

simrit[®] insight.

No 1 | 2007

The Magazine for Simrit Customers

Cover Story

Elastomer products for
the Oil and Gas Industry



Miles and miles of seals

Highly integrated modules
for fuel cell technology



Seals for alternative fuels

Simrit has the right material
for all requirements



Semicon West 2007 Trade Show

Simrit innovations in new
materials and sealing solutions



Seals that think for themselves

New design possibilities with inte-
grated sensor elements in seals



www.simrit.com

Freudenberg and NOK Group

Two Partners on the Best of Terms

"In TSMT as the Preferred Distributor we have found a reliable partner to provide seals for drive train components and hydraulic cylinders. The transfer of technological knowledge between the Simrit Academy and our Simrit Preferred Distributor TSMT in China provides us with an excellent foundation for achieving our target of offering premium product quality on a global basis."

LIANG Hua,
Director of Purchasing Department,
Liugong Group, P. R. of China

LO Sui Kei, General Manager,
Beijing Tung Sun Machinery Technology (TSMT),
P. R. of China



Your Technology Specialist

simrit[®]

Simrit innovations throughout the world



David R. Monaco
Simrit Americas

As everyone knows, energy is a hot topic these days. Whether it is the price of gasoline as we take our summer vacations or the long-term concern of developing alternative energy sources, the energy sector is evolving at a rapid pace. Many separate avenues are being pursued, but they each have one thing in common – the need for innovative and reliable sealing solutions. In this issue of Insight, we profile some of the ways Simrit is working to keep the power flowing.

As I reviewed the articles in this issue, I was again struck by how global Simrit really is. Inside you will find articles highlighting innovations from all over the world. I would like to draw particular attention to NOK, our partner in Japan, and their work on not only fuel cell seals, but also specialized seals for the semiconductor industry. These revolutionary designs and materials allow sealing capabilities to keep pace with the rapid technological developments in these burgeoning fields.

I must, of course, mention our European partners as well. We continue to work closely with Simrit Europe to provide local support to our global customers and the European development teams are constantly inventing new products which we can also utilize in the Americas. You will find some of these innovations in the following pages.

Simrit stands for more than innovative products and materials. We also offer a complete set of services including a comprehensive website which displays our redesigned home

page. Over the next several months we will continue to revamp the entire site, so I invite you to log on regularly at www.simrit.com to monitor our progress.

The last item I must mention is the new testimonial advertising campaign that makes its American debut in this magazine. Customers from around the world have spoken out about the advantages of choosing Simrit as their seal supplier. Testimonials have come from many countries including Italy, China, Germany, South Africa and the Americas. I hope you enjoy these new advertisements which reinforce the multinational reach of Simrit.

Of course, all of this means nothing without you, our customer. I wish to thank you for your continued support and invite you to tell us how we can satisfy your sealing needs. Let's keep the dialog going as we develop this business together!

Sincerely,

Imprint

Simrit® insight is the magazine for Simrit customers. **Publisher:** Freudenberg-NOK General Partnership, 47690 East Anchor Court, Plymouth, MI 48170-2455 **Managing Editor:** Tim Lomax **Telephone:** (734) 354-5336 **Coordination:** Julia Hoppner **Internet:** www.simrit.com
Editing & Design: Trurnit & Partner Media Group. Reprinting and reproduction only with approval of the publisher

Contents

Editorial	03
Material for the aerospace industry Fuel-resistant compound F229	04
New brochures Small leaflets with large content	05
Cover Story	06
Fuel cell technology Miles and miles of seals	10
Contribution to environmental protection Seals for alternative fuels	12
Volume compensator Stable long-term performance	15
Bi-Component seal for extreme conditions Low temperature and pressure resistant	16
Materials and sealing solutions Simrit innovations at Semicon West 2007	17
Energy saving radial shaft seal Significantly reduced power loss	20
Materials with fillers Signal detection and shielding	21
Integration of sensor elements Seals that think for themselves	22



Cover Story



Elastomer products for the Oil and Gas Industry

The equipment for the Oil and Gas services sector is both critical and demanding. With the materials competency of its chemists and engineers worldwide, Simrit is providing its customers with elastomer sealing solutions suitable to meet the specific needs of the Oil and Gas service industry through its Oil and Gas products lead center in Nisku, Alberta, Canada.

Fuel-resistant compound for the aerospace market

Simrit's new polytetrafluoroethylene (PTFE) modified fluorosilicone (FVMQ) F229 compound meets the requirements of AMS 3383 specification in the aerospace market.

Approved by a world leading U.S.-based aircraft engine manufacturer, as well as a U.S.-based global supplier of aircraft landing gear and related systems, the F229 compound is designed specifically for applications ranging from -76 to +302 °F (-60 to +150 °C). "This new material demonstrates how Simrit is growing and evolving its products to meet the special needs of the aerospace industry," says Vinay Nilkanth, vice president of business development, Simrit. Simrit's new PTFE modified fluorosilicone compound has improved tear and extrusion resistance over typical fluorosilicones. Additionally, the material's increased tensile strength allows for easier installation. Approved for o-ring, molded shape and plate seal products, some of the material's applications include: aircraft engines, auxiliary power units, fuel controls that require seals resistant to jet fuel and HTS lubricating oil, and fuel dispensing seals (pumps, nozzles, break-aways and swivels). This compound is also appropriate for oscillating and dynamic fuel system seals.

Small leaflets with large content

Simrit – the industrial sealing products division of the Freudenberg and NOK Group Companies – is one of the largest suppliers of elastomeric seals and custom-molded products in the world. Three new brochures for different vertical sectors – aerospace, heavy industry and the oil and gas service industry – indicate the universal sealing approach of Simrit.

Heavy Industry Sealing Solutions

The Heavy Industry Sealing Solutions brochure provides detailed information on several of Simrit's product developments, including Merkel™ Shaft and Hydraulic Seals, Rod and Piston Seals, Wiper Seals, Guide Rings, PTFE Seals, V-Packings, and Static Seals.

It also highlights Simrit Xpress™ – Simrit's rapid prototype and production cell, which is redefining the way our customers think about producing their designs.

Aerospace Industry Sealing Solutions

The new comprehensive profile seals catalog was created as a reference for aerospace engineers to help them better understand and utilize Simrit's extensive products and capabilities.

All of the catalog's profile seal concepts can be produced in a variety of manufacturing methods and incorporate various substrates, which can be spliced together to form complete sealing solutions. The applications for these seals are numerous and can be found in everything from abrasive aerodynamic environments to areas where the seal is required to be fireproof.

The brochure features a variety of seals, including pull-thru; "P" seals, "D" seals, "E" seals, "Omega" seals, "T" seals, "U" seals, and a wide section on specialty seals, with cross-sections that detail the specific measurements for each product offering. Simrit manufactures both homogeneous and fabric-reinforced seals that are made



New Simrit brochures for aerospace, heavy industry and the oil and gas service industry.

primarily from silicone and fluorosilicone materials to handle the harsh environments of aerospace applications, including door seals, hatch seals, interior trim seals, etc.

Seals for the Oil and Gas Industry

The Oil and Gas Industry Sealing Solutions brochure provides detailed information on several of Simrit's product developments, including Cementing products and Downhole components, Swabmaster™ Well Service products, Oilfield Safety products, O-rings and Loaded

U-Cups, PTFE products and Engineered Plastics. The recent acquisition of Imperial Rubber & Urethane Corporation – a leading ISO 9002 certified researcher, developer, and trusted Oil and Gas Service Industry supplier – further enhances Simrit's ability to provide our customers with unmatched experience, product availability, and service expertise for the Oil and Gas market.

