Green sealing

Explore how Trelleborg products contribute to a greener environment.

Service
Totally interactive

Trelleborg Sealing Solutions has developed a number of online tools that make the working life of an engineer specifying seals easier.
Trelleborg takes its responsibility for the environment very seriously. The Group’s corporate responsibility work spans the entire area of sustainability, in other words environment, health and safety issues as well as ethical relationships with employees, the market and society. Trelleborg Sealing Solutions is able to carry these ideals forward. Explore how Trelleborg products contribute to a greener environment.

**Green sealing**

Trelleborg Sealing Solutions worked with semiconductor equipment maker AP&S to create, for a wafer carrying capsule, a sealing system that is proven to have virtually zero leakage.

**Service**

**Totally interactive**

Trelleborg Sealing Solutions has developed a number of online tools that make the working life of an engineer specifying seals easier.

**Semiconductor**

**Handled with care**

Trelleborg Sealing Solutions worked with semiconductor equipment maker AP&S to create, for a wafer carrying capsule, a sealing system that is proven to have virtually zero leakage.
New rotary seals catalog
Low-temperature aerospace compound launched

No room for improvement
SAE elects Krebs
World Expo Shanghai 2010

Concrete proof of success
The German company Putzmeister developed a range of mobile solutions for delivering concrete including a record-breaking truck-mounted pump, with a little help from Trelleborg Sealing Solutions.

Polyurethane wearing well
Zurcon® polyurethane seals are ideal in high-wear situations. Here we give an overview of this type of sealing material's benefits.

It's all in the geometry
Molding allows Zurcon® polyurethane material to be formed into seals in a wide variety of different geometries.

Well-sealed in flight
Trelleborg Sealing Solutions has responded to more challenging sealing requirements in aircraft hydraulic flight controls with enhanced sealing materials and optimized seal designs.

Better than a nano
Trelleborg Sealing Solutions proves through research that traditional fillers outperform nanoparticles as additives in Turcon®.

Concrete proof of success
The German company Putzmeister developed a range of mobile solutions for delivering concrete including a record-breaking truck-mounted pump, with a little help from Trelleborg Sealing Solutions.

Polyurethane wearing well
Zurcon® polyurethane seals are ideal in high-wear situations. Here we give an overview of this type of sealing material's benefits.

It's all in the geometry
Molding allows Zurcon® polyurethane material to be formed into seals in a wide variety of different geometries.

Well-sealed in flight
Trelleborg Sealing Solutions has responded to more challenging sealing requirements in aircraft hydraulic flight controls with enhanced sealing materials and optimized seal designs.

Better than a nano
Trelleborg Sealing Solutions proves through research that traditional fillers outperform nanoparticles as additives in Turcon®.
New Rotary Seals Catalog

In its more than 300 pages, our new Rotary Seals catalog has information on virtually the complete range of rotary seals offered by Trelleborg Sealing Solutions. Details of our proprietary products and materials have been completely updated and the catalog includes part numbers and recommended materials, as well as advice on design and installation.

The Rotary Seals catalog is available online. To download it free-of-charge, go to www.tss.trelleborg.com/rotary_seals_catalog

Or you can order a printed version from your local Trelleborg Sealing Solutions marketing company. To find the nearest marketing company to you go to www.tss.trelleborg.com/worldwide.

Low-temperature aerospace compound launched

The new VCT11 sealing compound from Trelleborg Sealing Solutions is a specially engineered low-temperature fluorocarbon (FKM) material. It is ideal for aerospace engine applications requiring high-temperature performance combined with low-temperature capabilities, something older generation FKM materials cannot achieve.

Meets AMS 7379 low temperature requirements

Operating at temperatures below -40°C/ -40°F, VCT11 is one of only a few materials that meet the requirements of AMS 7379, the globally recognized specification for low-temperature FKM. With an unrivalled low compression set, it has outstanding stability and uniquely, the material is available as O-Rings and seals in a variety of geometries and gaskets. This offers the engineer greater flexibility in component design.

