

simrit® insight.

No. 2 | 2008

The magazine for Simrit customers

Dynamic seals

Shock absorbers from FOX



Engineered
Hydraulic cylinder
sealing systems



Brewed
Solutions for
coffee machines



Protected
A fireproof portfolio



Investigated
Lubricants
put to the test



www.simrit.com

Freudenberg Group



David R. Monaco
Simrit Americas

Dear Readers,

It seems that each time I prepare to write an editorial for Simrit Insight I am always mentioning new additions to the Simrit family. This issue is certainly no exception as we have several new developments that we are very excited about.

The first is the acquisition of the assets of the Tetralene companies on June 17. Tetralene specializes in producing components in many elastomeric compounds and engineered plastics and they have an established history of providing sealing solutions to the Oil and Gas market. This makes them a great fit with our current efforts in this market and solidifies our position as a strong supplier to Oil and Gas customers.

We have also added many new materials in the last few months, several of which we featured at the IFPE Show in March. Many people were interested in our new high-temp hydraulic seal materials and their advantages in demanding cylinder applications. For those of you who could not get away to Las Vegas for the show, this issue of Insight includes some highlights from the technical paper Joel Johnson, VP—Technology, presented there.

As a final word on additions, I would like to send a greeting to all of our new customers. We're glad you've made the decision to join with us and we take our commitment to you very seriously. I look forward to a continuing dialog as to how we can help you achieve your goals.

I hope each of you has a great summer. Take some time to relax and re-energize while spending time with friends and family. Remember, you don't have to worry about your sealing needs—Simrit has you covered.

Best wishes,
David R. Monaco
Simrit Americas

Simrit expands oil and gas industry capabilities through acquisition

Simrit announced on June 17th, 2008, the acquisition of the assets of the Tetralene companies of Houston, Texas, a developer and manufacturer of specialized custom sealing components for the oil and gas industry. Tetralene manufactures custom high-performance thermoplastic and elastomeric components that range in diameter from 1/64" through 72". Their products include custom spring-energized seals as well as complete seal stack solutions

for the most demanding applications and environments. Tetralene is a full-service supplier, providing mold design and material testing while producing a wide range of machined thermoplastic and custom molded elastomeric seals, packing and components for high temperature and/or high pressure environments. They also bring a new and unique process for fabricating PEEK components to the Simrit manufacturing portfolio.

The products produced by Tetralene are a perfect complement to Simrit's existing activities in the energy sector," stated Dave Monaco, president of Simrit. "We currently produce oil and gas components in the U.S., Canada, Norway, and Scotland, and this acquisition exemplifies our commitment to grow in the global oil and gas market."



Simrit facility wins Schlumberger award for service and product quality

Inaugural honor awarded to Simrit's Nisku, Alberta, Canada, facility for exceptional service

In recognition of its outstanding performance in service and product quality, Simrit's Nisku, Alberta, Canada facility recently received the first performance award ever given by the Edmonton Product Center of Schlumberger Limited. Part of the Simrit Division of Freudenberg-NOK, the Nisku facility was unanimously selected as the only recipient for this award. "It's a great honor to be recognized by Schlumberger, a leading oil field services provider, for our dedication to providing superior service and products," said Carla Bugler, product manager, Simrit. "At the Nisku facility, we strive to offer exceptional customer service, as well as quality products that impeccably fit our customers' needs."

According to Bugler, in recent years, the oil and gas industry has evolved from the "faster is better" mind set to placing a greater emphasis on service and product quality. Simrit has been on the forefront of driving and maintaining outstanding quality controls processes and engineering standards for sealing products that surpass customer expectations. Simrit's Nisku facility, which manufactures elastomer products for the oil and gas industry, has supplied bonded seals and elements to Schlumberger for 23 years. These products are used by Schlumberger in down hole completions tools in the production of oil and gas. With 65 employees located in the heart of the oil and gas industry, Simrit's Nisku facility also designs and manufactures safety products (blow out preventers), cement products (cement plugs) and well service products (swab cups). Certified to the ISO 9001:2000 standards, Simrit's Nisku facility ensures product quality and customer satisfaction are top priorities and is dedicated to finding and addressing any issues prior to delivery. Extensive raw material testing (to ASTM standards) is performed on all rubber products and Certificates of Analysis are available upon request with results from rubber testing. Additionally, Simrit engineers conduct rigorous final inspections, which include a test for physical defects and a dimension check to drawings.

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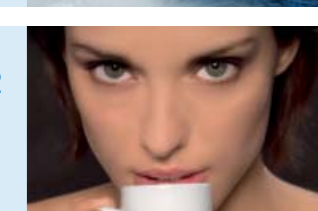
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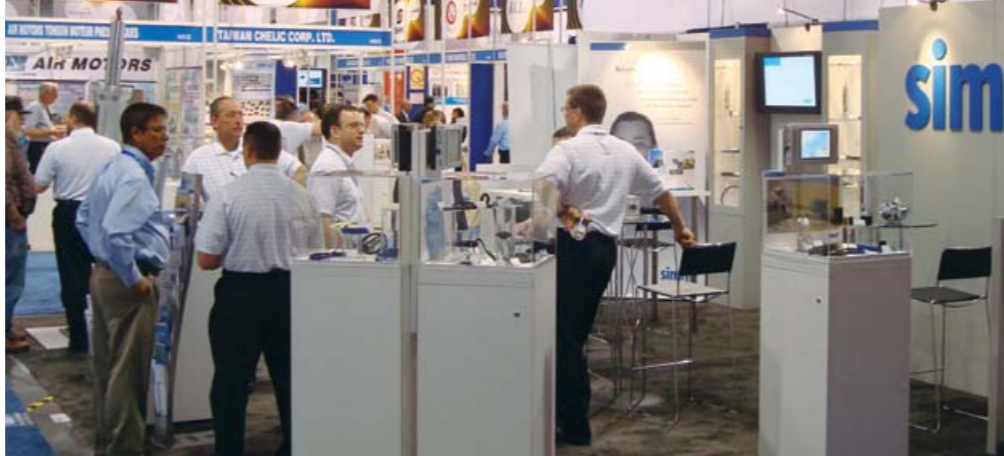
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Harmony of wear, friction and lubrication



Imprint

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Simrit's presentation at the International Fluid Power Expo in Las Vegas

Where you've seen Simrit over the past few months

Simrit has been busy exhibiting at many trade shows in the US and Brazil. Take a look at some of the shows we were present at over the past few months.