To obtain a copy of the brochures, please visit www.simrit.com and use the Literature Request Form to have the brochure shipped directly to you.

Elastomer products for the Oil and Gas Industry

The equipment for the Oil and Gas services sector is both critical and demanding. With the materials competency of its chemists and engineers worldwide, Simrit is providing its customers with elastomer sealing solutions suitable to meet the specific needs of the Oil and Gas service industry through its Oil and Gas products lead center in Nisku, Alberta, Canada.

In a demanding field, literally and figuratively taking Oil and Gas sealing to the next level means surmounting some of the industry's most intense challenges. Energy industry equipment must endure incredible pressures and repetitive wear and tear in unforgiving environments. Sealing components must withstand harsh downhole environments that constantly stress a sealing materials integrity. Failure can spell financial loss or, worse, compromise safety of site workers. Combined with the need to cost-effectively ensure utmost reliability to meet both environmental and seasonal demands, the design quality and functionality of every sealing component must be considered.

As the need for oil and gas increases worldwide, companies continue to push the limits of the elastomer compo-

nents to meet the most demanding environments. Pushing the limits for extreme environment service is what differentiates the Oil and Gas industry as it explores deeper wells with higher temperatures with pressures to 20,000 lbs. In addition, sealing components must survive chemical attack from a wide range of drilling, fracturing and stimulation fluids including invert drilling muds, acids and hydrogen sulfide in order to bring the flow of oil or gas to the surface. These conditions subject the elastomers to swelling, temperature degradation, extrusion and explosive decompression under high pressures and temperatures which are becoming more common. These factors singularly or combined can cause catastrophic part and equipment seal failure which can have huge financial consequences.

Simrit Oil and Gas Industry Sealing Products


Here is where Simrit comes into play. While known for parts with a field-proven track record and a history that spans over 150 years, Simrit is looking toward the future with a commitment to make its mark in the energy sector. Innovation is the cornerstone of the company and Simrit's pioneering spirit comes through in practical reality for its customers every day. Simrit's expert engineers are dedicated to open and instant information exchange throughout the entire Freudenberg and NOK global network. It's Simrit's way of ensuring that its customers receive "best of breed" solutions. Simrit total sealing solutions leave no stone unturned when it comes to getting the specific job done right. That's why each Oil and Gas sector product group

In brief

- Energy industry equipment must endure incredible pressures and repetitive wear and tear in unforgiving environments.
- Simrit supplies quality products for standard oilfield segments including a full range of O-rings, PTFE seals, and engineered plastics for the oil and gas service industry.
- Simrit's fully equipped labs enable comprehensive testing including chemical and

environmental compatibility, and complete pre-production material and process validation.

- Not only does Simrit develop its own groundbreaking materials, Simrit has also complete product design capabilities including Finite Element Analysis (FEA).

 **Tim Lomax**
tim.lomax@simrit.us



Simrit has unbeatable oilfield sealing knowledge.



Taking oil and gas sealing to the next level means surmounting some of the industry's most intense challenges.

consists of a range of exceptional molded products specifically designed and engineered for the application. Simrit supplies quality products including Cementing, Well Servicing, Downhole Tool components, Safety and Pressure control, Fracturing and Well Servicing and the full range of Simrit high performance O-rings, PTFE seals, and engineered plastics. Simrit's range of sealing solutions for the energy sector was broadly enhanced by the acquisition of Imperial Rubber & Urethane Corporation in 2006. The ISO 9002-certified Imperial Rubber & Urethane Corporation is a proven, state-of-the-art Oil and Gas elastomer products manufacturer with cost-effective designs, testing and prototyping capabilities and is well versed in Oil and Gas elastomer product appli-

cations. The acquisition gives Simrit expanded knowledge and market expertise to provide its customers with a "One-Stop Shop" for their sealing and elastomer requirements. This includes molded products, tool design capabilities and in-house tooling manufacturing. Simrit's dedicated Oil and Gas Lead Center in Edmonton, Alberta, Canada, can be reached at + 1 (780) 955-7500. Simrit's comprehensive material expertise enables the company to offer a wide variety of Oil and Gas materials spanning rubber, urethane, PTFE and drillable phenolics. In addition, rubber and urethane can be bonded to drillable phenolic materials and ferrous and non-ferrous components to offer our customers design flexibility for many

downhole components and sub-component applications. Just as Imperial Rubber has become synonymous in the industry with outstanding products and customer service, Simrit continues to champion the importance of knowledgeable and expert local service on a one-to-one basis with its customers. Simrit's global communication network puts the best technology and brightest minds together, to offer solutions and support no matter where the customer is located. Likewise, Simrit's ability to process special orders is unmatched in both stock and custom products. Fast turnarounds can be achieved thanks to Simrit's reliable customer service personnel, extensive in-house engineering and dedicated manufacturing capability.

The Simrit Service Package

- World's largest product range – superior design solutions from a single source
- Continuous innovation – Technological prominence gives competitive advantage to its customers
- Unique expertise in materials and high-quality standards – the end-to-end leader for safe, cost-effective applications
- A vast range of integrated services – holistic support from development through product deployment
- “Globality” – Global expertise united with the knowledge of local market requirements and customer demands



Simrit's Xpress service for custom-designed sealing solutions

A \$25 million marvel: Simrit's Technology Center

Simrit engineers are in constant collaboration with the finest chemists of the company's lead centers throughout the world. The nerve center of this continual and vital information exchange is Simrit's 55,000 square foot Technology Center based in Plymouth, Michigan. This \$25 million marvel was created for a single ultimate purpose: to provide our clients with an “unfair advantage.” Simrit's fully equipped labs enable comprehensive testing including chemical and environmental compatibility, and complete pre-production material and process validation. When developing and testing new rubber compounds and

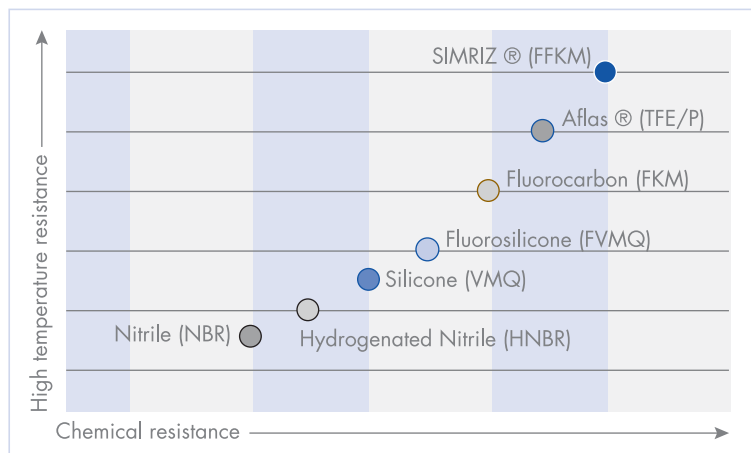
other materials, this intensely focused R&D process not only ensures a material's “manufacturability,” but also that the material will perform optimally in the exact application for which it was developed. The Simrit Technology Center is supporting the Oil and Gas industry in the research and development of new high performance elastomers to meet the challenges for high performance molded components and seals.