Compatibility with aviation fuels is excellent, and VCT11 is also proven in tests to be resistant to High Thermal Stability (HTS) oils. These complex synthetic oils contain antioxidants and additives which can cause embrittlement and deterioration of FKM, inhibiting their function.

Typical applications: Gearboxes, lubrication, scavenge and fuel systems

Aerospace
No room for improvement

They’ve done it before and they did it again.

Trelleborg Sealing Solutions in Fort Wayne, US continued its trend of flawless audits. In October, the three and a half-day surveillance audit for ISO 14001 Environmental was completed with no findings. In November, the three-day reassessment audit for ISO AS9100 Aerospace and the two-day surveillance audit for ISO TS16949 Automotive were completed with no findings. With the completion of these audits, Fort Wayne has achieved an outstanding record of seven consecutive 100 percent perfect audits!

“The auditors expressed their delight with personnel moral, plant layout and ergonomics, training and workmanship and the maturity and strength of the Quality Management System,” says Frank Williams, Quality Manager. “The strive to make it easier to do business with Fort Wayne continues through system automation improvements such as online certifications, quote turn-around and electronic air worthiness approvals.”

SAE elects Krebs

Georg Krebs, Product Manager for Aerospace at Trelleborg Sealing Solutions, Helsingør, Denmark was elected as the Chairman of the Seals Panel at a recent meeting of the SAE Committee A-6, Aerospace Actuation, Control and Fluid Power Systems in San Antonio, Texas, US.

An active participant in SAE work for many years, Georg was chosen because of his expertise in sealing systems for primary flight controls, especially fly-by-wire and electronic hydraulic actuators for the A330/340 and A380.

About SAE and the A-6 committee

SAE International (SAE), formerly the Society of Automotive Engineers, is a professional organization for mobility engineering professionals in the aerospace, automotive, and commercial vehicle industries. It is a standards development organization for the engineering of powered vehicles of all kinds. This A-6 Committee addresses all facets of aerospace fluid power, actuation and control-design, maintenance and in service experience.

World Expo Shanghai 2010

Next year, Trelleborg is one of the official partners of the Swedish Pavilion at what is expected to be the biggest World Expo ever. It will be held in Shanghai, China from the beginning of May through the end of October, with over 200 countries and organizations participating in the event, and 70 million visitors are forecasted to attend, mostly from China.

As a teaser for the big show the Sweden Expo Week was held in November this year. The spotlight was on the Swedish theme for the Expo, “Spirit of Innovation.” Prominent Swedish companies operating in China, such as Trelleborg Group, IKEA and Ericsson were there demonstrating how a culture of constant innovation makes them successful.

For more information on Sweden’s involvement in the World Expo go to www.exp02010.se/en
Trelleborg Sealing Solutions has developed a number of online tools that make the working life of an engineer specifying seals easier.

There are now over one and a half billion internet users worldwide; that’s virtually one quarter of the global population. Without a doubt, the internet has become an important part of people’s lives and for the majority an essential tool which has transformed the way they work.

“We spent a considerable amount of time trying to decide the best way of utilizing the web to provide value-added services to the engineer,” says Robert Zahiri, Manager Global Marketing and Communications. “The focus for development was on making the engineer’s job easier and over the past few years we have launched a series of online tools that achieve this.

“We began with the O-Ring Calculator which has had a number of enhancements in line with our customers’ expectations. This was followed with our highly regarded and much used CAD Service. After that we added our Electronic Catalog along with a Materials and Chemical Compatibility check. Our most recent introductions are the unique Sealing Solutions Configurator and an online shop for Mechanical Face Seals.”

All these industry-leading online tools are available free-of-charge from the Trelleborg Sealing Solutions website at www.tss.trelleborg.com. To use these advanced services all you have to do is register on the Members Area.