IFPE
March 11 to 15, 2008
Las Vegas, Nevada, USA

Simrit exhibited at the International Fluid Power Expo in Las Vegas this past March. The company showcased many new product innovations for the power transmission and motion control industries, presented at the show's Technical Conference, and held a Press Conference for the trade media to inform about our new sealing solutions.

Agrishow
April 28 to May 3, 2008
Ribeirão Preto, Brazil

In April, Simrit was present at the largest agricultural show in Brazil, where the company exhibited an incomparable range of products. Many innovative sealing solutions and advancements in sealing technology were presented, such as Disogrin® polyurethane compounds, new UH05 and U641 materials, track roller seals, the Plug & Seal solution, wipers, wear rings, and Simrit Xpress parts.

AIST
May 5 to 8, 2008
Pittsburgh, Pennsylvania, USA

In May, Simrit exhibited at the Aluminium, Iron & Steel Show in the David L. Lawrence Convention Center in Pittsburgh. The technology specialists showcased Merkel hydraulic seals, Simrit Xpress parts, high-pressure sealing solutions, our material capabilities, and other fluid power innovations.



Feira Internacional da Mecânica
May 13 to 17, 2008
São Paulo, Brazil

At the International Mecânica Show in São Paulo, Brazil, Simrit South America showcased the latest in innovative sealing technology. The entire line of Simrit solutions was displayed, with a focus on Merkel hydraulic seals, the HDR-2C Bi-Component Polyurethane Rod Seal innovation, magnetic encoders, Disogrin polyurethane O-rings, wear rings and other special sealing products.

You can find brochures and flyers on many of Simrit's products on the "Brochures" page of our website, www.simritna.com.

New literature for Simrit customers

Here's the newest literature offered by Simrit to keep you up-to-date on the company's new products, applications and services. For PDF versions of these brochures and flyers on the internet, please go to the "Brochures" page at www.simritna.com. To order printed copies, fill in the Literature Request Form on that same page.

Agriculture and Construction Industry Sealing Solutions

This brochure details Simrit's capacity to provide complete internal engine and hydraulic cylinder sealing solutions. It explains how Simrit's unique applications and materials such as Disogrin® polyurethane and Simriz® perfluoroelastomers are used in equipment that faces extreme conditions.

Floating Seals ES Series

The unique characteristics of Simrit Floating Seals are described in this piece of literature. Ranging from the materials to the important installation and maintenance, the brochure covers both the ES100 and ES764 product styles.

Encoders—Active Speed & Position Sensing

This two page flyer explains how a multi-pole magnetic encoder will allow precise measurements in engine crankshafts, drive axles and transmissions. It lists the many benefits from using Simrit encoders as compared to older technology.

HDR-2C: Bi-Component Polyurethane Rod Seal

Outstanding flexibility at cold temperatures and excellent resistance to extrusion characterize the bi-component polyurethane rod seal HDR-2C. The investment costs for the user are moderate in spite of the seal's innovative material characteristics. This is an example of how Simrit's design philosophy makes a standard product an affordable way to greatly improve cylinder performance.

High-Pressure Piston Seal—HDP 330

This flyer outlines how this special polyamide seal complements the Merkel piston seal program for the installation space DIN ISO 7425-1. The HDP 330 piston seal withstands the most extreme pressures (up to 800 bar) and allows for the use of rougher cylinder liner surfaces, which can cut cylinder production costs.





Photos courtesy of FOX Racing Shox

FOX Racing Shox are at the top of the list for high performance shock absorbers.



Keeping the dirt out of extreme suspension

For more than 30 years, FOX Racing Shox, of Watsonville, California, has led the industry in the design and development of high-performance shock absorbers and racing suspension products. The company has grown from a garage-based business into a world leader of extreme performance shock absorbers serving a variety of markets, including snowmobiles, mountain bikes, motorcycles, off-road cars and trucks and ATVs.

Making Tools, Not Toys

FOX designs, tests and manufactures high-performance, engineering-driven shock absorbers that have equipped vehicles and racers in every extreme sport. Its team of engineers performs rigorous tests with racers year round, collecting data about performance and product robustness. FOX's application

of this knowledge is what separates it from every other suspension company. Employing approximately 500 employees, who are never satisfied with "good enough," the company has a dedicated Continuous Improvement Team that constantly strategizes to gain manufacturing efficiency. In 2007 alone, FOX improved 91 manufacturing processes

and made 35 design changes to enhance quality and increase efficiency. FOX's suspension is an integral part of most extreme sports vehicles, as the ability of shock absorbers to take in energy allows for a smoother, more controlled ride. This increased control improves rider comfort and performance, which, in turn, allows riders to

push their abilities to the limits. As a result, FOX-equipped vehicles and racers have stood atop podiums in every sport its vehicles compete in—from the sands of Baja to the dunes of Dakar.

Keepin' the Dirt Out

In 2000, FOX was planning to enter the front suspension mountain bike fork market. Committed to superior performance, the company wanted to enter the market with a quality, robust product that addressed design challenges and ensured rider comfort and control. One of the challenges in shock absorber design is contamination, which is caused

The design of the Samurai seal is an integral part of the suspension forks on the mountain bikes.

+ In brief

Simrit helped FOX Racing Shox enter the front suspension shock absorber market without sacrificing quality for performance.

Simrit developed a new sealing design to reduce contamination and better showcase FOX's extreme products.

FOX's initial product introduction was a great success.

The company philosophies of FOX and Simrit complement one another perfectly with regard to customer and quality orientation.



Do you have any questions or suggestions? Please contact katharina.bergman@simrit.us

needed fluid. A unique element of the seal is the Samurai lip, with its customized exclusion design created specially as a solution for FOX.

The new seal design allowed the company to better showcase its damping ability and technology, as it eliminated the need for the boot that previously covered the shock absorber. Additionally, the new lip reduced the time spent cleaning the shock absorber and enabled FOX's ultimate goal of entering the market with a quality, robust product that satisfied the extreme needs of the industry.