Simrit's Capabilities and Certifications

The mark of a tried and true supplier is the ability to grow and adapt to the needs of the industry it serves. Simrit's greatest advantage is bringing flexibility

and creativity to its customers' demands for design innovation. Customization is where Simrit gives the edge to its customers. Simrit provides complete in-house rubber mixing, custom elastomer compounding, tool and part design and rubber-to-metal bonding. Our customers can be sure that every stage of the manufacturing process is internally controlled to insure the utmost product quality through every stage of manufacturing. With 27 years of experience in oilfield molded products and sealing components, Simrit's industry-tailored compounds are proven to be reliable through many years of “In-Field” use. Simrit quality certificates include: ISO 9001:2000, ISO 9002, ISO 14001, QS9000, ISO-TS-16949, and many customer-specific quality programs.

Comparative temperature/chemical resistance limits



Materials for the oil and gas industry

FEA and Simrit Xpress

In addition to our highly specialized elastomer materials, Simrit also provides complete product design capabilities including Finite Element Analysis (FEA), which ensures a robust design and maximum service life. Moreover, with its rapid prototyping and low-volume production cell for custom-designed seals, Simrit can deliver product in 24 hours or less. Capabilities include over 200 standard designs in a variety of materials including PTFE, PEEK, polyurethane, and many rubber compounds.

Simrit's products for the Oil and Gas Industry

Simrit's comprehensive manufacturing process includes sophisticated tooling and design, bringing customers premium molded products specific to the application. Simrit's products include:

Well Cementing Products

- Drillable Phenolic Core Cementing plugs in a full range of sizes from 4 1/2" to 13 3/8"
- Tubing plugs from 2 3/8" to 3 1/2"
- Custom molded mineral and fiber reinforced drillable phenolic components
- Prompt delivery from Simrit's fully stocked inventory

Downhole Tool Components

- Custom Molded Elements and Bonded Seals
- Generic Packer Elements in 4 1/2", 5 1/2" and 7" in Arroset and BPR geometries
- Packer Cups for both retrievable and non-retrievable packers, available in sizes from 4" to 11" in a wide variety of casing weights
- Materials include NBR, HNBR, XNBR, Viton®, Aflas® and EPDM
- Rubber Packer Cups for gas well fracturing with nitrogen or CO₂
- Urethane Packer Cups for sand fracturing to prevent cup washout
- Engineered products derived from Simrit's in-house tool shop through custom compounding of field-proven materials with in-house mixing

Swabmaster™ Well Service products

- Tubing Swap Cups
- Casing Swap Cups
- Oil Saver Rubbers
- Pipe Wipers
- Pack-Off Rubbers
- Rod Wipers
- Well Service Pump Packing
- Rubber and Urethane Strippers

Oilfield Safety Products

Simrit offers a dependable family of replacement elastomer products for Annular, Spherical and Ram style BOPs (Blow-out Preventers) in field tested and proven elastomers.

- Featuring both Spherical and annular style replacement elements
- Providing 7 1/16", 11", and 13 5/8" sizes in Nitrile and Natural rubber grades for both wellhead safety and drill pipe stripping applications
- Custom manufacturing of BOP (UBOP) elements for underbalance drilling
- Manufacturing a full range of Ram Packers for 3", 4", 5", and 7" wire-line and coiled tubing BOPs

O-rings and Loaded U-Cups

Simrit offers off-the-shelf availability for standard AS568-size O-rings, including: Simriz®, Simrit's proprietary perfluoroelastomer (FFKM), Viton® Extreme (FKM), Aflas® (TFE/P), nitrile (NBR),

hydrogenated nitrile (HBNR), and carboxylated nitrile (XBNR). Loaded Symmetrical U-cups are available in NBR, HNBR, XNBR, FKM and polyurethane with O-ring energizers in a variety of materials (see table on page 8).

PTFE Products

Simrit supplies a large range of machined Quantum™ PTFE shapes for all sealing applications:

- Merkel™ spring-energized seals
- Filled PTFE compounds in combination with glass, carbon, graphite, moly, bronze, and other materials for a variety of sealing options
- PTFE provides excellent chemical and thermal resistance and is a "self-lubricating" material
- Excellent for dynamic sealing applications
- Operating temperature range: -38 to +500 °F (-164 to +260 °C)

Engineered Plastics

Simrit's innovative, customer-oriented product design and in-house manufacturing also include extensive machine capabilities in a wide range of materials:

- Virgin and filled PEEK
- Polyimide/Vespe®
- PPS/Ryton®
- UHMW-PE
- Hytrel®



Premium Drillable Phenolic core Cement plugs delivered from Simrit's fully stocked inventory



Well Head Safety – 13 5/8" Spherical Blow-out preventer (BOP) 450 lbs.



Bonded seals are important downhole components.



In a few years, tour boats – such as those plying River Spree here in Berlin – could be propelled by fuel cell technology.

Miles and miles of seals

With a new technology for manufacturing highly-integrated modules, made of a gas diffusion layer with an integrated seal for fuel cells, the developers at Freudenberg and NOK have achieved a quantum leap forward in the technical large-scale manufacturing of such modern energy transformers.

The basic principle of the fuel cell was known before the first dynamo was built, yet the large-scale technical transformation of chemical into electrical energy – which is fundamental to the fuel cell – had to wait another 150 years. It simply was not competitive for the longest time.

The dwindling reserves of crude oil has changed this viewpoint, of course. Today, hydrogen is considered one of the most viable options for a modern energy

policy, and fuel cell technology is considered by many sectors of the energy provider industry as a very interesting alternative to traditional sources of energy.

Innovative seal technology

No one seriously doubts any more that fuel cells are suitable for many types of energy supply. Now the focus is on developing systems viable for the market. In detail this means: A longer service life for

the systems, lower costs and above all establishing series-ready and quality-assured manufacturing processes. New organizational structures are also necessary for a globally oriented and long-term project such as the development of series-ready fuel cells.

That is why Freudenberg founded its own company in 2002 which concerns itself solely with the development of suitable components. In this regard, Freudenberg counts on the close coopera-



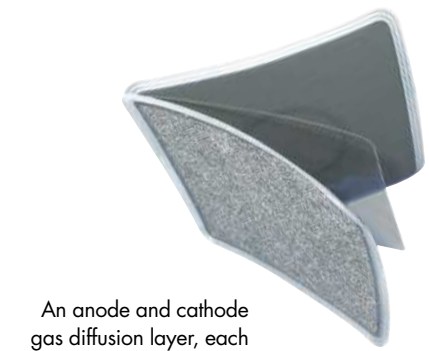
tion of its Japanese partner NOK. The superb expertise of both companies, particularly in the area of materials and process technology, positions Freudenberg and NOK for a worldwide leadership role in the field of fuel cell components. This involves, of course, extra-

ordinary materials and new manufacturing techniques with which an extremely high density of various components can be integrated in a process-stable manner. Along with bonded fiber fabrics for the gas diffusion layers and moisteners, an innovative seal technology is necessary. This had to be adapted for large fuel cell stacks. A stack can, depending on the application, consist of up to 400 individual parts, whereby the sealing area can reach up to several kilometers.

New materials are required

One way to reduce the number of components, and thus the costs, is to integrate the seals into the other components of the fuel cell. That is easier said than done, as the components in question present a very fragile picture: brittle graphite plates, just a few tenths of a millimeter thick metal plates, carbonized paper or also diaphragms that are as thin as plastic wrap. The mechanical sensitivity of these components precludes the use of traditional, highly viscous elastomers. Thus, it is necessary to develop low-viscosity, processable elastomers along with suitable processing techniques.