Register now!!
The Trelleborg Sealing Solutions Members Area gives you access to a unique range of online services:

- **Sealing Solutions Configurator** - Recommends the seals that will work best in your application
- **O-Ring Calculator** - Allows easy specification of seal dimensions
- **Electronic Catalog** - Search for more than 100,000 products, get detailed product information and submit a request for quotation online
- **Materials Check** – Helps identify the most suitable material for your application
- **Chemical Compatibility Check** – Find out the compatibility of sealing materials to hundreds of different media
- **CAD Service** - More than 40,000 parts online, in 2D and 3D, in many different file formats

**Internet Usage Worldwide**

| Users globally (June 2009) | 1,668,870,408 |
| Penetration of global population | 362% |
| Penetration of Americas population | 25% |
| Penetration of European population | 74% |
| Percentage of global users in Asia | 50% |
| Percentage of global users in Asia | 42% |

Source: www.internetworldstats.com
Why worry about finding the right seals for your application, when Trelleborg Sealing Solutions can provide you with the solution… at the click of a mouse. Whatever your industry, wherever the seal is needed, our unique Sealing Solutions Configurator can recommend the optimum sealing configuration for your application.

The Sealing Solutions Configurator is the first tool of its kind offered by any seal supplier and allows engineers to identify a proven sealing solution for their specific application.

The right sealing solution…

at the click of a mouse

The innovative Sealing Solutions Configurator combines the expertise Trelleborg Sealing Solutions has gathered over 50 years of meeting sealing challenges in one intuitive program. Using the Sealing Solutions Configurator you can feel confident in finding the right sealing solution for your application, without spending hours going through catalogs. In just four easy steps you can find the optimum sealing solution in minutes, at the click of a mouse, 24/7.

To find your recommended solution...

1. Simply choose your industry
2. Then the equipment for which the seal is required
3. Next select the solution type
Recommended sealing configurations can be stored in your “My Projects” area.

You can access the solution at a later date from there and use other services like: download related CAD files, create a PDF of the configuration, issue request for quotation or additional technical information.

It’s even possible to discuss your configuration online with one of the technical experts from your local Trelleborg Sealing Solutions Marketing Company.

New equipment is continually being added to the Sealing Solutions Configurator. If you subscribe to our newsletter at www.tss.trelleborg.com we’ll keep you updated.

And the operating parameters

That’s all that is required. Less than a second later you’ll have our recommended solution along with possible alternatives.
**O-Ring Calculator: Saving time and energy**

The O-Ring Calculator provides an easy method of calculating O-Ring specifications and housing designs.

The innovative O-Ring Calculator software from Trelleborg Sealing Solutions enables you to calculate O-Ring dimensions by simply entering installation specifications for your application. With its unique functions, it is wholly intuitive and remarkably easy to use.

**The calculator offers the following functions:**

- Calculation for installation types - axial sealing, inner and outer radial sealing.
- Metric and inch sizes
- Wide range of materials included
- ISO Quick Search Button - gives an O-Ring recommendation conforming to ISO 3601-1 and the housing conforming to ISO 3601-2
- O-Ring Quick Search Button - gives O-Ring nominal sizes according to national/international standards:
  - ISO 3601-1, AS568C (USA), JIS B 2401 (Japan) NFT 47-501 (France), SMS 1586 (Sweden)
  - O-Ring tolerances according to ISO 3601-1 Class B
  - Design recommendations applicable to calculation results can be obtained by clicking on the i-buttons
  - Calculation results, data input and detailed drawings generated can be easily saved within the application, printed in PDF format or forwarded by email with the option to add your own comments.

**Shop online**

Mechanical Face Seals can be ordered from the Trelleborg Sealing Solutions E-Shop.