Today, the Samurai Seal is used in all of the company's shocks, helping FOX stay true to its promise of always manufacturing quality products. Working to ensure FOX keeps its promise is what Simrit does best... that is, designing products and materials to the specific requirements of its customers.



FOX supplies shock absorbers for all kinds of racing bikes.

Design more robust cylinders that meet evolving challenges

Increasing industry challenges—including temperature, hydrolysis resistance and bio-friendly fluid compatibility—are driving the demand for better performing seal designs and materials.

Times are Changing—Are You Ready?

The main sealing challenges for cylinder makers today are excessive temperature and fluid compatibility (mainly hydrolysis and glycol fluids resistance). Excessive temperature—caused by higher speeds, increased “under hood” temperatures and higher pressures in smaller packages—result in hardening of the material or accelerated compression set which leads to seal failure via cracking at the main lip and/or loss of interference. Damage by hydrolysis and glycol exposure—often due to high humidity, new environmentally friendly bio-oils and/or glycol-based fluids—can result in material crumbling. Simrit anticipates the following 2010 market needs, which exceed the capabilities of most off-the-shelf sealing solutions:

- High temperature resilience—continuous 120°C oil temperatures;
- Cold temperature resilience—actual application capability of -40°C;
- High pressure resilience—capable of 42 MPa (6,000 psi) with spikes up to 55 MPa (0.5mm dia. gap);

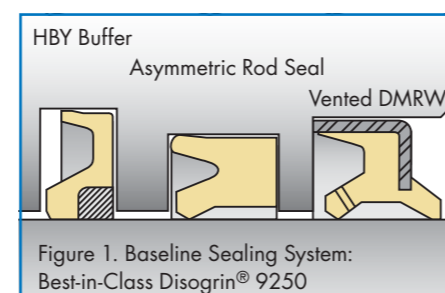
- Fluid compatibility—compatible with all hydraulic and biodegradable fluids;
- Water and chemical resistance—hydrolysis and glycol resistant; and
- Retrofit capable—compatible with standard grooves (North American, DIN [German] and JIS [Japanese]).

The changes to temperature range are especially troublesome as they affect a broad range of applications. Bench testing within the Freudenberg and NOK groups with proven correlation to field results has shown that increasing the system temperature by 10°C over the recommended limit can decrease the seal life by five times (or greater). To address these concerns, Simrit has established and tested new sealing materials and design advancements that will help fluid power engineers design more robust cylinders that meet upcoming market demands.

Simrit's Proven NOK U641 and NOK UH05 Solutions

To test its new material and design

innovations, Simrit utilized its best-in-class Disogrin® 9250 (urethane) sealing system (fig. 1, buffer seal + asymmetrical rod seal + vented rod wiper) as a baseline to assess new urethane and elastomeric blends. This TODI based urethane system has decades of field experience and has proven itself to work in the lab for millions of cycles at above mentioned system running parameters up to



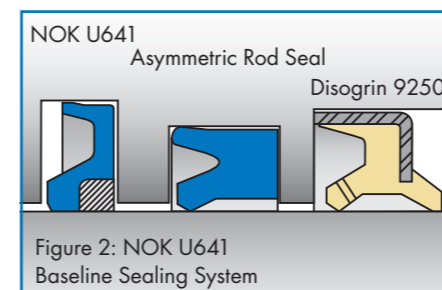
temperatures of 100°C, but it is not hydrolysis or bio-fluid resistant. A properly designed and maintained system using this best-in-class configuration has proven to provide 8000 to 10,000+ hours of running time in the field without failure.

NOK UH05—Simrit's innovative new material sets higher standards



NOK U641 in Baseline

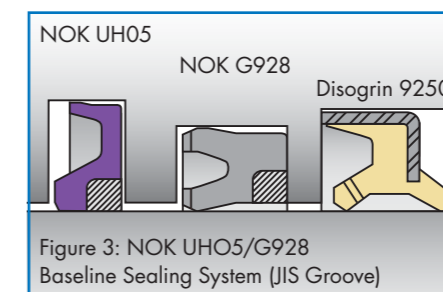
For several years, Simrit has offered a proprietary blend of urethane, NOK U641 (Simrit 94 AU20889), which is capable of handling 110°C system temperatures and low temperature capability of -25°C, as a problem solving solution. This solution provides customers an exceptional cost/performance benefit. Backed by years of lab and field tests, this solution is extremely hydrolysis and glycol resistant, capable of handling the pressure requirements stated earlier, improves the overall system temperature capability and can be produced in existing tools. Using the baseline sealing system with NOK U641 provides similar hours to our Disogrin® 9250 at 100°C, but at an elevated system temperature of 110°C. As mentioned earlier, elevating the system temperature above the recommended limit by as little as 10°C can decrease the seal life by a factor of five.



NOK UH05 in Baseline

In many cases the U641 solution will meet

the customers' immediate needs, but it has similar limitations when the temperature is increased to 120°C that the Disogrin® 9250 does when the temperature is increased to 110°C (i.e., the material does not immediately fail but the life expectancy is significantly shortened). To meet the anticipated high and low temperature requirements, NOK UH05



was developed. NOK UH05 urethane matches the original Disogrin® 9250 cold temperature performance of -40°C, while increasing the system high temperature capability to an industry leading 120°C. Currently in production for select cylinders, this solution is best suited for the thinner cross section of the buffer seal as it is more challenging to process.

Helping Engineers Adapt—Simrit's New Elastomeric Rod Sealing System

In order to maximize the life of the sealing system, Simrit has developed specially formulated elastomers for use in rod sealing applications. Properly formulated elastomers take significantly less compression set than urethanes at elevated

temperatures and make an excellent choice for seals if the wear and extrusion characteristics can be overcome. A lower compression set equates to improvement in residual interference, which is advantageous when longer life and performance during pressure cycling (at high and low pressures) is required. Although Simrit specially formulated elastomers resist extrusion well beyond the majority of elastomers on the market, in general they do require back up support to prevent extrusion at pressures above 12 MPa (1750 psi). Extrusion is not an issue if back-up support is provided and the correct extrusion gaps are maintained as Simrit has successfully used filled/reinforced PTFE (polytetrafluoroethylene) back up rings to reach 42+MPa (6000+ psi).