Simrit has recently exhibited a highly-integrated assembly which will serve as the basis for fuel cell manufacturers to quickly develop marketable prod-



An anode and cathode gas diffusion layer, each one having an encircling, elastomer seal with a profiled edge

ucts. The components consist of an anode and cathode gas diffusion layer, with each one having an encircling, elastomer seal with a profiled edge. The seals of both gas diffusion layers are then bonded to each other on one side by means of a film hinge. On the one hand, this assembly fulfils the typical seal functions in a fuel cell. Beyond this, using the film joint ensures an exact alignment of the sealing lips against each other as well as a simple, skew-tolerant diaphragm for positioning when mounting the diaphragm-electrode unit. In addition to those technical characteristics already mentioned, the assembly has one other enormous advantage. The manufacturing process is quality-assured, large series production capable and capable of complete automatization.



The fuel cell energy central building of the heating technology specialist Viessmann

In brief



- Fuel cells can be utilized in a variety of ways in terms of energy technology.
- Freudenberg has, in its global partnership with NOK Japan, taken the worldwide lead in innovative components for fuel cells.



Joel Johnson
joel.johnson@simrit.us

Seals for alternative fuels

Biogenous fuels will play an increasingly important role in general industry. The sealing elements in these units must, however, be adapted to each respective biofuel. Simrit has the right material for all requirements.

Biofuels offer a multitude of possibilities for reducing the dependency on oil imports as well as minimizing emissions of greenhouse gases such as CO₂ and NO_x. Biodiesel gained from rapeseed oil (RME) and fuels derived from biomass (BTL= biomass to liquid) and dimethylether (DME) are also worth considering. Biodiesel can be distinguished from conventional diesel by its ignition performance and especially its viscosity. Both fuels have a comparable viscosity at high temperatures; with sinking temperatures, however, the viscosity increases disproportionately with biodiesel. Accordingly, conventional diesel units must be adapted to the special demands of pure biodiesel in order to ensure optimum usage. Due to the fatty acid esters contained in biodiesel, this fuel is unstable thermally and in terms of oxidation – which can result in polymerization reactions and gumming in the combustion chamber. This can lead to deposits on the pistons and to premature wear and tear of piston rings, as well as to blockage of valves and injection nozzles. Further-

more, biodiesel is slightly aggressive in contact with paints and seals. Due to these reasons, conventional diesel units and their seals must be designed for usage with pure biodiesel or, alternatively, blends with a high proportion of biodiesel, in order to avoid the danger of damage to the engine.

FKM is most suitable

For years now, Simrit has developed materials for seal components that are suitable for usage with biofuels and other mixtures. The portfolio encompasses materials that, among other things, are characterized by extremely minor swelling properties and remarkable flexibility at cold temperatures (down to -40 °C), suitable for dynamic applications, for instance. Fluoroelastomer is clearly the most suitable material for use with biodiesel. Depending on the application case and load, copolymers, terpolymers and tetrapolymers are the basis for Simrit materials. It is fundamentally true that the heat and chemical resistance improve with increasing fluorine content. That is why

terpolymers and tetrapolymers with a high fluorine content (>67 %) have less swelling by volume in biodiesel than copolymers. Analyses performed with pure biodiesel at + 212 °F (+100 °C) for

In brief



- The seals of the diesel units must be specifically designed for usage with pure biofuels.
- Tests involving pure biodiesel together with FKM materials from Simrit produced swelling of less than 6 % by volume.
- Seals made of FKM materials are also well suited for BTL fuels in terms of their media and temperature resistance.



Joel Johnson
joel.johnson@simrit.us



1000 hours exhibited less than 6 % swelling by volume for FKM materials from Simrit. Another alternative is biomass-to-liquid (BTL). The biomass from quick-growing plants, as well as from organic waste such as straw and wood by-products, are transformed into a synthetic gas consisting of CO₂ and hydrogen by means of Fischer-Tropsch synthesis. BTL is an extremely pure fuel that contains neither sulfur nor aromatic hydrocarbons. Compared with conventional diesel, BTL fuels produce significantly exhaust pollution, especially nitrous oxide. The fuel possesses a high cetane number and thus a greatly improved ignition

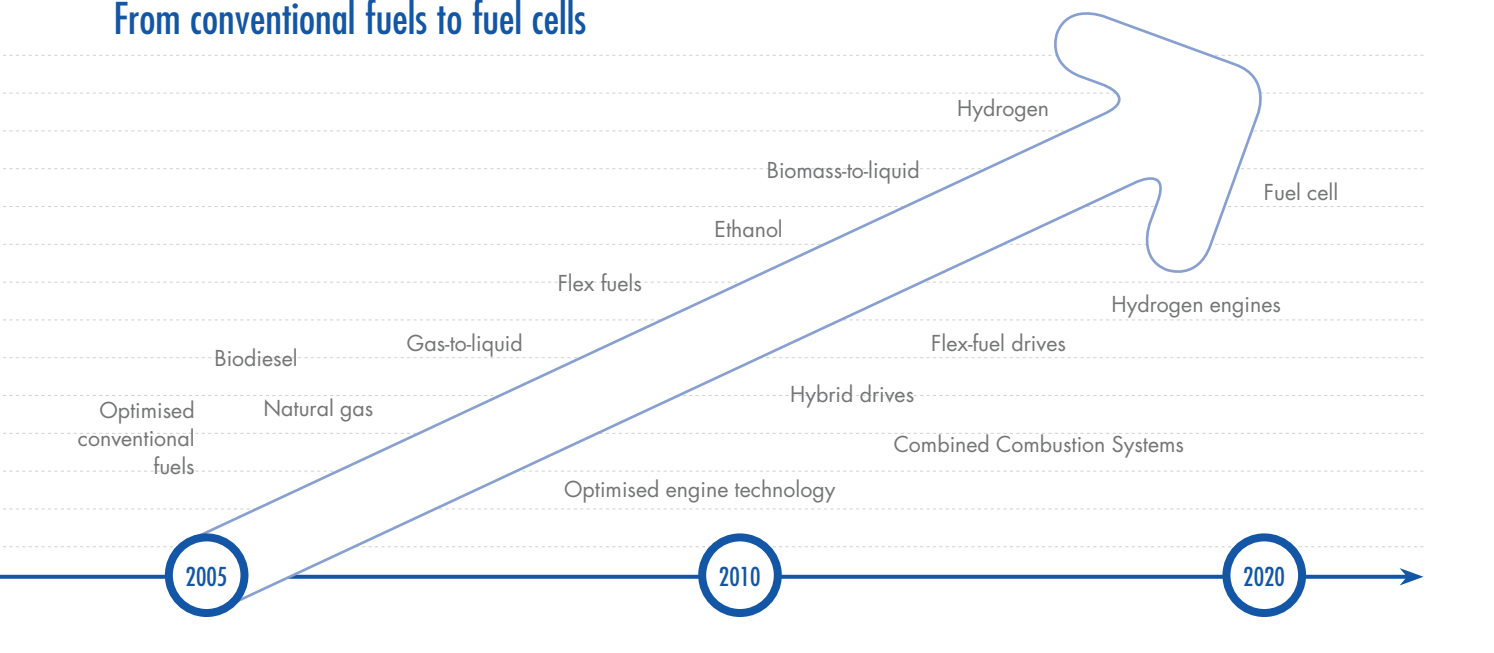
Clean exhaust gases through treatment with AdBlue

In order to comply with future emission limit values, particularly for nitrous oxide, post-treatment of exhaust gases is necessary. SCR (Selective Catalytic Reduction) technology is used for this purpose, whereby particles are reduced by 80 % and nitrous oxide emissions by up to 60 %. To achieve this, a non-toxic urea solution named AdBlue is injected as a reductive agent into the hot exhaust gas flow before the catalytic converter, transforming the poisonous nitrous oxide (NO_x) into harmless nitrogen and water vapour. In order to ensure faultless transport, transfer or safe storage, seal materials (EPDM, CIIR and HNBR) are required that are resistant to urea solution. If the seals also come into contact with oils or oil fumes, then HNBR is the material of choice.

