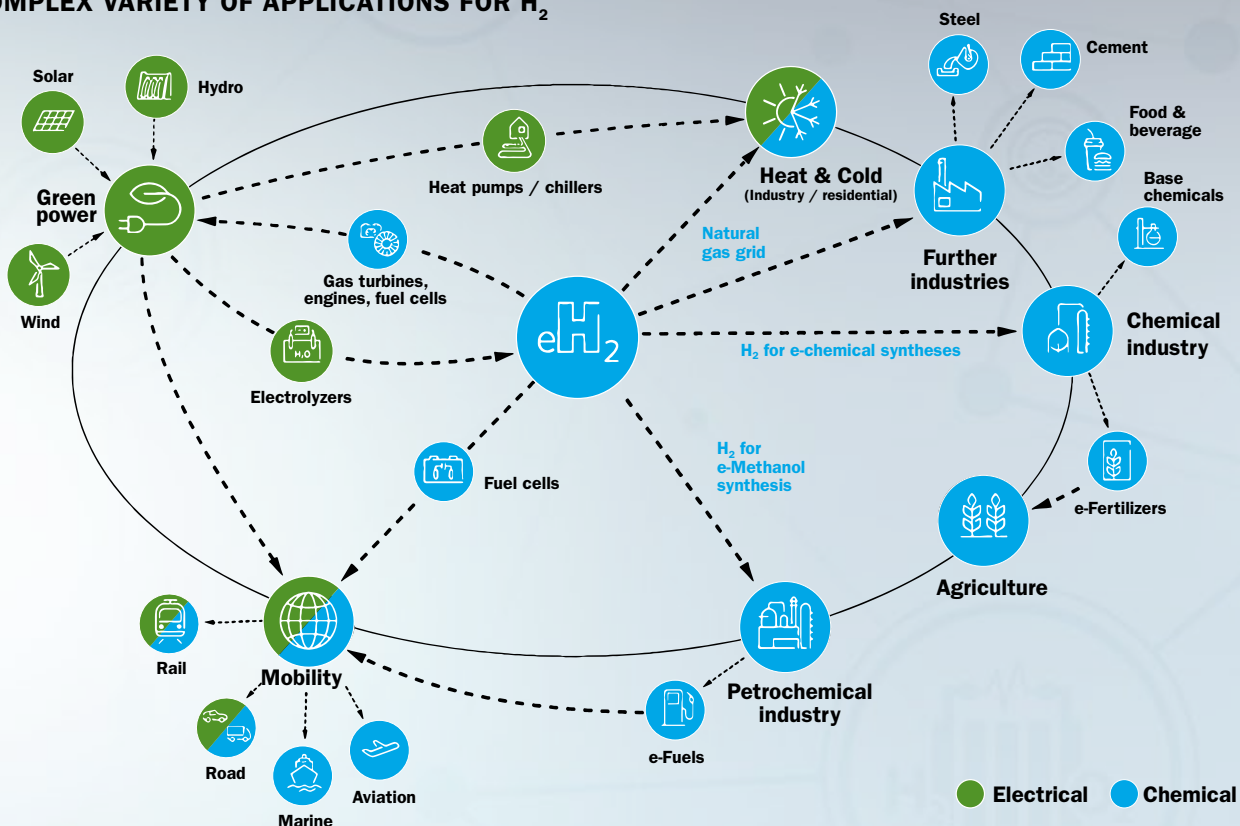
But “green hydrogen” offers the potential to store this surplus energy and redeploy it when demand exceeds supply in a process with no harmful effects. Green hydrogen is created by using renewable energy to power the electrolysis of water, splitting hydrogen from oxygen. The only by-product is harmless oxygen which is released back into the environment, leaving green hydrogen. This zero-carbon fuel can be stored and deployed on demand or transported to places where energy consumption exceeds energy produced by renewable sources.

As electricity demand soars, sustainable development policies reduce fossil fuel dependence, and geopolitics drive a focus on energy diversity, hydrogen's potential as a storage medium will be an essential element of the “smart grid” required to decarbonize while keeping the lights on.

Many of these changes may seem intangible today, but revolutionary change is coming on an enormous scale. Predictions envisage 9 trillion EUR in investment pouring into hydrogen, which would make the industry bigger than the oil and gas sector and automobile market combined.

The challenges

Hydrogen clearly presents an enormous opportunity but its chemical characteristics and the environments where it can be deployed also pose significant challenges. There will be a huge market for seals within the pumps, valves, connectors and numerous other devices that will be required, and manufacturers will want to find a reliable sealing partner like Trelleborg, with its established pedigree, to help them surmount the issues.

COMPLEX VARIETY OF APPLICATIONS FOR H₂

First among the challenges posed by hydrogen is that it is the simplest and lightest element, with the **smallest molecular structure**, making sealing hydrogen difficult. Permeation of hydrogen through a seal, and equally leakage of hydrogen around a seal, are potentially significant issues.

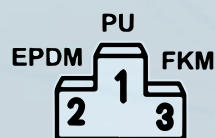
A second related issue is **rapid gas decompression (RGD)**. In a high-pressure system the small hydrogen molecules can be absorbed into a seal. This is not necessarily an issue. However, if the pressure in the system is suddenly relieved, gas trapped in the seal can expand to match the new ambient pressure, potentially causing the seal to blister and crack as the gas tries to escape.

Finally seals for different hydrogen systems need to withstand seriously tough environments, **including high pressures of up to 1,000 bar/14,504 psi** (for example in high-pressure valves) and **extreme low temperatures down to -250 °C/-418 °F** (for example in liquid hydrogen storage and transportation).

Advanced testing capabilities

Trelleborg has advanced testing rigs that produce data on permeation and leakage using helium as a proxy. Seals are tested to ISO 15848 conditions using full vacuum data collection at temperatures from -40 °C to +177 °C/-40 °F to +351 °F and pressures from 690 bar/10,008 psi to 1,500 bar/21,756

psi. Trelleborg conducts different tests to ISO 15848 primarily for valve sealing and PTFE stacks. Other tests include ISO 17268 for hydrogen RGD, EC79 and SAE J2600, along with some permeation testing on these materials. Existing test data covers materials including EPDMs, FKMs, and polyurethanes, notably our proprietary Zurcon® material. The harder the material the lower the permeation:



Materials for hydrogen

Our **H₂Pro™ range** is a family of specially engineered materials designed to meet the unique needs of many hydrogen applications.

James Simpson adds: “Hydrogen is undoubtedly a significant component in the energy transition, and Trelleborg is developing its knowledge, expertise, materials, and applications to be the sealing partner of choice as its deployment becomes widespread as a fuel source and a store for electricity.” →

HYDROGEN – DIVERSE APPLICATIONS AND PARAMETERS

Trelleborg already has and is currently developing a number of sealing materials and sealing profiles for the production, storage, usage and transportation of hydrogen. In 2023, Trelleborg will bring to market materials including:

- EPDMs for low-temperature use, under -55 °C/-67 °F and pressure up to 1,050 bar/15,229 psi
- FKMs for the widest possible temperature range from -60 °C to +200 °C/-76 °F to +392 °F
- PUs for low-temperature use, under -60 °C/-76 °F, especially for dynamic applications
- High-performance plastics (modified PTFE, PEEK, PA, PI), offering reduced friction and reduced wear

Our seals and materials can be used in a wide range of applications including:



High-pressure Valves

At filling stations and in compressors, high-pressure valves control the flow of hydrogen into and out of tanks. LH_2 is stored in cryogenic conditions and CGH_2 at extreme high pressures, making high-performance sealing solutions crucial. Seals in high-pressure valves must withstand pressures of up to 1,000 bar/14,504 psi and a temperatures between -50 °C and +85 °C/-58 °F and +185 °F

Products

- Orkot® bearings and HiMod® advanced composite bearings
- Turcon® Variseal® MC and Turcon® V-Stack
- O-Rings
- Groove rings



Compressed Hydrogen Gas (CGH_2) Storage and Transport

Sealing solutions for hydrogen storage and transportation must be suitable for use at low temperatures and high pressures, while minimizing the sealing gap and resisting permeation. CGH_2 is stored and transported at -50 °C to +85 °C/-58 °F to +185 °F with high pressures of up to 700 bar/10,153 psi.