The Spare Parts E-Shop is open at www.face-seals.com. This innovative facility allows customers to choose from a selection of Mechanical Face Seals made from roller bearing steel and Nitrile Butadiene Rubber (NBR). Selection is quick and easy either by size cross references of equipment manufacturers and seal suppliers or seal dimensions. It also provides express delivery, convenient payment and a technical information hotline.

![www.face-seals.com](image)

**Browse and request a quote**

The electronic catalog makes identifying the right seal easy and allows you to request a quote over the web.

Our powerful electronic catalog allows you to search for seals by item number or by their properties, such as type of seal, installation dimensions or approvals, to find the best product to suit your needs.

Once you know the product you require, then request a quotation online. A simple to use service lets you load up a shopping cart and send it through to your local Trelleborg Sealing Solutions marketing company for quotation. You are guaranteed a rapid response, making the whole process of specifying and ordering seals easier and quicker than ever!
Delivering the large amounts of concrete needed in today’s ambitious construction projects often demands high pumping speeds over great distances in confined spaces. The German company Putzmeister developed a range of mobile solutions, including a record-breaking truck-mounted pump, with a little help from Trelleborg Sealing Solutions.

In short...
- Last year, Putzmeister Concrete Pumps GmbH launched the largest truck-mounted concrete pump in the world, the M 70-5.
- Montanhydraulik GmbH supplies the hydraulic cylinders and Trelleborg Sealing Solutions provides the seals for these.
- Seals that demonstrated durability and reliability were used to meet demanding sealing requirements in the M 70-5 such as withstanding vibration and leak-tightness.

Record-breaking concrete pumping

Putzmeister’s major customers are the larger rental firms, since it is usually more economical for a contractor to hire such construction machinery rather than buy it. The company has played a role in some impressive engineering feats over the past few decades, such as the 55-floor Torre Mayor in Mexico City and the St. Gotthard Tunnel in Switzerland. In fact, the company holds the current record for a concrete pumping height of 606 m/ 2,000 feet, set in 2008 during construction of the Burj Dubai tower.

Coinciding with the 50th anniversary of the company’s foundation last year, Putzmeister set a new record with the biggest truck-mounted concrete pump boom in the world, the M 70-5. Featuring a vertical reach of around 70 m/ 230 ft and the largest working radius ever achieved, the machine is fitted with large-capacity twin-cylinder piston pumps that can attain a maximum output of 200 m³/ 260 yd³ per hour.
The five-section boom in an RZ-fold configuration has a vertical reach of around 65 m/ 214 ft. When operating in a restricted space, the boom can be completely unfolded above the area where the truck is parked. During pumping operations, the cab unit remains rigidly connected to the trailer so as to act as a counterweight and further improve stability.

**Hydraulic cylinders from Montanhydraulik**

To reduce the load moment of the huge boom, Putzmeister uses special high-strength yet lightweight materials both in the steel frame of the M 70-5 and for the hydraulic cylinders that extend the boom. Designing and manufacturing such cylinders for weight-optimized and safe applications is the core competency of Montanhydraulik GmbH.

The German-based company has been supplying Putzmeister for around 20 years with the cylinders used in its concrete pumps, including the new M 70-5. Founded in 1952, Montanhydraulik employs around 1,000 people at its eight sites over two continents. The company develops hydraulic cylinders and systems tailored to customer requirements, carrying out experiments on its own test benches as well as monitoring the products in operation at the clients’ sites. The results obtained are then used to further develop Montanhydraulik’s leading products.

**Over twenty years of teamwork**

These results are also passed on to Montanhydraulik’s suppliers, which include Trelleborg Sealing Solutions, who provides the company with seals, scrapers and Wear Rings. The head of Engineering & Design at Montanhydraulik GmbH, Gerd Erdmann, explains that “Trelleborg Sealing Solutions supplies exactly the right components for our applications, while maintaining a constant high quality. What’s more, they also develop and improve on their existing sealing systems.”