For those customers who are looking for increased life over the U641 solution at 110°C, Simrit offers its NOK A505 NBR; actual field results have shown that seal life can be doubled for high temperature applications. For those that require systems to meet the 120°C requirement, Simrit can substitute UH05 for the buffer seal and NOK G928 HNBR for the rod seal. The NOK A505/U641 solution has been used in Japanese cylinders for numerous years with proven results and the NOK G928/UH05 solution is currently in production for select cylinders.

In brief

- To help engineers create more robust cylinders, Simrit has designed and tested new sealing systems that meet the increasing requirements of the industry.
- NOK U641 is a hydrolysis/glycol resistant option for 110°C systems with standard and biodegradable hydraulic oils providing 100 percent sealing.
- NOK UH05 (buffer) in combination with NOK G928 HNBR (rod seal) is a hydrolysis/glycol resistant material option for 120°C systems with standard and biodegradable hydraulic oils providing 100 percent sealing.



For questions or comments please contact Joel Johnson, Simrit Vice President of Technology: joel.johnson@simrit.us.



Good vibrations

The challenge was clear: Volvo Penta wanted to design their dynamic D4 series speed boat engines to be as static as possible in terms of vibration. The solution was found in custom-designed conical mounts from Simrit. A mere nine months were needed from the initial meeting to mass production.

Modern recreational skippers want both performance and comfort. The boat should have a strong acceleration and a brisk cruising speed, but at the same time it should run smoothly. This represents a typical conflict of objectives. Among the world's leading manufacturers of ship engines, Volvo Penta is familiar with these requirements and takes the high demands of its customers seriously. Because, for starters, higher-power

engines generate stronger vibrations. Developing better, more novel mounts to dampen these vibrations sufficiently is the key to keeping boats running smoothly, even when driven to the extreme.

Extensive Simulations

To find an ideal solution for these conflicting goals, Volvo Penta got the vibration specialists from Simrit on board. With software simulations, the

vibrations, smoothness of running and maximum deformation can be modeled precisely in a quasi dry run. The results of the simulations formed the basis for discussions regarding further optimization. The goal of a skipper's calm hand and a simultaneously high acceleration of the Volvo Penta engines gradually became technical reality. After a few simulation runs, the way in which the vibrations of the Volvo Penta D4 engine

could optimally and effectively be dampened, became clear. Another very important criterion was defined to be the interchangeability of the engine mount, i.e., the ability of the mount to be installed in all boats with the same engine. After all, Volvo Penta manufactures engines for the world market, so the engine needed the ability to be used in a wide variety of boat designs.

Customized Conical Mounts

The demanding requirements for the D4 engine project could no longer be achieved with a catalogue vibration product. In light of the installation situation, the component properties and the required lifetime, as well as the test results, the team of experts from Volvo Penta and Simrit finally selected a conical mount as the ideal solution. Further

Volvo Penta D4 diesel engines are produced in Vara, Sweden.



adjustments were made to find the suitable Shore hardness, after which intensive fine-tuning of the conical mount to the structural conditions followed. An optimally adapted mount with integrated console emerged in mid-February 2007. In the end, a product combining a long life with optimum stiffness and fitting perfectly into the available installation space had been developed by the two companies.

Rapid Implementation

The entire project was not only technically very successful, but also implemented in a very short time. Between the start of the cooperation and the delivery of the first mass-produced parts, a mere nine months had passed.

Photos courtesy of Volvo Penta

Yes to waves, no to vibrations: Volvo Penta has calmed down.



A catalog product served as the basis for this customized solution.



Volvo Penta D4: To ensure that the engine vibrations are not transmitted to the boat hull, the drive unit rests on a conical mount from Simrit.

+ In brief

- Mountings on speed boat engines must be as vibration-free as automobile engines are today.
- Together with specialists from Volvo Penta, Simrit carried out simulations to find the best-suited mount.
- Volvo Penta's requirements could not be met with a standard product.
- After just nine months, mass production was started.



Do you have any questions or suggestions? Please contact vera.boehner@freudenberg-ds.com.



Photos courtesy of Thermoplan

Innovations brewing

As suppliers to Thermoplan, one of the world's largest manufacturers of commercial automatic coffee machines, Simrit can demonstrate both its great materials expertise and its flexibility in providing customized solutions.

Automatic coffee machines for commercial use are complex machines with sophisticated mechanics and electronics. They are designed for global hotel empires such as Hilton, fast-food chains and



Special valve with a magnet inside which acts as position sensor

special standardized coffee shops such as Starbucks. The coffee machine specialist Thermoplan grew with Starbucks as its customer. Each of the 13,500 Starbucks outlets currently in operation has at least one automatic coffee machine from the company headquartered in the central Swiss town of Weggis, and this cooperation with Starbucks has just been extended. A new generation of machines called 'Mastrena' was developed for the coffee shop chain. Of course, Thermoplan is not without competitors in this lucrative high-tech market. The Swiss do not have to go far to find their competitors as nearly all

other market participants also are based out of Switzerland. Just like their competitors, the engineers and technicians from Weggis only build a few parts themselves. They are responsible for the overall conceptualization of the automatic coffee machine, but there are specialized suppliers for each individual part.

Food-Grade Materials

Simrit is Thermoplan's main parts supplier for seals. Simrit is currently in the planning phase in terms of the cooperation for the "Mastrena" machine project mentioned earlier. In the preceding "Tiger" project, Simrit has been delivering

critical sealing parts that nearly all had to be composed of materials that were FDA- and NSF-approved, i.e., approved for the food industry. Most sealing parts that Simrit developed for Thermoplan's Tiger project were customer-specific. The Thermoblock seal is a good example. The element must safely seal the entire pouring spout. Dead space is not permitted and the assembly must be simple. Simrit uses the material 70 EPDM 281 because the sealing component comes in contact with steam and milk, as well as with cleaning agents for the machine. The use of conventional vulcanization processes often fails to meet the high food standards (primarily defined in the U.S. through FDA regulations). Thus, the component, which seals the support element for the coffee pods and is made from silicone, must be vulcanized on the metal grid, but for reasons of FDA conformance, can only have a mechanical, not a chemical, bond.