Products

- $\text{H}_2\text{Pro}^{\text{TM}}$ elastomer materials for low-temperature applications



Connectors

Connections are everywhere in the hydrogen supply chain and reliable sealing is vital to maintain efficiency and reliability whether liquid or gaseous hydrogen is being transported. Seals must be able to operate under high and low pressures and low and very low temperatures.

Products

- O-Rings and O-Ring with Back-up Ring for high pressure
- XploRTM S-Seal
- Turcon® Variseal® H and Turcon® Variseal® HF
- Wills Rings® metal seals



Low-pressure Valves

Low-pressure valves are commonly used between the electrolysis process and compression of hydrogen. These valves function at pressure below 100 bar/1,450 psi. The expansion behavior of hydrogen leads to rising temperatures in the application and seals must function at temperatures between -40 °C to +150 °C/-40 °F to +302 °F

Products

- O-Rings
- Wills Rings® metal seals
- Engineered molded parts
- Turcon® Variseal® H and Turcon® Variseal® HF
- Valve tappet seals



Liquid Hydrogen (LH_2) Storage and Transport

Stored in cryogenic conditions, our family of metal seals is suitable for sealing in extremely low-temperature environments as well as PTFE.

Products

- Wills Rings® metal seals
- Turcon® Variseal® H and Turcon® Variseal® HF

ENERGY



Electrolyzers – converting electricity to green hydrogen

The market for electrolyzed hydrogen as a store of energy is developing rapidly and hydrogen's efficiency as a storage medium is increasing. Seals in electrolysis equipment play a critical role in ensuring efficiency and protecting hardware from electrochemical attacks. Typically applications are at pressures of up to 80 bar/1,160 psi and temperatures of +50 °C to +100 °C/ +122 °F to +212 °F.

Sealing solutions include:

- O-Rings
- HMF FlatSeal™ flat gaskets and frame gaskets
- Rubber-to-metal bonded gaskets



Hydrogen Turbines

Natural gas turbines can be transitioned to blended hydrogen-natural gas turbines to generate electricity. These innovations are designed to phase out natural gas altogether. Components within turbines must be able to withstand high temperatures, be compatible with various gas mixtures and resist rapid gas decompression.

Products

- Wills Rings® metal seals
- Turcon® Variseal® H and Turcon® Variseal® HF
- Custom-engineered plastic bearings



Hydrogen Compressors – energy storage

Compressors require high performance sealing solutions to protect hardware and prevent leakage, which can operate at speeds up to 4 m/s or 13 ft/s, a wide temperature range from -40 °C to +200 °C/-40 °F to +392 °F, and very high pressures of up to 1,000 bar/14,504 psi.

Products

- Hydraulic rod and piston seals, such as Turcon® Variseal® M2 and Turcon® Variseal® W2
- Specially designed piston ring systems
- Advanced thermoplastic solutions

HYDROGEN AUTOMOTIVE APPLICATIONS



Internal Combustion Engines

Hydrogen can be burned in a combustion engine in a similar way to gasoline or diesel. Beside the obvious change of the tank and feeding lines, the injection system needs to be adapted. Depending on the design of the injectors and position of the seal, they must be able to operate in a wide temperature range of -40 °C to +85 °C/-40 °F to +185 °F and under high pressures, up to 40 bar/580 psi, and prevent leakage to ensure passenger safety.

Products

- Multicomponent parts
- Static seals – typically O-Rings and engineered molded parts
- Rubber-to-metal bonded gaskets



Fuel Cells

Fuel cell applications are especially challenging for seals, since they operate in a wide temperature range of -253 °C to +85 °C/-423 °F to +185 °F and there is a significant risk of electrochemical attack, which can damage sealing materials and hardware.

Products

- Rubber-to-metal bonded gaskets
- HMF FlatSeal™ flat gaskets and frame gaskets
- O-Rings

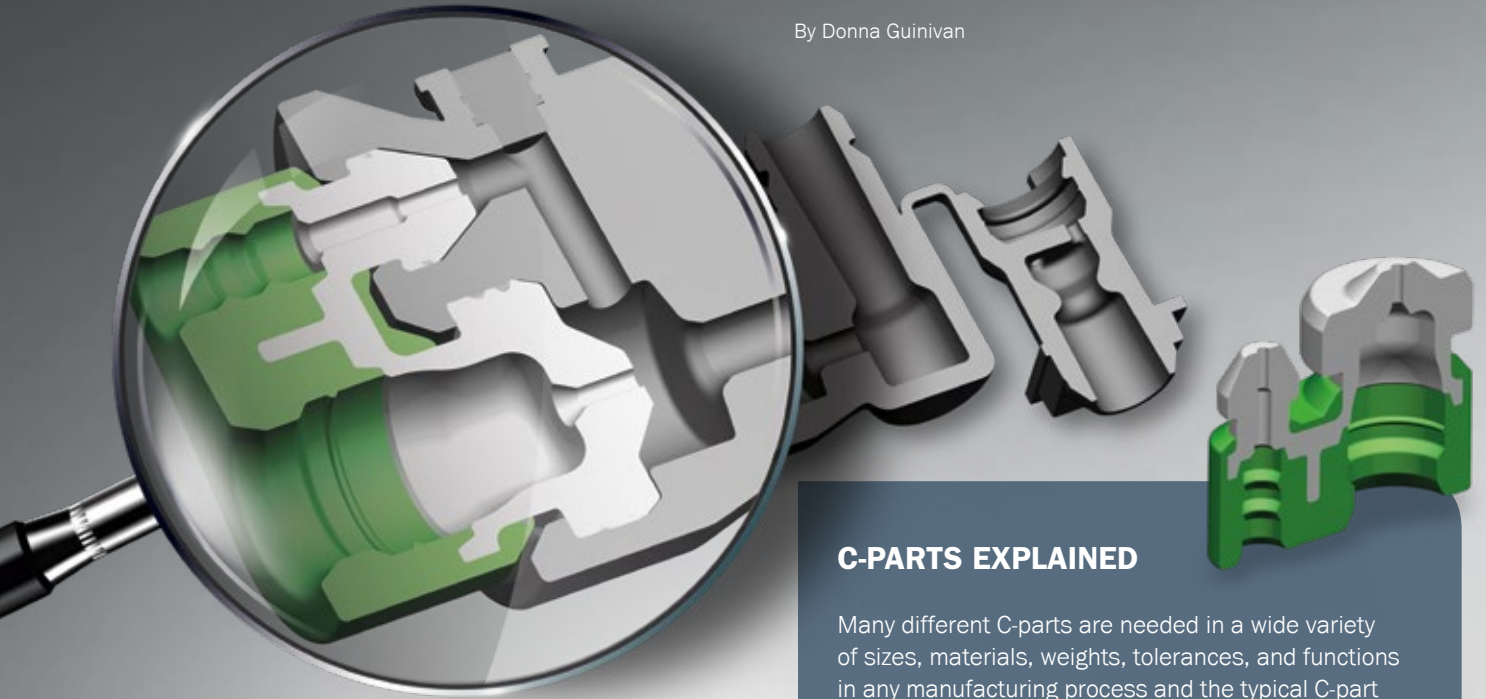
Scan the QR code to learn more about our solutions for fuel cell electric vehicles (FCEV)



A Small Focus

As C-parts, seals are usually the poor relations of A- and B-parts. However, focusing on seal design can have a significant impact, not only on total cost of ownership, but also on the overall function and performance of an application.

By Donna Guinivan



“AT TRELLEBORG SEALING SOLUTIONS WE ARE TRYING TO CHANGE THE C-PART MINDSET

when it comes to seals,” says Daniel Hauser, Manager Sales Development in Europe. “A manufacturer’s engineers may be experts in designing an A-part or a B-part, but the seal is often seen as insignificant, and engineers tend to select a standard offering based on function alone. This leads to procurement sourcing ‘make-to-print’ items.