Rapeseed is one of the most important organic sources for producing biodiesel.



From conventional fuels to fuel cells



performance compared to conventional diesel. Moreover, BTL can be used in conventional engines without modification or retrofitting. Seals made of FKM materials are also suitable here to withstand the demands of media and temperature resistance.

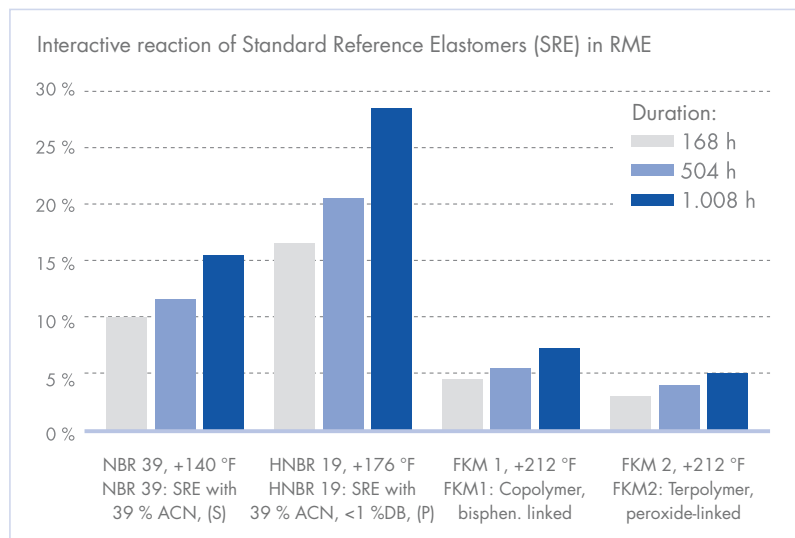
Peroxide-linked and highly-fluoridic

Along with BTL, DME is also regarded as a second generation biofuel. Dimethylether is conceivable both as a fuel as well as an additive to conventional fuels and is currently being tested regarding its characteristics. DME is an environmentally friendly non-carcinogenic fuel that can be refined from natural gas, bituminous coal or biomass. It has a cetane number comparable to that of conventional diesel, also providing for similar ignition performance under normal operating conditions. The fuel burns without leaving any residue, as DME does not contain any carbon-carbon composites and the oxygen content is as high as 30%. However, it has less viscosity and the combustive energy is about 35% lower than that of diesel fuel. Due to the low temperatures, the

formation of nitrous oxide is reduced, providing for a smooth and quiet combustion. In contrast to other fuels DME does not cause any metal corrosion. Hence, DME is superior to both conventional diesel and biodiesel. Nevertheless, the different fuel properties of DME compared with conventional diesel fuel necessitate a modification

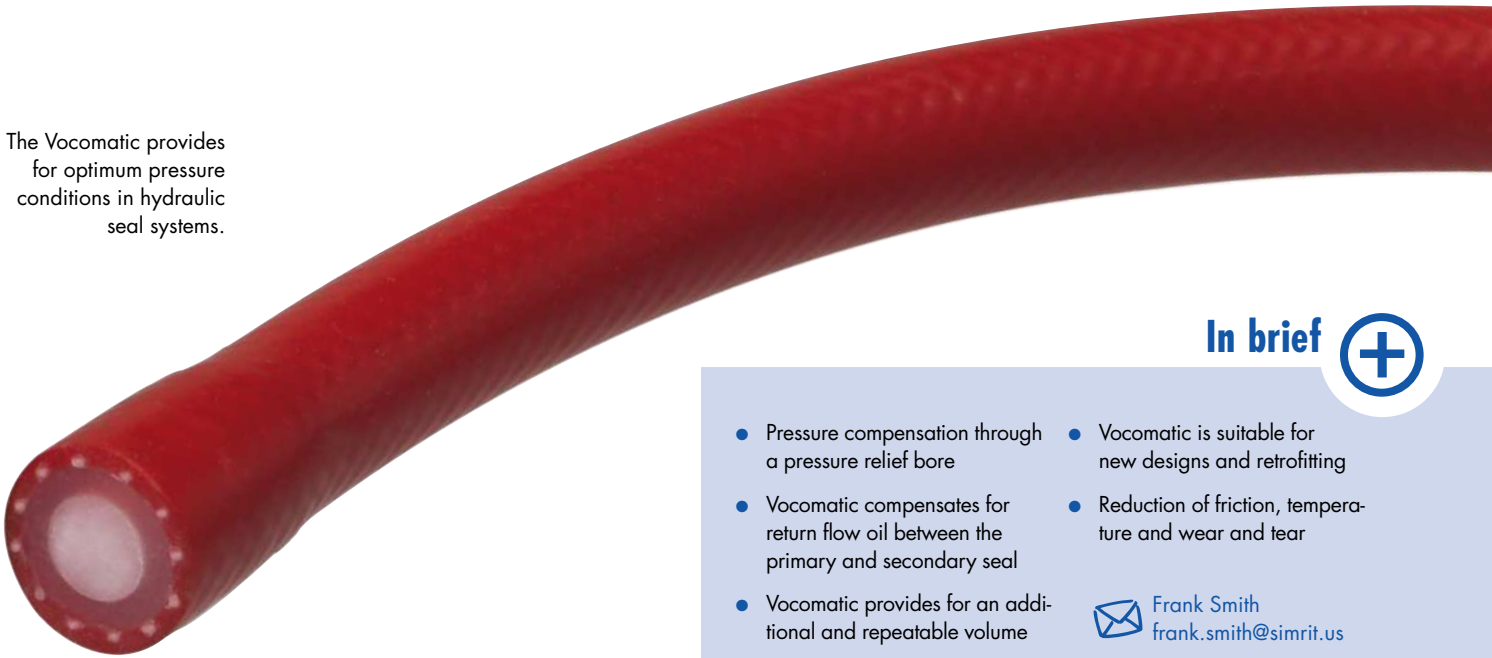
of the injection system as DME requires a higher injection pressure. The seal materials must also be matched to an application using DME. In order to attain an adequate media resistance, the use of peroxide-linked, highly-fluoridic materials is necessary. The media resistance of the seals must be verified on a case-by-case basis.

Effect of biodiesel (RME) on sealing qualities




Seal materials must be matched with biogenous fuels.

The Vocomatic provides for optimum pressure conditions in hydraulic seal systems.



In brief

- Pressure compensation through a pressure relief bore
- Vocomatic compensates for return flow oil between the primary and secondary seal
- Vocomatic provides for an additional and repeatable volume
- Vocomatic is suitable for new designs and retrofitting
- Reduction of friction, temperature and wear and tear

 Frank Smith
frank.smith@simrit.us

Stable long-term performance

By means of two ingenious optimization measures, Simrit has succeeded in preventing the undesirable pressure build-up between the primary and secondary seals in hydraulic systems. This way the service intervals for the seals can be extended significantly.

When extending the rod of a hydraulic cylinder, a lubricating film is always expelled out from beneath the sealing edge of the primary seal. The secondary seal wipes this off. During retraction the remaining oil residue is drawn completely into the main hydraulic chamber through the draft effect of the primary seal. Depending on the system, it is possible that the volume of oil that is drawn back in is less than that which was forced out. This leads to a rise in the pressure in the chamber between the primary and secondary seal, which can exceed that of the main hydraulic chamber after a brief period.