The two companies have been cooperating for over 25 years, so Montanhydraulik knew which Trelleborg Sealing Solutions products to use when it came to equipping the M 70-5 for Putzmeister and immediately selected the heavy duty option. Montanhydraulik demands as standard that its seals demonstrate little or no extrusion. They also need to withstand pressures of up to 50 MPa/ 7,250 psi and operate in temperatures of -40°C to +80°C/ -40°F to +176°F. Specifically the M 70-5 needed seals that retained their tightness even under the harsh conditions caused by vibrations within the boom.
Controlling the vibes

“Vibrations are always a problem in concrete pumps, due to the very nature of the load,” notes Gerd Erdmann, “so when you have such a long boom as found on the M 70-5, you have a lot of vibrations to contend with. Fortunately, our many years of experience with Trelleborg Sealing Solutions meant we could be sure of finding the right product – without losing time experimenting.”

Martin Gusenbauer of Engineering & Design at Putzmeister Concrete Pumps GmbH adds that the M 70-5 also required a tighter seal in the boom due to the fact that the cylinders, like the conveyor belts, visibly sag under gravity while being extended horizontally. This means additional wear and tear and can lead to various degrees of deflection in the end hose.

Seals from Trelleborg were chosen on a cost-performance ratio

Putzmeister chose Trelleborg Sealing Solutions after experiencing problems with their former supplier. “We conducted a series of trials in 2003 with a number of candidates,” recalls Gusenbauer. “Our decision to use Trelleborg Sealing Solutions was based on cost-performance ratio and the expert advice Trelleborg was able to offer.” In line with Putzmeister’s own after-sales service – which promises replacement parts delivered directly to the building site within 24 hours, worldwide – it was also imperative that the new supplier could provide components quickly and globally.

Upon winning the contract, the engineers at Trelleborg Sealing Solutions would have been willing to develop new cylinder seals together with Putzmeister, but this ultimately proved unnecessary. “We have always found a product from among those already available,” says Gusenbauer, adding that their current pipeline projects also make use of tried-and-tested Trelleborg Sealing Solutions products.

Sealing configuration uses a variety of advanced seals

Trelleborg Sealing Solutions products used in Putzmeister concrete pumps include Turcon® Glyd Ring® T, Turcon® Stepseal® 2K and Zurcon® Rimseal in its cylinders and pistons, while Turcon® Slydring® is used in the company’s conveyors. In terms of static seals, Putzmeister favors Zurcon® Dualseal between the guide bush and cylinder tube and between the piston and piston rod.

When prompted, Martin Gusenbauer does remember one occasion when a standard seal needed refining. A problem was discovered with a cylinder seal while operating at the extremely cold temperatures found on some construction sites. “The experts at Trelleborg Sealing Solutions quickly remixed the sealing material and there has not been a problem since,” he is pleased to report.
Explore how Trelleborg products contribute to a greener environment.

Seals from Trelleborg Sealing Solutions are used in many critical applications in wind turbines. More details on solutions from Trelleborg Group are given in our special wind power article beginning on page 36.
Cleaner energy

From 2000 to 2014, the number of new wind power facilities is expected to grow from 5,000 to 23,000 worldwide, with wind farms located both on land and offshore. Older and smaller facilities will be replaced by new, more efficient ones that will generate more than double the power of their predecessors, decreasing the cost of wind power.

Seals for these turbines need to provide low friction, long life, zero leakage and easy installation, with meantime between maintenance being a key requirement.

Effective sealing in biofuels

In the future, biofuels will be the source of 10 percent of the world’s fuel. Biofuels are liquid fuels made from organic matter, typically crops, and they include Biodiesel, Bioethanol and BTL (Biomass-to-Liquid). Biofuels can have a significant effect on sealing in fuel systems, engines and exhaust systems.