“In such cases, purchasing departments will ask us for an offer for a pre-specified seal. The emphasis is then on direct costs: the piece price, lead time and supply security costs. Functional integration and total cost of ownership are lost in the process.”

Partnership is key

Though ‘C-parts’, seals typically have ‘A-functionality’. This requires a partnership with early involvement of Trelleborg in a manufacturer’s component development.

C-PARTS EXPLAINED

Many different C-parts are needed in a wide variety of sizes, materials, weights, tolerances, and functions in any manufacturing process and the typical C-part inventory can run into hundreds for an application. C-parts will generally be small products such as fasteners, and various turned, injected, extruded, stamped, forged, milled, or molded parts, including seals. They have the highest level of variation compared to A- and B-parts and are the components kept in the highest quantity by manufacturing companies. Since C-parts are relatively inexpensive and do not take up much space, they are usually stored in high quantities and are often sourced from a large number of suppliers.

The direct cost is the purchase price of the parts and as C-parts are inexpensive, companies do not consider their cost very important. The indirect cost is everything else – the cost of sourcing, ordering, delivery, handling, and inventory management. The main cost of C-parts is not in the piece price, or direct costs; generally indirect costs make up around 80 percent of the total cost of the parts as opposed to A-parts where the direct cost is 80 percent and indirect cost is 20 percent.



“At Trelleborg Sealing Solutions we are trying to change the C-part mindset when it comes to seals.”

DANIEL HAUSER,
Manager Sales Development in Europe

“By developing solutions together with our customers, attention is given to optimization of total cost of ownership and better functionality of the overall application,” says Tim von der Bey, Service Development Specialist. “So, we look not only at design for function, but also at sustainability, lifetime, manufacturing processes and delivery. It is ‘make-to-design’ rather than ‘make-to-print’.”

“Short-term optimization of direct costs can influence the overall cost of ownership negatively,” says Daniel. “An item may have a low purchase price, but long-term indirect costs need consideration to minimize total cost of ownership.”

What indirect costs a manufacturer takes into account will depend on how detailed they want their cost analysis to be. “Indirect costs can include anything within the supply chain, such as development, manual or automated handling, assembly, energy, lead times, stocking, and disposal,” Daniel points out.

“Trelleborg has a wealth of experience in sealing solutions, and in design we consider more than the seal. We look at counter surfaces, the seal’s function and functions of surrounding parts, as well as the component and application as a whole,” says Tim. “Our different services and processes allow us to present unique solutions not focused on lowering piece part cost but overall cost of ownership.”

One of these is multicomponent liquid silicone rubber (LSR) moldings. To receive the maximum benefit to total cost of ownership from this technology, early involvement by Trelleborg is vital.

Considering more than the seal

“One of the primary advantages of multicomponent LSR technology is the creation of complex geometries, which can combine multiple assembled separate elements into a single component,” continues Tim. “It results in considerably more robust and cost-effective solutions that are of higher integrity, and which offer tangible benefits to the manufacturer in terms of improved performance, automating production →



SEAL-GLIDE®

Seal-Glide® is a nanoscale surface treatment that improves on the friction performance of conventional coatings. It is applied through an innovative process, leading to a finish up to 50 times thinner than many conventional coatings. The technique also enables treatment of components with complex geometries and features, such as undercuts, that would otherwise be impossible with lacquer-based coatings. Even after stretching, Seal-Glide® returns to a smooth finish with no breakouts, maintaining its improved sliding properties.

Treating seals with Seal-Glide®:

- Increases lifetime of the complete sealing system
- Boosts assembly and operation of products
- Improves performance through significant reduction of friction and stickiness



MULTICOMPONENT LSR TECHNOLOGY

Multicomponent LSR technology is the simultaneous injection of Liquid Silicone Rubber (LSR) in combination with engineered plastics and potentially other substrates. In what is also commonly referred to as 2K, 2-shot, 2C LSR, multicomponent injection molding, or co-injection, it is used to develop innovative solutions, combining two or more individual materials into one fully bonded component in hard-soft and soft-soft combinations.

CASE STORY: HOT COFFEE SOLUTION

A manufacturer of a professional coffee machine asked Trelleborg Sealing Solutions to reengineer the machine's milk handling system. The seal consisted of two separate parts mounted together and between them was dead space that created a risk of bacteria growth. A multicomponent LSR part replaced this, which lowered manufacturing cost and improved quality.

“By developing solutions together with our customers, attention is given to optimization of total cost of ownership and better functionality of the overall application.”

TIM VON DER BEY,
Service Development Specialist



More than just basic design

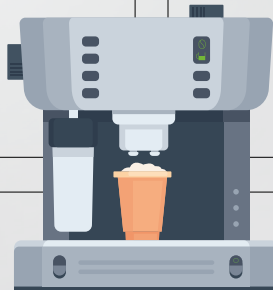
Many considerations and capabilities were involved in development of the LSR part for the coffee machine.

Multicomponent solutions

- 2K components reduce assembly costs and eliminate defects
- Dead space free design
- Easy cleaning by the end user
- Better performance and service life of the end product

Rapid prototyping

- From FEA to functional prototypes in less than 20 days
- Additive manufacturing technologies
- Rapid tooling
- Functional prototypes in series material



Traceability through laser marking

- Product traceability on the component
- Enables feeding as bulk material in the assembly line
- Saves extensive documentation and reduces packaging effort

Material compliance

- Extensive testing and qualification of material for global approvals
- Ensures long-term suitability
- Reduces customer approval effort, eliminates costly material changes and re-qualifications

Influence of Value-Added Services

Partnering with Trelleborg Sealing Solutions to create a unique solution to meet your requirements brings numerous benefits. Through early involvement, you can take advantage of our knowledge and capabilities. By forming a development partnership, we increase transparency for more success. And we work closely with you to consider the entire value chain, preventing one-dimensional cost considerations and long-term risks.

Indirect savings and effects:

- Clean working environment
- Optical inspection systems are not affected by particles
- Elimination of costly cleaning cycles
- More robust production processes

... what savings might result from combining several services at an early stage?

lines elimination of risk of misassembly, lower inventories and ultimately, a significantly reduced total cost of ownership.”


Part function and maximizing performance of an application are primary in the design of multicomponent LSR moldings. In addition, right from the earliest point possible, Design for Manufacturing (DfM) is a focus and considers automation, creation of flash-less parts, waste-free production, in-process quality checks, batch by cavity and packaging.

Daniel gives another example of where swapping to a more advanced process at a seemingly higher cost can have a major positive impact on total cost of ownership. “A popular choice for preventing seals sticking during automated assembly is dusting them with talcum powder. An alternative is our unique Seal-Glide® surface treatment.”

Low-cost parts do not mean low overall cost

“If you look at the base part and then the cost of the talcum powder versus Seal-Glide®, plus freight which is the same for both, cost-wise the talcum is the better option. But there are other costs involved, primarily handling – in-bound, separation, feeding of machines,” continues Daniel. “Talcum gets everywhere, so when you additionally consider assembly and cleaning of machines, using Seal-Glide® makes processes quicker and easier with no dust or particles, significantly lowering costs. Add to that the quality costs associated with talcum; visual checking, residuals left on the parts, for example. Though talcum powder may seem the cheaper alternative, when considering total cost of ownership in the assembly process, we see benefits and huge savings potential with Seal-Glide®.”

Tim encourages manufacturers to focus on seal design in partnership with Trelleborg. He says: “By being involved in the product development stage we are sure that we can add value. We usually kick things off at a customer’s site where we examine the application or the current status of design. At this stage we don’t have a fixed idea of the final solution but taking a holistic view, we’ll come up with ideas considering every element in the production process, throughout the supply chain and even packing and delivery options.”

“By treating seals as if they have an ‘A-function,’ manufacturers can achieve real bottom line benefits and a better product,” concludes Daniel. 

Want to find out more about ServicePLUS?

Scan the QR code or visit trelleborg.com/seals/literature to read the brochure.



ServicePLUS THE PLUS FOR YOUR BUSINESS

When you partner with Trelleborg Sealing Solutions through our ServicePLUS program, you can focus on your core business while we focus on making sure all your value chain needs are covered. We concentrate on those business activities that typically offer the largest opportunities for saving resources.