Pressure relief bore

This critical pressure differential has an effect on the rear side of the primary seal, so that it can cant into the housing or extrude in the direction of the main chamber. Using a patented pressure re-

lief bore with a diameter of < 1 mm at an angle through the PTFE sealing component of the primary seal, Simrit has succeeded in solving this problem. Thus, if the pressure in the main chamber is greater than that in the gap area, the primary seal is positioned in the housing in such a manner that the pressure relief bore – by resting against the PTFE sealing component on the groove wall – is closed. If the pressure in the gap area increases above that of the pressure in the main area, then just a minimal pressure differential will raise the seal slightly from the wall of the seal housing and open the pressure relief bore. The pressure compensation occurs automatically. This Merkel sealing system is offered in two designs – as the Omegat OMS-MR PR for normally loaded mobile hydraulic systems and as the Omegat OMS-S PR for applications in the area of heavy-duty hydrau-

lics. The Vocomatic volume compensator provides for an additional and repeatable volume between the primary and secondary seal. This consists of an O-ring type tube that is placed in an additional groove between the primary and secondary seal, providing for additional volume and thus optimal pressure ratios in the gap area between the primary and secondary seal in the rod sealing system.

Optimum pressure range

In a sealing system with a volume compensator, the secondary seal is not deformed and works in the optimum pressure range. This reduces friction, temperature and wear and tear. A sealing system with a volume compensator exhibits stable, long-term performance and extended service intervals. The Vocomatic is also suitable for new designs and retrofitting.

Low temperature and pressure resistant

Outstanding flexibility under cold temperatures and an excellent resistance to extrusion characterize the bi-component polyurethane U-ring Merkel HDR-2C. The investment costs for the user are moderate in spite of its innovative material characteristics.

Mobile hydraulic systems are almost always used under very rough operating conditions. The systems and their seals are exposed to heavy contamination and temperature fluctuations. Often the cylinders are subjected to enormous pressure peaks during operation. Thus, the rocking motion of a load-carrying excavator while driving can generate up to 60 MPa.

Flexible at cold temperatures and resistant to extrusion

Although the chemists and engineers at Simrit can 'conjure up' a broad spectrum of material properties in a

single material, for certain requirements bi-component solutions are ideal. With the HDR-2C U-ring, Simrit has now developed a component that combines outstanding flexibility in low temperature ranges – down to -58°F (-50°C) – with exceptional extrusion resistance at high pressures. The component consists of the static and dynamic sealing edge made of the low-temperature polyurethane 92 AU 21 100 and, on the back side of the seal, the extremely extrusion-stable polyurethane 98 AU 928. This combination provides for a significantly extended application temperature range with accompanying high extru-

sion resistance of the seal. Design engineers are able to benefit from larger gap widths and thus greater protection against metallic contact. Mounting is made easier, due to the elimination of the back-up ring.

Significantly increased service life

With regard to applications characterized by a high pressure impact, the bi-component U-ring increases service life by up to 50 %. Inexpensive plastic guides can be used instead of elaborate metallic guides. And, last but not least, the bi-component U-ring fits in standard housings. Despite the innovative character of the U-ring, the manufacturing technology is based on the manufacturing techniques for standard products, which makes this an affordable way to greatly improve cylinder performance.



Flexible at cold temperatures and resistant to extrusion – the Merkel HDR-2C U-ring.

In brief

- Bi-component U-ring made of low-temperature PU 92 AU 21 100 and extrusion resistant PU 98 AU 928
- Usage under low temperatures and high pressures
- Larger gap widths possible – greater protection against metallic contact
- Compatible with standard housings

 Frank Smith
frank.smith@simrit.us

Simrit's products span a wide range of sealing applications.



Simrit innovations at Semicon West

At Semicon West 2007 in San Francisco, CA, Simrit - booth # 6486 - will present a lot of new materials developed for the semiconductor industry as well as optimizations of its well-proven sealing solutions like magnetic fluid vacuum seals, welded metal bellows and bonded gates.

This year, at Semicon West 2007 in San Francisco, CA, Simrit will present several new materials for semiconductor manufacturing as well as special sealing solutions for this fast-paced industry. Besides the well-proven O-ring series, the showcase will contain Simrit's line of magnetic fluid vacuum seals specifically developed for high-performance, low-friction, rotary seal applications. These seals offer excellent thermal resistance and minimum contamination in high-temperature environments.

The second highlight will be Simrit's line of welded metal bellows used for semiconductor manufacturing equipment. Produced using a unique ultra-thin metal plate welding technology, these nesting-type bellows can secure a wide stroke within a limited space,

achieving a compact equipment design. Simrit welded bellows can be made almost completely with weldable materials, guaranteeing design efficiency for each specification and providing optimal performance. Last but not least Simrit will present its bonded gates. Through a unique manufacturing process, seal profiles are bonded directly to the process chamber gates. This allows for less seal movement reducing contamination in process. Bonded gates are available in a wide range of compounds to suit the particular process from FKMs for mild chemical processes to advanced perfluoroelastomers for the most aggressive and particulation-sensitive environments. Bonded gates are available for most of the major OEM tool sets.

Materials suited for the semiconductor industry

Simriz 485

This is a black, 75 durometer, FFKM material with enhanced resistance to a broader range of solvents than most FFKM compounds. The application temperature range for this material is 23 to 482 °F (-5 to +250 °C).

Simriz 486

Simriz 486 (FFKM) is a 75 durometer white material that provides excellent plasma resistance and low particulation with temperatures ranging from 20 to 446 °F (-7 to +230 °C). Its typical environment is "clean" process applications, such as chemical vapor deposition, plasma etching and metallization, and can be found in a variety of products including chamber lid seals, endpoint windows and valve seals.

Simriz 487

Simriz 487 (FFKM), a black perfluoroelastomer, was specifically developed for high-temperature applications ranging from 21 to 570 °F (-6 to +300 °C). Found in locations such as door and lid seals, exhaust valves and chemical containers, Simriz 487 can be used in a variety of wet processes, including wafer preparation (cleaning and rinsing), etching, stripping and copper plating.

Simriz 488

With excellent plasma resistance and high physical properties, Simriz 488 (FFKM) is a 70 durometer white perfluoroelastomer with temperature ranges from 21 to 570 °F (-6 to +300 °C). It is recommended for several dry processes such as deposition, ashing, oxidation and diffusion. Simriz 488 can typically be found in bell jar seals, gas inlet seals and isolator valve seals.

Simriz 489

Simriz 489 (FFKM) is a clear unfilled

material that offers excellent chemical compatibility in wet and dry processes and is also recommended for dry processes. This 65 durometer clear material provides plasma resistance and the lowest particulation and extractables in a wide range of acid, solvent and plasma environments. Its temperature range is 21 to 536 °F (-6 to +280 °C).

Simriz 495

Simriz 495 is a black FFKM material that was specifically developed to be

a cost-effective, high-performance compound for applications in wet chemistries. This 80 durometer black material has a temperature range of 20 to 446 °F (-7 to +230 °C) and is used in items like drain seals, fittings and connectors.

Simriz 498

Simriz 498 is a black FFKM that offers outstanding chemical and solvent resistance including compatibility with Nitric Acid and amine chemicals. It also exhibits excellent heat resistance up to

Simrit offers a broad variety of O-rings for the semiconductor industry.