Customized Parts

Commercial automatic coffee machines such as the Tiger model have integrated electric coffee mills. For this, Simrit designed a decoupled gear for the mill drive. "Our parts resist the hot and humid environment arising in the machine during brewing of the coffee particularly well. This contributed to us getting the go-

ahead from Thermoplan," says Steve Barrot, engineer at Simrit and technical consultant for the Thermoplan project. Design of the gear keeps the vibrations as low as possible and simultaneously ensures that the 'grain size' of the ground product remains constant. Except for some O-rings, all elements that Simrit supplies for the automatic coffee machines from Thermoplan are custom-made. The range extends from simple seals for a non-return valve and a slide ring seal for installation without dead space, all the way to a high-performance polyurethane machine leg and a complicated valve with an integrated magnet.

The machine leg was designed in polyurethane because a leg made from the elastomer NBR, as is otherwise commonly done, often leaves ugly marks on the support surface when the machine is moved.

Doing Without Chemical Bonding

When valves are sealed using magnets it must be ensured during manufacture

The sealing components in (commercial) coffee machines must all be approved for use with food. Simrit scores points with Thermoplan through its great variety of materials.



that the vulcanization temperature is as low as possible because otherwise the magnetization is eliminated. "The magnet must be handled very carefully in assembly as well," explains Steve Barrot. With this sealing component, as with the seal for the coffee pod holder, no chemical bonding is allowed.

The sealing components in (commercial) coffee machines must all be approved for use with food. Simrit scores points with Thermoplan through its great variety of materials.

+ In brief

- Thermoplan develops commercial coffee machines for large coffee shop and restaurant chains. One of their major customers is Starbucks.
- In the area of seals, Simrit is their most important parts suppliers.
- Most seals that Thermoplan purchases from Simrit are customized.
- Simrit can especially score high points with its wide range of materials, as many seals come in contact with both steam and cleaning agents.



Do you have any questions or suggestions? Please contact steve.barrot@simrit.ch

We've got the right material

Standardization of installation spaces for hydraulic components in accordance with DIN-ISO and a wide application range: One of the secrets is the great materials competence of Simrit.

If users of hydraulic components had to redesign the installation spaces for the sealing system accordingly when they change the application field and the environmental conditions, that would take up a great deal of time and even more money. Simrit shows how this can be done more easily and economically. The solution is standardization of the installation spaces in accordance with DIN-ISO

and a precisely coordinated product program for sealing components and guides for hydraulic cylinders. The choice of components is greatly facilitated and enables lower-cost cylinder constructions. Using the example of the PRW1 double wiper with integrated pressure relief function for the installation space DIN-ISO 6195 type A, the variability of the standardized product range from Simrit

will be demonstrated in the following. The application diversity results from changing only the material; the sealing component dimensions remain unchanged. In general, such material alternatives are available for many series. For the PRW1 many non-standard wipers and hence expensive reconstruction efforts are unnecessary because the installation space can be retained.



The "Blue": Classic

The PRW1 double wiper is used in diverse applications, the majority of which work with hydraulic oils between -22°F and $+230^{\circ}\text{F}$. In these applications, the standard material 925 (the "blue") is usually sufficient. This material has been on the market for decades and has stood up to the test millions of times over. Outstanding durability and universal application possibilities characterize this mixture.



The "Red": Hydrolysis-Resistant Material V167

With the material V167 (the "red"), Simrit offers a hydrolysis-proof polyurethane. Through the simultaneous compatibility of the red polyurethane with water and hydraulic media, the material is particularly suited to tasks requiring resistance to both water and oil. For example, this enables agricultural and forestry machinery driven with water-based media to be sealed with "red PRW1" just as machines for mining or concrete pumping are sealed.



The "White": Low-Temperature Material 21100

However, there are also applications where the 'blue' reaches its limits. Sometimes excavators, caterpillar-track snowplows or mobile cranes have to withstand night temperatures below -40°F . Even under these extreme conditions, immediate and full functioning of the seals is required. Leaks, however small, are unacceptable for both financial and ecological reasons. In these cases, switching to the low-temperature material 21100 (the "white") is recommended. This material retains its cold flexibility even at temperatures of -40°F and below.

Simrit offers a portfolio of fire-proof materials for use in areas where sealing is required to contain a 2000°F flame for 15 minutes.



Safely sealed against the heat

A fireproof portfolio: Simrit creates innovative material solutions for extreme temperature applications

As a full service supplier, Simrit offers its customers material and sealing solutions that are as individual as the application/environment in which they are used. For extreme temperature environments, Simrit offers a portfolio of fireproof materials for use in areas where sealing is required to contain a 2000 degrees Fahrenheit (1094 degrees Celsius) flame for a minimum of 15 minutes. These materials can be vulcanized to a minimum thicknesses of .250 inches (6.35 mm) and have been designed and manufactured without the use of traditional fireproof fabrics to provide a cost-effective solution with maximum value. For applications that require a lower weight solution, Simrit has developed a range of fireproof materials that are qualified for applications with a minimum thickness of .032 inches (.81 mm).

Customized Solutions

For applications that require customized material solutions, Simrit works with its customers throughout the design process to ensure the end product meets or exceeds the manufacturer's unique requirements and expectations. As an example, Simrit partnered with a major very light jet provider in North America to develop a fire barrier silicone material

for the sealing of aircraft engine firewalls. The new material solution eliminates the need for traditional silicone/ceramic fabric constructions, while also providing significant cost savings—\$146,000 annually when full volume ramp is reached. This solution provides optimum functional value at the lowest cost. Developed for use in areas that are required to be fire proof, the Simrit solution has been tested to the requirements of FAA Circulatory AC20-135, showing compliance to 14 CFR Part 23, §23.1191, 23.1301 and 23.1309. Both the material and the product are FAA- and EASA-approved for use as

fireproof and fluid susceptible solutions for aircraft. The material also offers excellent low temperature resistance to as low as negative 55 degrees Celsius, assuring that the material will perform its function at both minimum and maximum operating altitudes.