TECHNICAL COLLABORATION: Whether starting a new development or enhancing existing products, make use of our experts in materials and design for sealing solutions with optimal application performance. Take advantage of digital tools, sealing technology training and customized seminars to support your technical and commercial teams.



TAILORED PRODUCTION SERVICES: State-of-the-art 3D printing and rapid prototyping help bring your products to market faster. Strengthen your core business processes by outsourcing subcomponent assembly and secondary operations to us.



PACKAGING SOLUTIONS: Our packaging and labeling solutions boost your aftermarket care. Designed to meet your specific needs, including custom tubing for direct insertion into automated feeding stations, bespoke machine-readable labeling for replacement part sets and aftermarket kits directly drop-shipped to your service centers or customers.



SURFACE TECHNOLOGIES: Improve friction characteristics and eliminate sticking with surface modifications, such as Seal-Glide®, to reduce costs in automated assembly and improve application performance. Ensure parts are as clean as they should be for sensitive applications and strict regulations with FlexClean™.



TESTING & QUALITY ASSURANCE: We are all set to run a full suite of material and product tests to improve efficiency and help reduce your inspection expenses. Fully automated inspection cells and quality clinics can verify performance and compliance with standards, along with full documentation.



ADVANCED DELIVERY & STOCK MANAGEMENT SERVICES: Simplify, streamline and enhance your supply chain by letting us manage your important C-Class parts or benefit from automated ordering services that optimize your replenishment processes and align with production flows.



SUBCOMPONENT ASSEMBLY: Our assembly services provide you with a single item to manage, rather than multiple individual components. Our experts ensure that seals have been installed properly, meeting quality requirements. Additional testing, such as leakage and magnetic testing, product marking and customized packaging can be integrated to ensure your quality requirements are met.

Can you Dig it?

Nexus Face Seal resists the effects of mud compression in heavily contaminated environments.

By Jan Sklucky



Find out more in the
Mechanical Face Seals
brochure



Where there's smoke, there's fire

Despite significant challenges over the last few years that led to supply chain disruptions and unsteady demand, the construction industry is still growing. Rising levels of urbanization and associated infrastructure developments, along with increasing investment in public facilities such as schools and hospitals, means that the forecast for the sector as a whole is looking bright. Indeed, by 2030, the global construction industry is estimated to expand by 4.5 trillion USD to 15.2 trillion USD, with growth concentrated in China, India, the US, and Indonesia^[1]. And, rising demand for buildings and infrastructure means rising demand for construction vehicles.

NEXUS FACE SEAL

Effective sealing for low-speed rotating applications in construction and tunneling equipment.

Key benefits:

More cost-effective than comparative products at high volumes due to a new cold stamp process and material

High sealing performance and long service life at low peripheral speeds, such as encountered in construction machinery and tunneling, boring and mining operations

Good flexibility against mud compression for longer-lasting performance on construction and excavation sites

Consistent quality with shortened lead times from a stable and efficient manufacturing process

Operating Conditions

Peripheral speed:	Up to 1.5 m/s/4.9 ft/s
Temperature:	Up to +200 °C/+392 °F based on O-Ring material
Differential pressure:	Up to 3 bar/44 psi as differential pressure
External diameter:	From 50 mm/1.97 inch to 460 mm/18.11 inch

“The solution required innovative thinking; rather than direct resistance, it was about flexibility.”

NICOLÒ OLIVETTI,
Product Manager,
Trelleborg Sealing Solutions



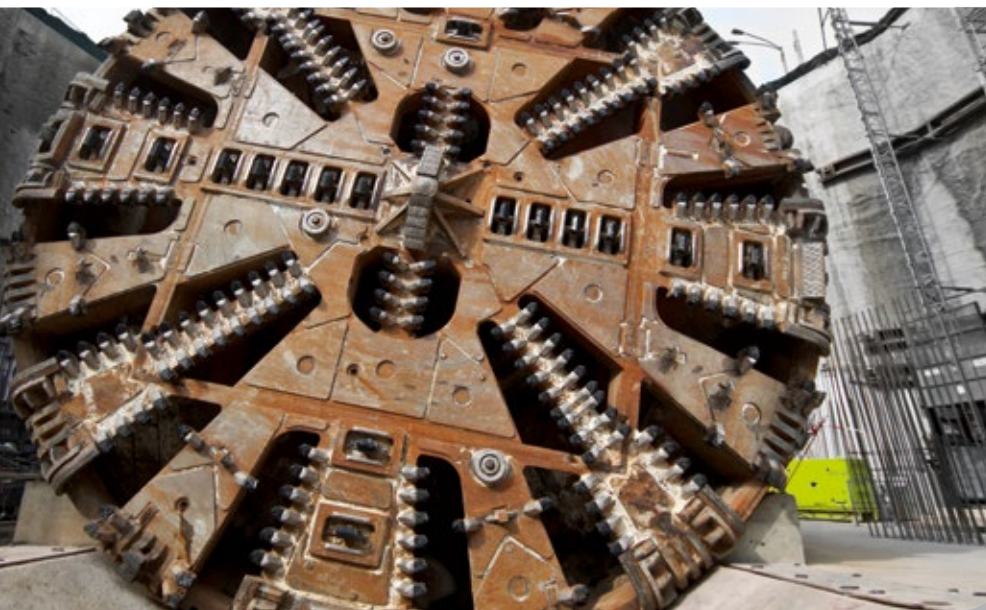
Vehicles that drive building projects

The operations on a construction site place unique requirements on the machinery employed. Constantly exposed to rain, sleet, and snow, the surfaces that vehicles maneuver over can quickly become quagmires. Deep ruts are formed by heavy construction machinery and fill with water, creating thick and viscous mud that aggressively clings to surfaces and works its way into every available crevice, such as around gearboxes and axles. In these locations, face seals are commonly used to retain lubricating fluids within rotary systems and ensure that external particles, such as mud, are prevented from reaching sensitive components.

As a vehicle moves around a site, mud builds up around the seal, packing against it and causing compressional stresses in the metal parts forming its body. As more mud accumulates, the pressure increases, eventually cracking the metal and allowing external contaminants into the lubrication media. →



In heavily contaminated environments, mud can compress between the housing and seal, creating pressure that reduces efficiency and leads to failure.



Excavators and tunneling equipment operate in extremely challenging conditions for seals.

Contamination of oil

When an axial seal fails, lubricating fluids become contaminated and cause excess wear to sensitive components, reducing machinery lifespan. The left image shows clear oil after 600 hours with Nexus Face Seal, while the right shows contaminated oil after the same test with a competitor product.



Dirt that makes its way into these fluids can act as an abrasive, quickly causing damage and leading to system failure. Failures mean additional downtime and maintenance, which is highly undesirable due to the tight deadlines typical within the construction industry.

Flexibility is key

“Seeing the issues with face seals related to mud build-up in the undercarriage of excavators, we knew that we could create a better solution,” says Nicolò Olivetti, Product Manager at Trelleborg Sealing Solutions. He has been helping his customers with engineering challenges just like this from his office in Modena, Italy, for over 13 years. “The solution required innovative thinking; rather than direct resistance, it was about flexibility,”

After in-house engineering teams had analyzed the application to determine the critical performance parameters, design constraints, and operating conditions, Nicolò's team developed an entirely new solution.

Nexus Face Seal was the result of the design process, which required re-consideration of both the application and possible solutions from the ground up, including the materials used and the geometry of the final product. “Part of solving the issue was the development of a new solution for Trelleborg’s portfolio. Instead of being rigid and brittle, this product is light and flexible,” says Nicolò. “By shaping two parts of this metal and combining them with two custom-formed elastomer elements, we have created a light and flexible barrier to external contamination that has improved lifetime versus face seals at a better price point.”

Taken for a test drive

Testing backs up Nicolò's claims. “Though it is impossible to see any leakage itself, it is possible to look at the contamination in the oil, and any dirt or water is a sign that leakage has occurred,” explains Nicolò. Nexus Face Seal endured 600 grueling hours in laboratory experiments, running at speeds of one meter per second in the same aggressive and viscous mud encountered on a building site. “We tested the Nexus Face Seal and competitive products to the same standards and conditions, and on all counts, it exceeded their performance.”