Simrit's bonded gates are available in a wide range of compounds from FKM to Simriz perfluoroelastomers (FFKM).



608 °F (+320 °C). Temperature range is from 23 to 608 °F (-5 to +320 °C).

Simriz 499

This is a clear, 75 durometer, FFKM material formulated with proprietary technology to have very low adhesion to aluminum and other mating surfaces. The application temperature range for this material is 23 to 536 °F (-5 to +280 °C). Simriz 499 has excellent resistance to both dry and wet processes and can be used in applications such as chamber lid seals, view



port windows, slit valve doors and dynamic applications.

CV75WH

This is a white, 75 durometer, highly fluorinated FEPM material. CV75WH is resistant to process gases and corrosive chemicals. The application temperature range for this material is -40 to 475 °F (-40 to +246 °C). It is recommended for vacuum sealing applications.

V75WH

This is a white, 75 durometer, FKM type copolymer material compounded for excellent long term compression set resistance. The application temperature range for this material is -4 to +392 °F (-20 to +200 °C). It is recommended for vacuum sealing applications.

F70

This is a medium blue, 70 durometer, FVMQ type material compounded for excellent long term compression set resistance and resistance to oxygen plasma. The application temperature range for this material is -85 to 349 °F (-65 to +176 °C). It is recommended for oxygen plasma sealing applications.

V75

This is a black, 75 durometer, FKM type copolymer material compounded for excellent long term compression set resistance and meets the requirements of AMS-7276. The application temperature range for this material is -4 to +392 °F (-20 to +200 °C). It is recommended for vacuum sealing applications.

Superior F815

This is a black, 75 durometer, high fluorine content FKM based on Simrit's proprietary technology. This material has

the advantage of being compounded with no metallic elements so that it will

not yield metal ions as contaminants in high energy plasma applications. The application temperature range for this material is -22 to +428 °F (-30 to +220 °C). Superior F815 has excellent high temperature compression set resistance – better than some competitive FFKMs. Superior F815 is suitable for lithography, wet etching, dry plasma etching and chemical vapor deposition.

Superior F850

This is an ivory colored, 85 durometer, high fluorine content FKM based on Simrit's proprietary technology. This material is compounded for enhanced physical strength for use in dynamic applications. The application temperature range for this material is 5 to 392 °F (-15 to +200 °C). Also, this material is formulated for enhanced resistance to carbon tetrafluoride plasma and oxygen plasma. Superior F850 is suitable for dry plasma etching, ozone cleaning, and chemical vapor deposition processes.

Superior F880

This is an ivory colored, 75 durometer, high fluorine content FKM based on Simrit's proprietary technology. This material has the advantage of being compounded with no metallic elements so that it will not yield metal ions as contaminants in high energy plasma applications. The application temperature range for this material is 23 to 302 °F (-5 to +150 °C). Superior F880 has excellent high temperature compression set resistance – better than some competitive FFKMs. Superior F880 is suitable for lithography, wet etching, dry plasma etching and chemical vapor deposition.

Significantly reduced power loss

Thanks to the combination of elastomers that are capable of withstanding extraordinarily high thermal loads and a friction-optimized sealing lip, the energy-saving ESS enables the power loss in drive assemblies to be greatly reduced.

With the energy-saving radial shaft seal ESS, Simrit shows that with changes to "simple" sealing elements the power loss in drive assemblies can be significantly reduced. This unsprung shaft seal is designed to maintain the pressure force at a consistently low level over a wide range of rpm, even at rising sealing operating temperatures.

This was made possible by the development of a special elastomer and a new type of design. The radial pressure force of the sealing lip ensures the optimization of function, abrasion resistance and friction. Excessive radial loads increase wear, overheat the sealing edge, allow the oil to carbonize and lead to energy loss and leakage. Deficient radial loads hinder the stable seating of the sealing lip on the shaft, so that oil is able to leak out, resulting in leakage. In order to maintain



Reduces the dissipation loss in drives: radial shaft seal ESS.

a reliable sealing effect over a longer period of time, conventional shaft seals require a spring. Seals of the design type ESS can omit the spring, thanks to the intelligent combination of design and elastomer. Through slight

contact pressure on the shaft and the resultant excellent lubrication with the energy-saving seals, frictional forces can be drastically reduced in comparison to conventional seals. For example, power loss caused by friction that occurs on a shaft with a diameter of 45 mm at an rpm of 6000 min⁻¹ can be reduced by up to 50 W. The special design, in combination with the cushioning qualities of the seal material ensures that the sealing lip – even with extreme shaft deflections – does not lose contact and remains reliably sealed. Service life tests of more than 20,000 hours prove the superior functionality of the ESS design. This enables engine and gearbox manufacturers to offer smaller and more economical units.

In brief

- Friction reduction through the intelligent combination of high-temperature withstanding elastomers and a newly conceived sealing lip
- Reduction of the power loss by typical industrial transmissions of up to 50 W
- No loss of functionality compared to traditional shaft seals

 Joel Johnson
joel.johnson@simrit.us



In brief

- Integration of additional functions in the seal
- Magnetizable elastomers for encoders
- Electrically conductive elastomers make shielding possible



Joel Johnson
joel.johnson@simrit.us

A seal with electrically conductive elastomers (right) simplifies the surrounding protection for the affected component.

Signal detection and shielding

More and more, seals are becoming integrated components. Accordingly, functions are performed not only by integrating additional components with the seal but rather through integration into the seal itself.

The growing importance of electronics in general and the increase in electronic drives demands new concepts in seals that are characterized by the intelligent integration of extra functions in the seal itself.

Magnetizable elastomers

Along with the integration of sensors in the seal, the elastomer material itself can take over additional functions. One possibility is the use of special fillers which make elastomers electrically conductive or magnetizable, for example, while retaining their thermal and mechanical characteristics. Materials with functions that are exactly matched to the application can be created by defining the type and amount of the fillers used.

Today, Simrit shaft seals are being manufactured with special fillers that have an elastomer layer that is magnetizable and can be encoded by sector. A sensor captures the varying intensities along the magnetic field, thus generating a signal for measuring the revolutions.

The growth of electronic systems can, however, also lead to electromagnetic interference, which can cause functional impairment of electrical components. It is important to avoid electrostatic charges and interfering interrelationships between electrical components.

As elastomers are generally not conductive, Simrit has developed elastomers with special high-performance, carbon-based fillers that achieve con-

ductivities of up to 10^{-3} S/m. As a result, it is possible to modify standard seal materials such as EPDM, NBR and ACM in such a manner that, for instance, the build-up of their electrical charges can be prevented through their electrical conductivity.

Electromagnetic compatibility

A seal with an electrically conductive elastomer not only fulfils its traditional sealing function but also provides for the electromagnetic compatibility of the component in which the seal is integrated. The spectrum of applications for these "Shield & Seal" seals from Simrit is extremely broad, reaching from measurement technology through drive engineering on to the production of optoelectronic systems.

Seals that think for themselves

Integrating sensor elements in seals offers a multitude of new technical design possibilities and, as a result of the reduced number of interfaces, fewer sources of error and less expensive cost structures.

The knowledge that seals are not only for sealing, but can be utilized for much more, has a tradition at Simrit. After all, the radial shaft seal – which was developed almost 80 years ago by Simrit – is now much more than just a seal. By virtue of its sophisticated mechanical design, it can be considered to be a small microscopic pump. With regard to the current demand for the integration of electronics, sensor technology and seal technology, Simrit sets the standard world-wide.