Our Customers Trust in Us

Simrit was the supplier of choice based on its ability to offer a solution with maximum value at a competitive price. This solution is just one example of the "out of the box" thinking that is typical of Simrit's culture.

In brief

Standardization of installation spaces for hydraulic components helps save time and money.

Simrit offers the PRW1 double wiper in various materials for diverse application areas.

The special material properties of the PRW1 are easily identifiable by the different colors.



Do you have any questions or suggestions? Please contact philipp.frey@freudenberg-ds.com

In brief

The Simrit portfolio of fireproof materials delivers a cost-effective solution with maximum value.

Simrit provides customized products for manufacturer's unique requirements.



Do you have questions or suggestions? Please contact todd.blair@simrit.us

Simrit fireproof materials and products are FAA- and EASA-approved for aircraft applications.

Radial shaft seals in an oil bath

Lubricants have to be adapted precisely to gear wheels and bearings as well as to radial shaft seals and other sealing components; otherwise failure is predestined. Practically all lubricant and oil manufacturers can test their lubricants on Simrit's test benches

In the selection of a suitable material for a radial shaft seal, apart from the temperature range in which the sealing component should be used, the liquid or gas-forming media the material will come into contact with must always be considered. These media affect the swelling behavior or shrinkage and the chemical stability of an elastomer and thereby the performance capabilities of a sealing component. Lubricant manufacturers face special challenges in the development of new lubricants. They must satisfy a large number of conflicting

requirements with a lubricant formula. In view of the high costs of such a development, the possibility of incompatibility between seal and lubricant only being discovered at the end must be avoided. Tests accompanying development are absolutely necessary.

Defined Limits for Interactions

An initial indication of the compatibility of an elastomer with a lubricant is gained through a static immersion test in accordance with DIN 51517. By means of changes in hardness, volume,

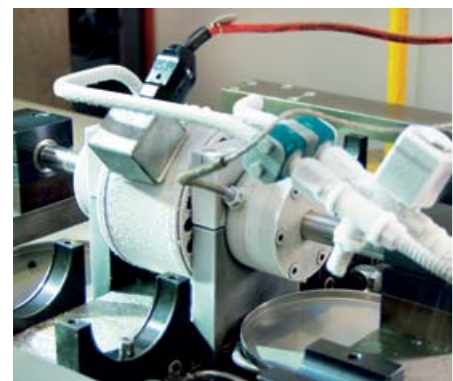
tensile strength and elongation at fracture before and after immersion, the seal manufacturer can make use of its lengthy experience to draw conclusions about expected interactions or material suitability. Exceeding the following limits often signals detrimental interactions: Change in hardness from ± 5 Shore A, change in volume from -2% to $+5\%$, maximum change in tensile strength of -50% , maximum change in elongation at fracture of -60% .

Static Tests Are Insufficient

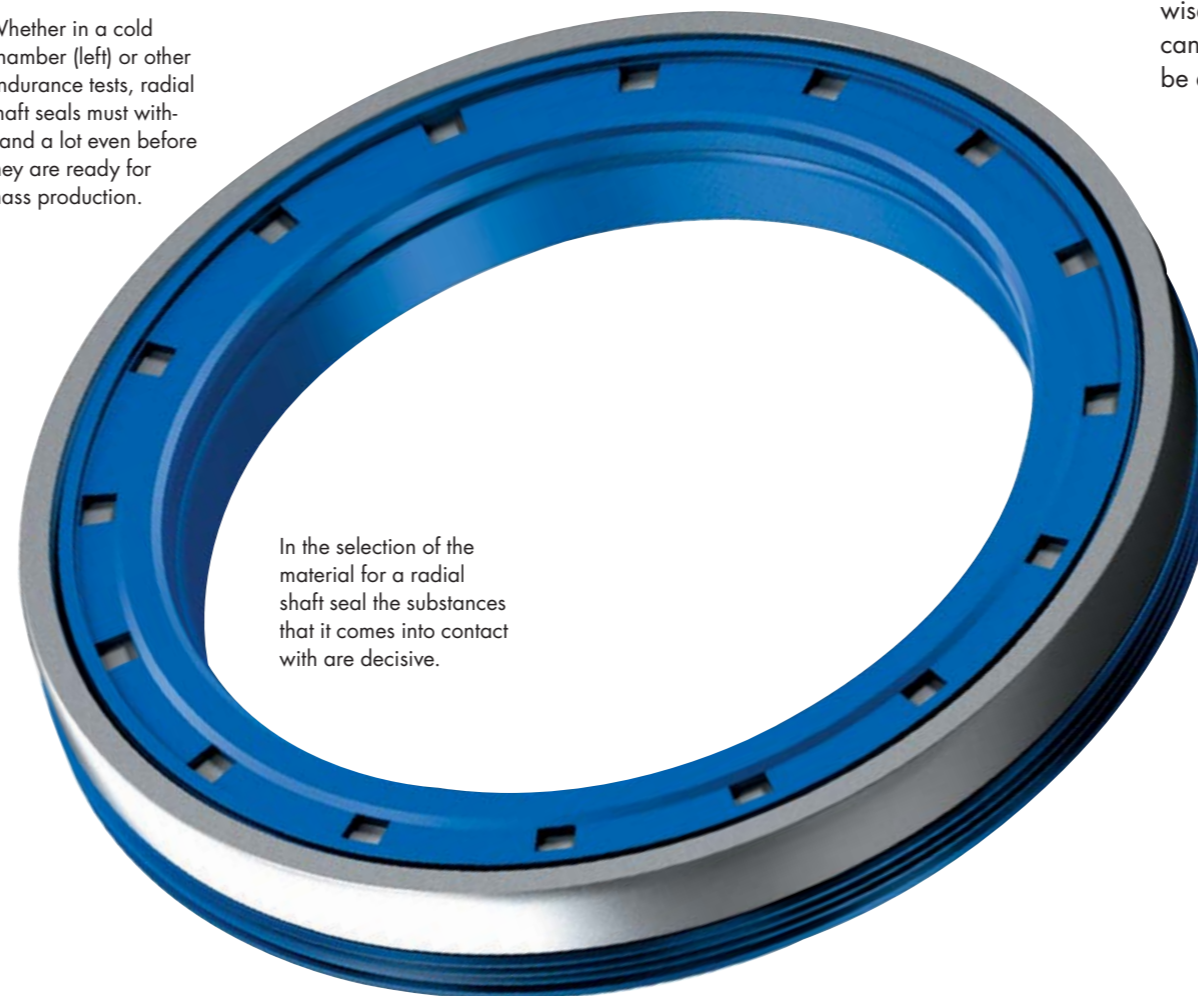
In the area of engines and gears, ever-higher demands are being placed on the seal materials. Apart from containing a wide variety of base oils, the new synthetic oil generations have higher additive contents which serve to increase the long-term stability and function of the lubricant and to prevent corrosion, contamination and foaming. At the same time the "additive packages" can chemically attack and destroy the seal material. Increasing temperature application ranges from -40°F to $+347^\circ\text{F}$, longer engine oil change intervals, and the trend towards fully synthetic lubricants demand specially tested materials. Given this, it has been recognized that static material tests considered in isolation are only of limited use. Apart from static tests providing initial indications of possible interactions between the radial shaft seal and the lubricant, dynamic seal investigations are carried out in Simrit's