Now Nicolò and his team are testing many other slow-speed rotating applications, such as other vehicles operating in contaminated environments like tunnel boring machines, to see if Nexus Face Seal can reduce maintenance requirements there. “Due to the aggressiveness of the external environment and the short service life of existing products, we believe Nexus Face Seal to be the right solution in these circumstances too,” expands Nicolò.

An essential facet of working with Trelleborg Sealing Solutions is the support its customers receive. “We are on-hand at the Nexus Face Seal Center of Expertise in Modena to assist with customizing and assessing applications, including quick sampling production. Our manufacturing and logistics are capable of scaling with you and providing the volumes you need quickly,” finishes Nicolò. 

Keep on Turning

Windpower is the fastest growing form of renewable energy. With the world's increasing demand for energy and the urgency of shifting toward renewable energy sources, the windpower industry is expected to continue its rapid growth, with turbine installations multiplying at a record pace.

By Meghan Cloud Braunger

“WIND TURBINES DON'T HAVE AN EASY JOB,” explains James Simpson, Global Segment Director Energy. “They are exposed to harsh environmental conditions, including high winds, salt spray, heavy rain, dust and extreme temperature variations. These can have a significant impact on the performance of turbines and their durability.”

Wind, rain and debris

Harsh operating conditions require advanced engineering and robust materials that can withstand environmental challenges. “High performance sealing technology plays an important role in ensuring the efficient operation of turbine components and protecting them from environmental factors,” says James. “By matching seal designs and materials to the operating conditions in the turbine, we maximize energy production, while minimizing maintenance costs.”

Seals prevent contaminants from entering critical parts such as gearboxes, bearings, and brake systems. Water, sand or dirt particles can damage components leading to premature failure and costly downtime.→

Seals are also responsible for containing internal fluids, such as lubricants and hydraulic fluids, in hydraulic cylinders. Leaks can cause damage to the surrounding environment and loss of fluid and lubrication means that components cannot operate efficiently.

Moving to deeper seas

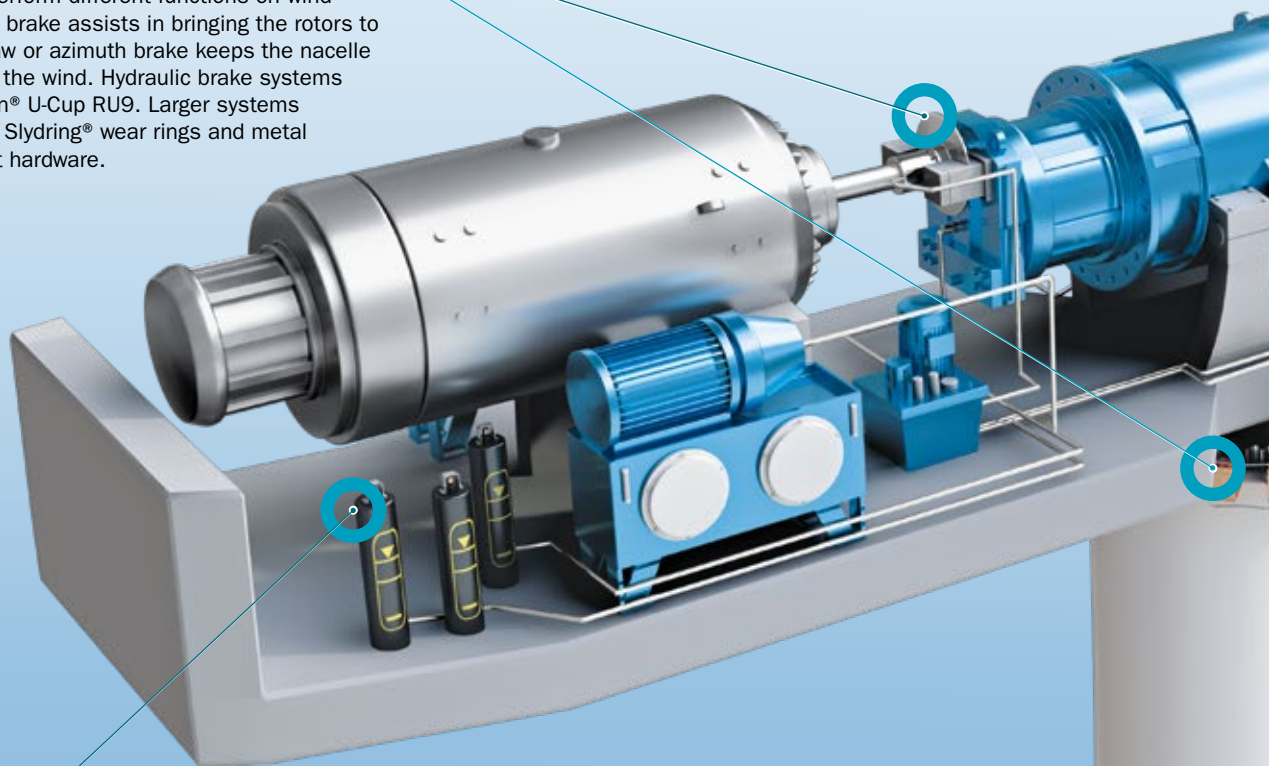
To unlock new areas of wind energy development, turbines are moving to deeper seas. James explains: “Floating offshore wind turbines are a promising technology. Unlike traditional offshore wind turbines that are fixed to the seabed, floating turbines can be deployed in deeper waters. This offers access to stronger, more consistent winds and reduces visual impacts. Wind farms can be bigger and single turbines can be significantly larger than the ones we are familiar with on land, meaning much more energy can be generated.

“These turbines make use of existing mooring and platform technologies from the oil and gas industries,” James adds. “In deeper waters, the conditions can be much harsher than on land. During storms, waves are very high and wind is strong. An effective mooring system reduces the impact of the waves, thereby reducing the forces on the turbine components.”

Advanced polymer technology is critical to mooring systems to ensure platform stability. Seals and polymer components protect against metal-to-metal contact and prevent wear on components. And because of the nature of the application, materials must demonstrate high strength and low water absorption, as well as being maintenance-free.

Hydraulic Brakes

Hydraulic brakes perform different functions on wind turbines. The main brake assists in bringing the rotors to a standstill. The yaw or azimuth brake keeps the nacelle positioned against the wind. Hydraulic brake systems typically use Zurcon® U-Cup RU9. Larger systems incorporate Orkot® Slydring® wear rings and metal scrapers to protect hardware.



Accumulator

Accumulators are an important safety feature in wind turbines. They help turn the blade away from the wind in an emergency and maintain pressure in hydraulic systems when the pump is off, reducing power consumption. A typical accumulator sealing system uses a Turcite® Slydring®, a Turcon® AQ-Seal® and a Turcon® Stepseal® 2K.

Floating Wind Mooring

Orkot® bearings in floating wind mooring systems protect against metal-to-metal contact and prevent wear on chain stoppers and line handling equipment. Our robust Orkot® material has low friction properties and is virtually maintenance-free.

Maximizing Power

When combined with battery storage and energy management systems, wind turbines can power the smart grid when energy consumption is high. O-Rings, HMF FlatSeal™ and engineered molded parts in high performance materials optimize the performance of these systems.



Blade Bearings

Sitting between the hub and the three wing blades, blade bearings are exposed to the environment, and offshore and desert climates can cause premature seal failure. The Forsheda® V-Ring rotary shaft seal and large diameter X-Seal are suitable solutions to withstand the extreme operating conditions.

Lock Cylinder

Typically, a standard hydraulic cylinder, the lock cylinder locks the rotor and blades in position for maintenance operations.

Main Bearing/Yaw Bearing

Large diameter rotary seals are needed to effectively seal the main bearing and yaw bearing. The unique Forsheda® V-Ring is suitable for large applications and is joined onsite after installation. Typically needed in four- to six-meter diameters, this seal can be manufactured in even larger sizes.

Find out more about the Forsheda® V-Ring on page 29.