The German Rubber Society is of the same opinion, and hence awarded the company a prize for its “Flexible printed circuit with seal” last year. With this Simrit innovation, sensor signals from a chamber containing pressurized fluid can be connected through a seal to an external socket. This integrated solution is now being mass produced and opens up a

slew of new benefits for applications in general industry.

Shaft seals with condition monitoring

Self-monitoring of the seal element is especially beneficial under extreme loads and very long operating periods. This makes remote diagnostics possible; errors are detected earlier, thus preventing damage to engines and gearboxes. Consumable components should no longer be replaced preventatively or on suspicion, but rather can be replaced exactly when necessary. With the sensor-equipped MSS1 + Condition Monitoring, leaking oil is thus captured in a repository and soaked up by a special formed fabric. The integrated sensor recognizes the contamination of the formed fabric and an analytic electronic element emits a warning signal. Leakage is prevented by means of a second sealing lip. The

switching threshold and trigger point can be set by software on a customer-specific basis. This sealing system operates up to +212 °F (+100 °C). In the meantime, there is also a similar (customer-specific) sealing system that can operate up to a maximum of +302 °F (+150 °C). It involves the seal MSS WP, which protects the seal against water penetration from the outside.

Plug-type connector with sensors

Every customer's sensor application is always unique, the overall solution – comprising the mechanical parts, sensor technology and electronics – delivered by Simrit, is a standard part. This is again true for the sensor-equipped plug-type connectors which provide for the dependable sealing of media streams over a broad range of temperatures and pressures for diesel



In brief

- Seals with flexible printed circuit
- Shaft seals with integrated condition monitoring
- Plug-type connectors and sealing plates with sensors
- Rotary encoders with sealing function and integrated magnetic field sensor

 Joel Johnson
joel.johnson@simrit.us



Plug-type connectors with integrated sensors.

The intelligent radial shaft seal MSS1 + CM knows when it is leaking.

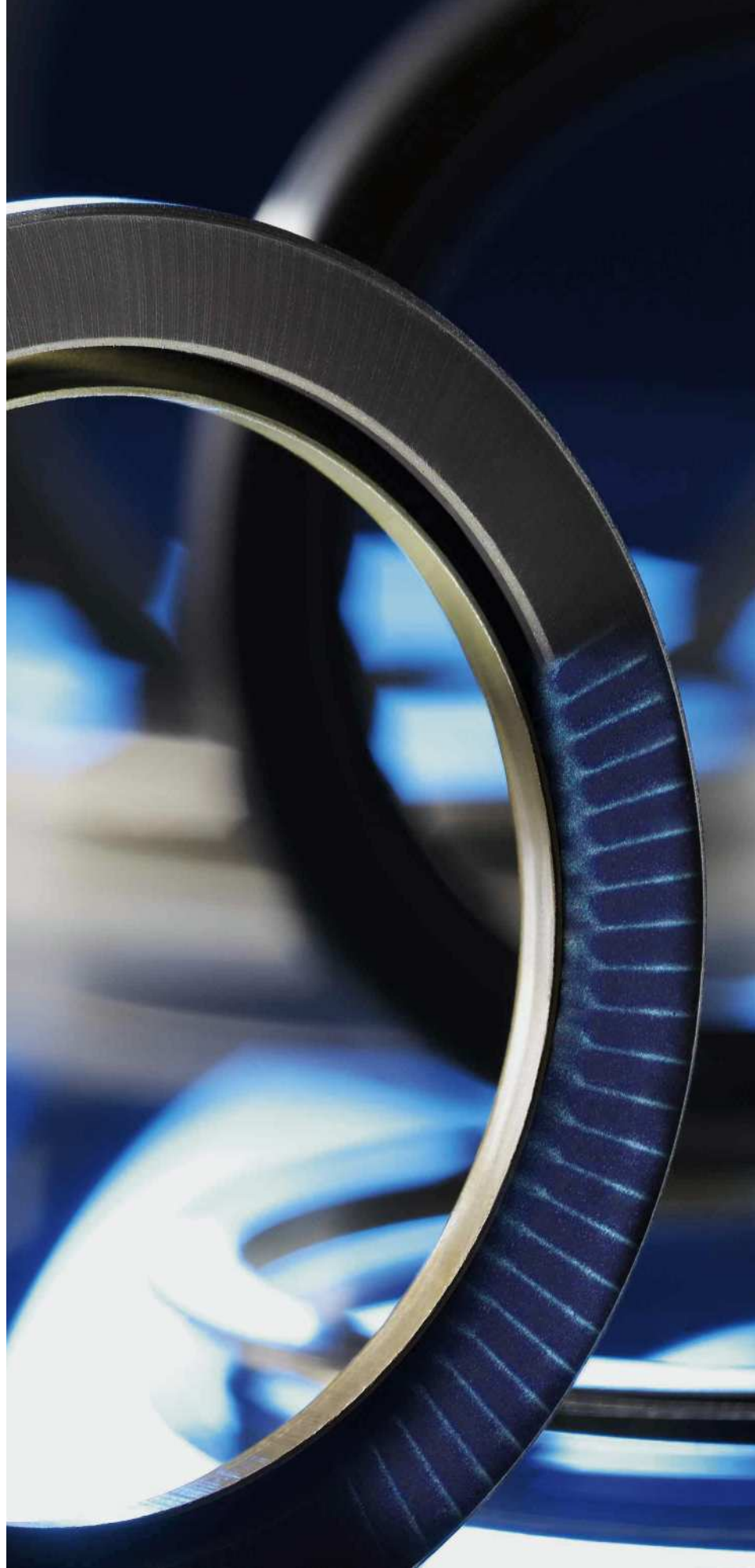
Radial shaft seal encoders with a magnetizable and sector-wise codable elastomer layer.

engines, auxiliary motor systems as well as in guidance, filling and exhaust systems. What is brand new is the integration of a temperature sensor directly on the sealing lip of a radial shaft seal.

New magnetizing technique

Along with leakage sensors and temperature sensors, Simrit offers multi-terminal encoder modules with integrated sensor technology. These modules can be utilized anywhere where rotational speed or the angle of rotation of rotating shafts must be measured. The multi-terminal encoder is an active transmitter wheel with a ferrite particle filled elastomer track, vulcanized on a metallic base, that is alternately magnetized with magnetic north and south.

In recent years Simrit has developed a new magnetization technique that is characterized by high precision, better space gap performance and greater flexibility. The resolution of the crankshaft rotary encoders in the automotive sector is about 60 impulses at rotational speeds of 0 to 10,000 rpm. Higher resolutions are needed in industrial applications or where more parameters need to be collected. This can only be achieved with multiple track rotary encoders and additional electronics. Simrit currently offers elastomer rotary encoders as axial and radial encoders – with and without sealing function – as well as cassette seals with rotary encoder functionality. The sealing elements with integrated sensors listed here are simply examples. Principally speaking, Simrit developers can integrate each specific sensor into high-quality, proprietary sealing concepts.



Our Innovative Technologies Make More out of Less

Better economy, fewer emissions – that's the course that has been set for diesel engines in the US market of the 21st century. We at EMP develop groundbreaking fuel delivery systems for diesel engines which optimize their consumption and performance. Utilizing Simrit as our sealing partner allows us to achieve these goals. Their research and development capabilities in regard to materials, seal design, sensor technology and future fuels provide us today with the sealing standards required to deal with the requirements of tomorrow.

*Bob Sims, Quality Manager,
EMP, Engineered Machined Products, USA*



Your Technology Specialist

simrit[®]