The radial shaft seals test fields at Simrit are equipped with many special installations, as well as standard test benches.



Whether in a cold chamber (left) or other endurance tests, radial shaft seals must withstand a lot even before they are ready for mass production.



In the selection of the material for a radial shaft seal the substances that it comes into contact with are decisive.

test laboratories. For instance, crack and blister formation on the sealing edge of a radial shaft seal due to lubricant incompatibility can never be simulated via a purely static test. Likewise, the wetting behavior of the lubricant with the radial shaft seal can only be evaluated through a dynamic test.

Practically all lubricant and additive manufacturers make use of these testing possibilities and have the compatibility of their products with the radial shaft seals tested in the test field prior to market introduction. This close cooperation with customers on the one hand and manufacturers of complementary products on the other hand is one of the quality factors of radial shaft seals.

Extensive Testing Possibilities at Simrit

In cooperation with gear and lubricant manufacturers, Simrit has established a service in which the functional relationships between seals and lubricants are investigated in standardized test series. Through this, Simrit's customers can be offered a coordinated "seal plus lubricant" system. By performing tests in advance, lubricant manufacturers are able to place new, but already tried and tested, products on the market.

In brief

- The compatibility of lubricants with sealing components such as radial shaft seal must be tested.
- Static immersion tests in accordance with DIN 51517 provide preliminary indications of compatibility.
- The compatibility of modern gear and engine oils with radial shaft seal and other sealing components can only be determined using additional dynamic tests.
- Practically all lubricant manufacturers have their products tested for compatibility with the sealing components in Simrit's testing laboratories prior to market introduction.



Do you have any questions or suggestions? Please contact matthias.arnold@freudenberg-ds.com.

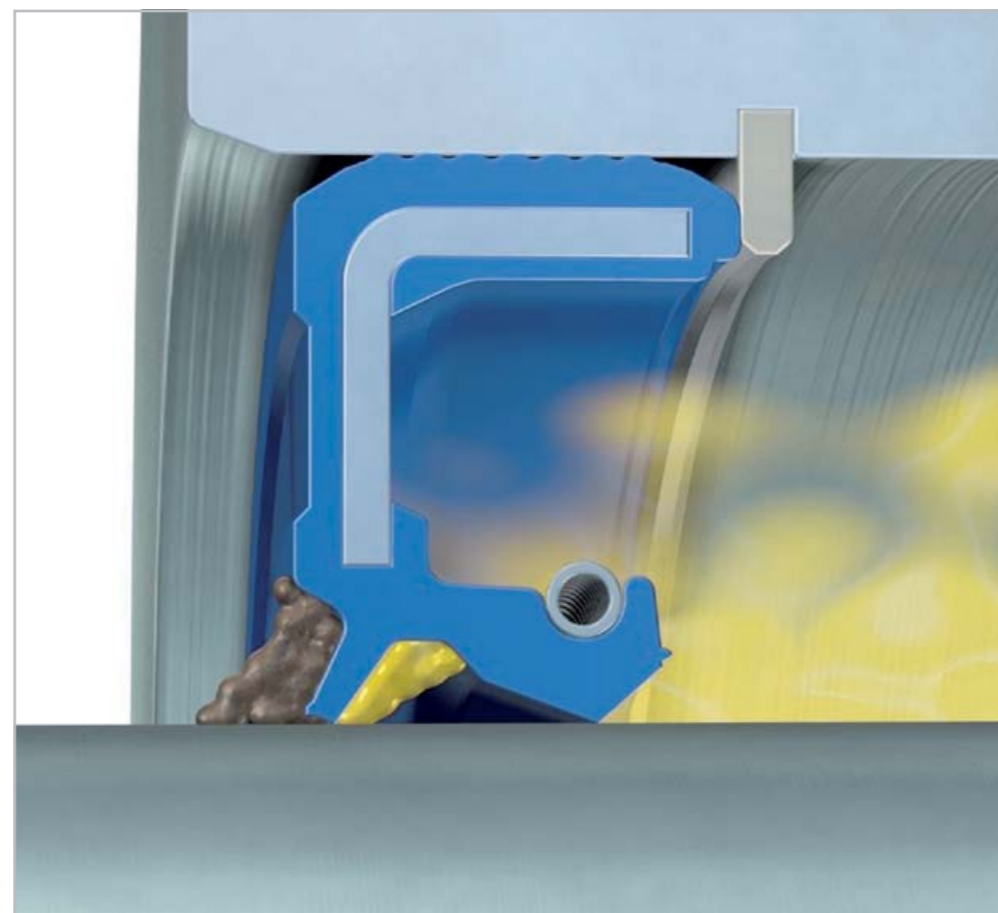
The tribological system: behind the scenes

An ideal interplay between elastomer seal, mating surface, and lubricant reduces wear. Through this the costs of service and maintenance are reduced and the lifetime extended. Simrit always designs its sealing elements with these overall interdependencies in mind.