Pitch Control

Pitch control systems consist of a series of cylinders and control valves that pitch the rotor to ensure the optimal angle against the wind. Pitch cylinders operate at a high frequency using short strokes.

In these hydraulic cylinders, the Orkot® Slydring®, Zurcon® Wynseal piston seal, Zurcon® U-Cup RU9 rod seal and Zurcon® Scraper DA22 offer reliable sealing with a long service life.

Sandwich Mount

At the sandwich mount, between the top of the tower and the turbine, anti-fretting pads facilitate smooth turning of the rotors. Orkot® pads prevent metal-to-metal contact and reduce wear and damage to the surfaces.

ON LAND AND IN THE SEA

Wind turbines are a common sight. There are three different types based on where they are located.



Onshore wind is becoming increasingly popular as costs decrease. The number of turbines is estimated to increase by 25% over the next five years.



Close-to-shore offshore wind is receiving significant investment as turbines can be larger in size than on land and generate more power.



Floating offshore wind is a newer technology based on floating platforms. It will potentially allow for even larger wind farms further out at sea.

Chips With Everything

Microchips make the world go round, and the need for the semiconductors that make up these chips is increasing exponentially. In parallel, semiconductor features are miniaturized and made more powerful to satisfy the demand for smaller, faster and higher-performing devices.

By Donna Guinivan and Paul Ravenscroft

IN SHORT



- 1** Semiconductors are found in everything and their technology has advanced significantly.
- 2** Microchips are manufactured at semiconductor 'fabs' with extremely specialized production equipment in cleanroom conditions.
- 3** Trelleborg supports semiconductor manufacturers with specialist materials that optimize production and reduce maintenance.



“THESE DAYS VIRTUALLY EVERYTHING CONTAINS SEMICONDUCTORS,” says Dr. Murat Gulcur, Technical Director, Semiconductor Technology and Innovation at Trelleborg Sealing Solutions. “The latest mobile phones have more computing power than big computers of 10 to 15 years ago, maybe even five years ago. We take what’s inside them for granted. We never really think about what is behind our ability to upload a high-resolution photo to social media in less than a second, while millions of users are doing the same thing at the same time globally.

“If only 10 percent of all social media users upload just one image a day, imagine how much data needs to be processed and stored,” he continues. “Add email to that, which requires storing and backing up constantly. The amount of data is growing and growing, and in the background all of that is processed using semiconductors.” The computing power of a microchip or integrated circuit is directly related to the number of transistors it has. Maximizing computing power means that more transistors need to fit on these devices.

“The technology behind semiconductors has evolved significantly over time, particularly around their miniaturization,” continues Murat. “In the very first integrated circuit, there were only 16 transistors with a feature size of 40 micrometers or 40,000 nanometers — about half the width of a human hair.” Murat explains that the term “feature size” refers to the size of the elements on a semiconductor.

In 1965, Gordon Moore, cofounder of Intel, said that the number of transistors that would fit on a given area of silicon would double every two years. A few years later he revised his statement, which is now known as Moore’s Law, and said that the number of transistors per integrated chip would double every 18 to 24 months — an astonishing prediction that proved true.

Today’s integrated circuits have billions of transistors, and the manufacturing process is at the nanoscale. The most advanced technology node, or feature size, as of today is down to five nanometers. That is five one-billionths of a meter. →

“Until they are ready to ship, our parts never leave the cleanroom and are specially packaged after an intensive cleaning process.”

DR. MURAT GULCUR,
*Technical Director, Semiconductor
Technology and Innovation at
Trelleborg Sealing Solutions*

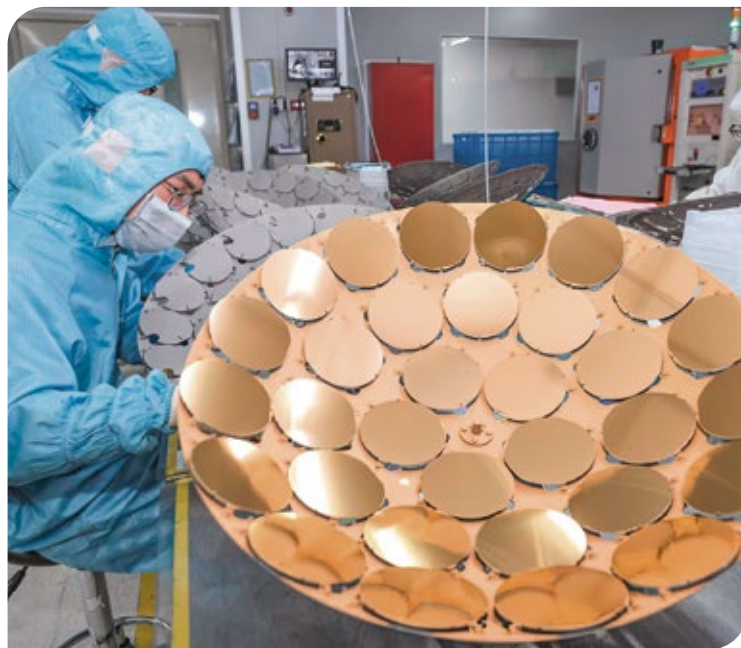


“Moore’s Law has applied up until recently,” says Murat, “but in the near future maybe we will finally see the rate of growth of the number of transistors in an integrated circuit slowing down.

“That’s because we are stuck, as the feature sizes are now approaching the physical limits of the space of a semiconductor, and we can fit no more transistors on a chip’s two-dimensional surface.”

However, processing power and data transfer speed need to increase further. It is not only required for the devices that we can see and handle but also for recently emerging critical trends that need huge storage and processing capacity, such as autonomous driving, Artificial Intelligence, big data, the Cloud and the Internet of Things.

“Semiconductor engineers are increasing processing power by creating complex architecture in three dimensions to fit more transistors in a unit area,” explains Murat. “We are going beyond the realms of traditional physics into quantum physics and mechanics, and the design rules are changing.”



The production line of an LED epitaxial wafer at a facility in China.

DO YOU KNOW THE LINGO?

Semiconductor: A type of material that has an electrical resistance adjustable from an insulator to a full conductor.

Semiconductor fab: A semiconductor fabrication plant or foundry.

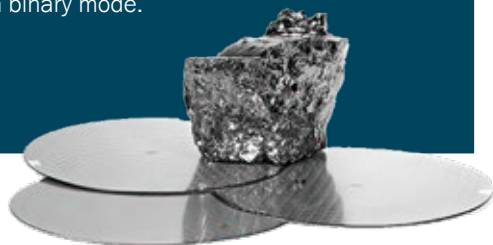
Wafer: The base of all microchips or integrated circuits. A wafer is made of pure silicon crystal with embedded ions to give it semiconductor characteristics.

Microchip or integrated circuit: These are almost the same thing – a bundle of semiconductor devices that consist of multiple circuitry elements.

Feature or node size: The feature or node size is the definition of a semiconductor device size. The smaller the feature size, the more advanced the microchip.

Transistor: A semiconductor circuitry element that switches or amplifies an electrical signal. In computers, transistors are mostly used as switches. Transistor arrays are used for storing data as memory and doing computation in binary mode.

Right: Pure silicon crystal and wafers.



Microchips are manufactured in semiconductor fabrication plants, which are essentially giant cleanrooms with extremely expensive and specialized production equipment. Much of this machinery relies on critical sealing that can stand up to the particularly harsh conditions of fab processing.

“Extending the life of seals is key to lengthening planned maintenance intervals,” says Murat. “This can reduce total cost of ownership in semiconductor fabs, but even more importantly it can optimize semiconductor wafer output. Every second counts on high-volume semiconductor production lines. Emergency downtime must be avoided and planned maintenance times minimized.”

At the nanometer scale, air is extremely dirty. In production, everything that is involved in microchip manufacturing, including seals, must be as clean as possible so that no particles enter the semiconductor manufacturing process from outside.

“Particles not visible to the naked eye can lead to defects on semiconductor wafers,” says Murat. “It is paramount that seals within semiconductor manufacturing equipment are super clean on delivery to avoid damage to minute electronic components, causing so-called killer defects. Our seals for semiconductor fabrication are therefore manufactured in cleanrooms, from raw material to end product. Until they are ready to ship, our parts never leave the cleanroom and are specially packaged after an intensive cleaning process. This helps our customers increase yields.”



Clean manufacturing. The operators are wearing sterile protective coveralls to ensure the quality of semiconductors.

Seals also need to perform effectively in all process steps involved in semiconductor production, and that is more challenging as the process steps increase and process conditions become harsher in fabs.

“Now there are a larger number of process steps to make a microchip,” says Murat. “For example, when feature sizes were 28 nanometers, there were about 400 process steps. For a five-nanometer feature size there are thousands, despite Advanced Extreme Ultraviolet (EUV) lithography in high-end semiconductor manufacturing.

“Every process step must take place in a cleanroom,” he says. “Our cleanrooms are clean; at ISO 5/Class 100, we’ll have a maximum of 100,000 particles larger than 0.1 μm per cubic meter. The semiconductor manufacturers’ cleanrooms are ISO 1, which is 10,000 times cleaner than ours.

“Our seals are in a continual development cycle,” he says. “As the industry changes to meet ever-increasing demands

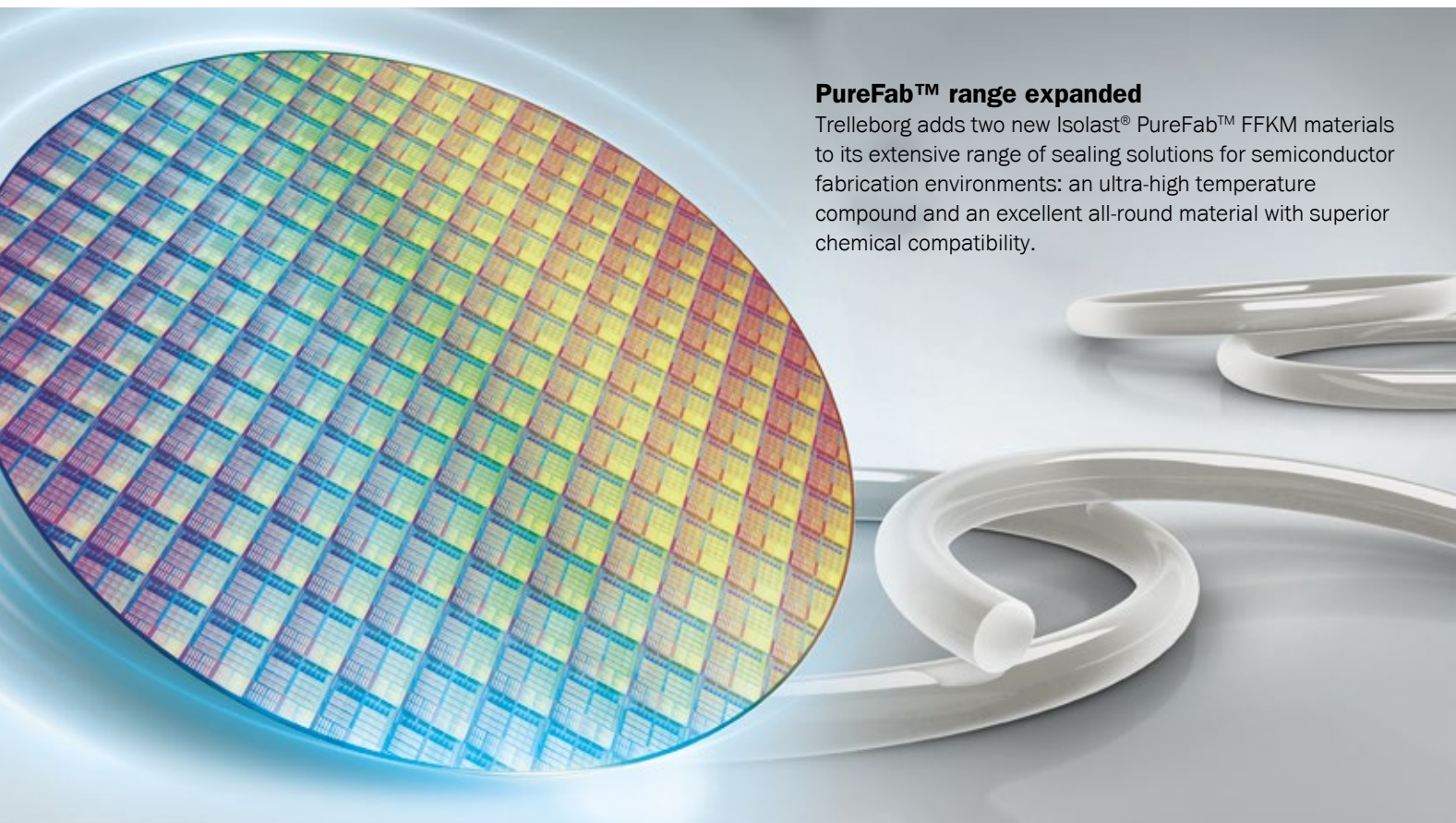
DID YOU KNOW?

THESE THINGS CONTAIN MICROCHIPS

- Talking teddy bears
- Self-ordering fridges
- Diabetic monitors
- Singing greetings cards
- Identification implants for dogs
- Credit cards
- Security tags
- Car keys

for processing power and volume, the challenges for both the microchip manufacturers and us increase.

“Specialist materials that once operated perfectly well are taken to their limits, and we need to develop the next generation of even better materials. To continue to fulfill the requirements of semiconductor equipment manufacturers, we must be continuously alert, not just to keep up with the trends but also to anticipate them and how they will impact our products. We need to be ready to take action.” →



PureFab™ range expanded

Trelleborg adds two new Isolast® PureFab™ FFKM materials to its extensive range of sealing solutions for semiconductor fabrication environments: an ultra-high temperature compound and an excellent all-round material with superior chemical compatibility.

Specialty semicon materials

Many of the world's most advanced semiconductor manufacturing facilities – and their customers who make device hardware – rely on the benefits of Trelleborg Sealing Solutions, a vital component in the supply chain.

Trelleborg's specially engineered range of leading-edge FFKMs for critical semiconductor applications provides the best performance in aggressive front-end processes including deposition, etch, ash/strip, plasma cleaning, and thermal processing such as atomic layer deposition.

Their unique properties help Original Equipment Manufacturers (OEMs) and fabs maximize system uptime with properties including high-temperature stability, high purity, exceptionally low trace metal content, and outstanding plasma resistance. This leads to reduced particle generation and ultra-low outgassing performance in high vacuum conditions, enabling end-users to extend their product maintenance cycles while ensuring maximization of process yield.

Superior performance

"Today's semiconductor environments increasingly feature extreme temperatures and more aggressive chemical precursors," says Chris Busby, Semiconductor Segment Director at Trelleborg Sealing Solutions. "Trelleborg's Isolast® PureFab™ materials provide the reliable sealing solutions that are essential to prevent premature seal failure, which can cause manufacturers increased costs of replacement and production downtime.

"For OEMs and semiconductor manufacturing facilities, the two new Isolast® PureFab™ materials provide benefits including increased product yield and decreased process defects. In turn, this reduces downtime, extends product maintenance cycles, gives greater process tool uptime, and results in a lower total cost of ownership. Individually, the materials are best-in-class for specific characteristics," concludes Chris. ▾



To arrange a discussion about materials for your application scan the QR code or visit:
www.trelleborg.com/seals/worldwide



Isolast® PureFab™ JPF22 is an excellent all-round FFKM material with superior chemical compatibility suitable for a wide range of semiconductor applications. The material offers excellent resistance to wet process chemicals and steam, as well as amine-based ALD precursors.

Isolast® PureFab™ JPF40 is an ultra-high temperature FFKM developed for demanding subfab applications and thermal processes, including rapid thermal processing (RTP), atomic layer deposition (ALD), and oxidation. The material offers unrivalled compression set performance at operating temperatures from +200 °C to +300 °C/+392 °F to +552 °F. This ensures sealing integrity for critical processes, withstanding peak application temperatures over +325 °C/+617 °F, the highest temperature capability of an elastomer material.