Dynamic seals must be able to maintain a lubricant film for as long as possible in operation and must exhibit low friction and no leaks. The interplay between friction, wear, and lubrication is termed a "tribological system" and plays an important role in the functioning and lifetime of seals. In practice, tribology deals with friction and wear and serves towards optimization of moving mechanical systems such as gears, engines, and other machine elements. The range extends from an increase in performance and efficiency to a reduction in energy consumption through a reduction in friction and conservation of resources all the way to an increase in reliability and service life and lowering

of service and maintenance costs. The tribological properties of elastomers (behavior in terms of friction and wear) are influenced both by the material itself and by the condition of the mating surface, the stress conditions such as temperature, speed and contact pressure, and the lubricant.

The tribological system describes the interplay between friction, lubrication, and wear.



Principles of Friction

In order for an optimum lifetime to be achieved for the friction partners, all components of the tribological system must be coordinated. Further development of only one of these components usually does not lead to success. In general, various phases of friction are distinguished (see the figures following). Due to its viscoelastic properties, the elastomer is capable of "creeping into" the depressions in the mating surface. When the system is started not all contact areas overcome the static friction simultaneously and start moving against one another at the same time. The breakaway forces must be overcome; hence an excessively high coefficient of friction is usually observed. The phrase "steady sliding" is used if the complete contact surface has broken free. This run-in process is characterized by a lower coefficient of friction than the starting value.

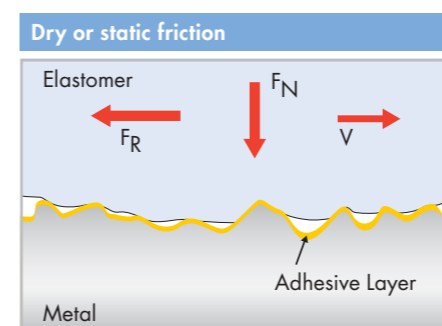
With dry friction, the sliding surfaces touch each other. Surface protrusions are thereby flattened (erosion or wear). Depending on the composition, the elastomer contains more or less abrasive fillers which result in wear of the mating surface (e.g., contact surface of a moving seal). With unfavorable material pairs

and a high surface pressure, the surfaces adhere to each other (adhesion) and mechanical interlocking results, thereby increasing wear. Dry friction occurs, for example, if no lubricant is used or if the lubricant fails. Mixed friction can occur in the case of insufficient lubrication or at the start of motion of lubricated friction pairs. In this case, the sliding surfaces contact each other only at specific points. The frictional force is lower for both mixed friction and fluid friction than for dry friction. Wear, however, is higher than for pure fluid friction. This condition is avoided wherever possible in continuous operation, although occasionally without success. If static and sliding friction alternate periodically, a so-called stick-slip effect is occurring. This transition is undesirable and is frequently accompanied by noise, for example, squeaking. Depending on the temperature and speed, elastomers have a greater or lesser tendency towards stick-slip.

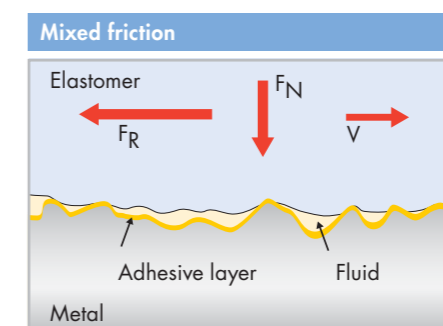
Fluid friction occurs when a continuous lubricant film forms between the sliding surfaces. Typical lubricants are oils and water, but also gases. The sliding surfaces are completely separated from one another. The friction which arises is caused by the fact that the lubricant molecules slide past each other. In order for the arising shear forces to lead only to a moderate increase in lubricant temperature, the generated heat must be suitably dissipated. Depending on the lubricant film thickness, the coefficients of friction can increase with increasing speed.

Interactions Between the Elastomer and the Lubricant

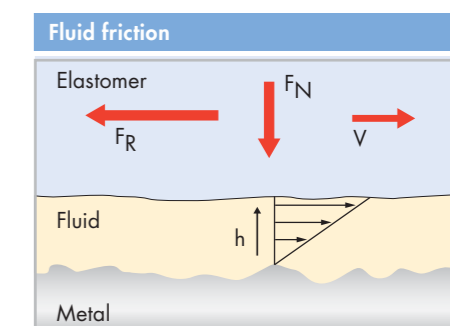
The basis for the chemical and thermal stability of elastomers is the selection of a suitable base polymer. Due to rising operating temperatures and greater lifetime requirements, synthetic lubricants with higher additive contents are increasingly being used. This can result in chemical reactions between the elastomer and the lubricant or operating media, leading to surface decomposition or changes in the properties of the material. The consequence of this for dynamic seals can be dry wear of the elastomer at the sealing edge, leading to insufficient lubrication. The resultant increase in friction causes the temperature at the sealing edge to increase. This can lead to damage of the elastomer network and hence to a reduction in lifetime. Simrit has a multitude of different friction and wear test benches available for simulating translational and rotational motions. Effects occurring in this connection, including the "stick-slip" effect, run-in behavior, adhesion effects and friction behavior, can be modeled over a wide range of temperatures and speeds. This allows for precise materials characterization as well as determination of the interactions between the seal and the lubricant.



Schematic illustration of friction: the friction force is the greatest in dry or static friction.



"Mixed" friction involves point contact of the sliding surfaces. This can occur if lubrication is insufficient.



Fluid friction occurs when a continuous lubricant film forms between the sliding surfaces.

In brief

- A three-part harmony of friction, lubrication, and wear lowers costs of service and maintenance.
- Simrit can investigate the behavior of elastomers in various conditions.
- Influencing factors include the material, the temperature, contact pressure, speed and lubricant.
- In close cooperation with the customer, Simrit can achieve system solutions for the most diverse of requirements.



Do you have any questions or suggestions? Please contact meike.rinnbauer@freudenberg-ds.com

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"Stihl products are directly linked with our natural surroundings. Our unique low-emission engines provide a distinct ecological advantage and Simrit's sealing design expertise and extensive testing capabilities ensure optimum performance. Innovative Simrit products put a reliable seal on both our technology and our commitment to the environment."

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