Features and benefits of Isolast® PureFab™

- High-temperature stability
- Highest purity
- Exceptionally low trace metal content
- Outstanding plasma resistance
- Best performance in aggressive front-end processes including deposition, etch, ash/strip, plasma cleaning, and thermal processing such as ALD
- Reduced particle generation and ultra-low outgassing performance in high vacuum conditions
- Enables end-users to extend their product maintenance cycles while ensuring maximization of process yield
- All Isolast® PureFab™ seals produced and packed in a Class 100 (ISO5) cleanroom environment to ensure purity of product



To find out more about the Isolast® PureFab™ range of materials scan the QR code

Isolast® PureFab™ range of materials

- **Isolast® PureFab™ JPF10** for high-end deposition processes with fully organic formulation
- **Isolast® PureFab™ JPF20** for plasma resistance against aggressive plasmas and minimal particulation in harsh environments
- **Isolast® PureFab™ JPF21** for long-term thermal stability and low trace metal contamination
- **Isolast® PureFab™ JPF22** for excellent all round performance and superior chemical compatibility
- **Isolast® PureFab™ JPF30** for its market leading high temperature rating and extreme purity in a translucent material
- **Isolast® PureFab™ JPF40** for demanding, ultra-high temperature subfab applications and thermal processes

“It is important to learn from other teams around the world, so we often share success stories and best practices ”

LISA PENG,
*Inside Sales Executive at our Customer
Solution Center in Shanghai, China,*

ABOUT ME

Favorite book: Harry Potter

Hobbies: Listening to lyrical music to relax,
and reading novels

Favorite food: Oranges

In Your Own Language

Trelleborg Sealing Solutions offers unmatched levels of engineering, commercial service and technical support. While benefitting from our global expertise and unique services, customers around the world can partner with local engineers to develop customized solutions to meet their individual needs through our Customer Solution Centers worldwide.

By Maria Rifaut

Lisa Peng, Inside Sales Executive at our Customer Solution Center in Shanghai, China, answers questions on how her role at Trelleborg supports a global but local focus.

ITG: What does a typical day at work look like for you?

Lisa: I am an Inside Sales Executive, responsible for more than a hundred customers in the East China Regional Team. A typical day for me involves communicating with customers and internal departments of our company through email or phone, placing orders, arranging delivery, and doing my best to assist our customers.

I do similar things every day, and while people may think it's not challenging to be repetitive, I like being there for our customers. I love this controllable daily routine, occasionally challenging, but within my control.

ITG: How do you and your team support our customers in their daily business?

Lisa: As an Inside Sales Executive, I receive first-hand information from customers. It is my responsibility to convey their needs to our internal team and work together to make sure we provide the best sealing solutions and ensure customer satisfaction.

ITG: How do you interact with your colleagues globally to provide solutions for customers around the world?

Lisa: It is important to learn from other teams around the world, so we often share success stories and best practices to make sure our customers receive the same quality and experience regardless of their location.

ITG: What is your favorite thing about working in the Customer Solution Center in Shanghai?

Lisa: We work in the same location as our manufacturing facility, R&D and supply chain management. This makes the information flow much quicker and easier.

ITG: How would you describe Shanghai to someone who has never visited it?

Lisa: Shanghai is international and prosperous. The developed economy has attracted many entrepreneurs and migrant workers, making the city very diverse. The people of Shanghai are very nice, and the city is beautiful. 🌃

MORE INFORMATION



Scan the QR code to learn more about our Customer Solution Centers worldwide, and to meet other local experts like Lisa.

Feeling SECURE

Trelleborg's Tran-SECURE™ Fluid Sealing Management Program provides the chemical transportation market in North America immediate availability of components critical to the maintenance and repair of railcars. It is backed by global resources, local support, and unrivaled material research so that regardless of the commodity transported, customers receive the right seal for their tank car to maximize seal life and minimize maintenance and downtime.

By Lauren Brune

When things go off the rails

When a tank car requires maintenance, it is not on the rails transporting chemicals and other commodities. That means equipment owners and shippers are losing money.

To minimize costly downtime, it is critical that high-quality seals, gaskets, and other valve repair components are available in the right materials for immediate shipment.

Trelleborg's robust fluid sealing management program, Tran-SECURE™, provides customers in the chemical transportation industry with immediate availability of components critical to the maintenance and repair of railcars. It offers high-performance engineered solutions and valve repair kits and is supported by a dedicated team of material experts, sales engineers and customer success advocates focused solely on the chemical transportation market.

Getting back on track

A reliable sealing partner that offers everything under one roof and serves as a one-stop-shop supplier helps tank cars quickly back on the track. In 2020, Trelleborg launched the Chemical Transportation Seals-Shop. This provides the industry's only comprehensive portal for convenient, 24/7 access to fleet management documentation and support materials, online ordering and shipment tracking. Today, the Tran-SECURE™ Fluid Sealing Management Program brings it all together and

offers an expanded product offering to include a new line of flat gaskets and manway gaskets.

"The Tran-SECURE™ Program provides peace of mind to our customers," says Thijs Menzel, Global Segment Director Chemical & Processing. "All of our materials - many of which are proprietary formulations and compounds designed to be compatible with a broad range of even the most aggressive chemicals - are fully tested and proven to be compliant with industry regulations."

**"The Tran-SECURE™ Program
provides peace of mind to
our customers."**


THIJS MENZEL,
*Global Segment Director Chemical
& Processing.*





Service in action

Thijs shares a story, “When a tank car customer transporting anhydrous ammonia (AA) experienced O-Ring leakage on several pressure relief valves, they reached out to us to conduct an extensive root cause analysis. Our experts visually inspected the O-Rings and performed a Fourier-Transform Infrared Spectroscopy (FTIR) analysis and dissolution testing with nitric acid. Through this it was found that material incompatibility caused the O-Rings to swell and soften, leading to deformation and tearing.

“Based on these results and the needs of our customer, the team recommended an ethylene propylene diene rubber (EPDM) material for the O-Rings, which offers long service life in applications with AA. We pride ourselves on our ability to offer a full portfolio of services to support customers.” 

MORE INFORMATION



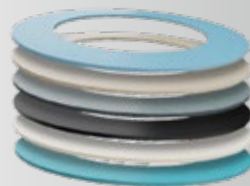
Scan the QR code to find out more about our portfolio of products and capabilities for chemical transportation customers.

Ready & Reliable, Right Now!

Trelleborg's Tran-SECURE™ Fluid Sealing Management Program is built upon immediate availability, unrivaled material research, and assured regulatory compliance supported by global resources and local support.

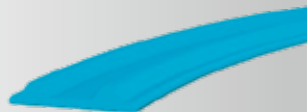
Flat Gaskets

Trelleborg's flat gaskets are available in elastomer, flexible graphite, non-asbestos fiber, and PTFE in both standard and custom geometries. All flat gasket materials are compliant with REACH, RoHS and Prop 65. Specific materials are compliant with FDA, 3A, and USP regulations.



Manway Gaskets

Trelleborg's PTFE lid gaskets and elastomer nozzle gaskets are specially designed to provide superior sealing performance in torqued tank car manways, even when transporting the most aggressive chemicals.



Valve Repair Kits

Trelleborg's valve repair kits include all OEM-approved components needed to maintain a particular valve. All materials used in kit components are specifically selected and tested to suit the commodity transported. Each kit also contains full documentation, including detailed parts references, expiration dates and material traceability forms to ensure increased safety, compliance assurance, and peace of mind.



Nexus Face Seals

Minimize Contamination in Heavy-Duty Equipment

now



Effective sealing for low-speed rotating applications in construction and tunneling equipment.

Nexus Face Seal is an alternative to Mechanical Face Seals that provides extended service life. It offers a light and flexible barrier against external dirt and mud compression in slow-rotating applications, such as the excavators it was originally developed for. It can also improve longevity and total cost of ownership of gear boxes, undercarriages and axles in nearly any construction or mining machinery.

Scan the QR code or visit www.trelleborg.com/seals to learn more.