For example, the addition of ethanol in high-pressure gasoline applications increases the possibility of rapid decompression failure. The resulting cracks dramatically reduce the integrity of seals and are difficult to detect while still subsurface. These challenges can be met with the right material compound selection. Trelleborg Sealing Solutions has undertaken substantial research, which means that we can recommend the optimum sealing solutions for biofuel applications.
Solar energy is brought to life

The sun is the best source of energy we have. In fact, in just one hour it can potentially provide our planet with all the energy its inhabitants demand over an entire year. Not only can the sun provide us with all of our energy needs 10,000 times over, it can also do so without the disadvantages of fossil fuels, such as polluting the air or depleting the ozone layer. And best of all, this is one resource that will never run out – at least not for the next five billion years.

As a result, solar photovoltaic is the fastest growing renewable energy technology on earth, the industry witnessing a 60 percent market growth in the period between 2000 and 2004. The specialized sealing products offered to this industry include O-Rings and custom-engineered components manufactured from low outgassing fluoroelastomers and Resifluor™ high-performance fluoroelastomer materials, along with Turcon® Variseal® spring-energized seals, other sealing profiles in Turcon® PTFE based material and Airseal®.

All of our sealing products are tested at independent institutes and certified accordingly. They display a high thermal resistance coupled with extremely low outgassing. This makes them ideal for use in equipment for the manufacture of solar cells, modules and wafers, where process contamination needs to be kept to a minimum.

Hydro Power is Possible

Hydroelectricity is electricity generated by hydropower: the production of power through use of the gravitational force of falling or flowing water. It is currently the most widely used form of alternative energy. Hydropower provides 20 percent of the world’s electricity. It is a clean, renewable energy source and does not contribute to global warming.

Orkot® self-lubricating bearings are replacing classic greased bronze bearings on new and refurbished Francis, Kaplan, Pelton, Pump and Bulb turbines, allowing a cleaner downstream environment.

Trelleborg Sealing Solutions supplies bearing materials for a wide range of hydro applications including; wicket gate bearings, water-lubricated turbine main shaft guide bearings and pump bearings, servomotor bearings, linkage bearings, Kaplan hub bearings, operating ring wear pads, thrust washers, wheel bearings, fish screen bearings, trunnion bearings, and lock gate bearings.
Less smog

Vehicles are one of the main sources of Nitrogen Oxide (NOx) emissions. For example, according to the United States Environmental Protection Agency, mobile sources (vehicles) are responsible for more than half of all NOx emissions in the United States. NOx can travel long distances, resulting in health and environmental impact in locations far away such as increase in ozone and creation of smog.

Exhaust Gas Recirculating (EGR) systems aid smog reduction by helping cut down Nitrogen Oxide (NOx) expelled into the atmosphere. They do this by diverting exhaust gases back to the air intake of an automobile to burn exhaust gas twice.

Trelleborg Sealing Solutions meets the challenge of sealing EGRs in engines. Turcon®, our proprietary PTFE based material range, is ideal in these applications as it is compatible with virtually all media, operates at extreme temperatures and withstands high pressures.

Cleaner Water

Orkot® self-lubricating bearings, bushings and custom shapes are replacing classic greased bronze bearings, rubber lined cutlass bearings, rollers, wear pads and many other shapes in a myriad of applications in the marine industry. Orkot® Marine products are self-lubricating, eliminating the use of environmentally-damaging grease.

These products are subjected to wet (salt and fresh water) and dry conditions, heavy side loads, misalignment and impact loads during their normal operating cycles. Bearing pressures can be as high as almost 138 MPa/ 20,000 psi without grease or water lubrication. The low-friction capacity of Orkot® bearings allows the material to operate completely dry or in submerged conditions. Its excellent mechanical strength and wear resistance enables it to perform with virtually no swell in water. Furthermore, Orkot® Marine products weigh much less than their metallic predecessors, thereby reducing energy consumption leading to a cleaner environment.

Trelleborg Group business concept – Corporate Responsibility

Through our polymer solutions that seal, damp and protect, Trelleborg contributes to the development of society in the environment and health and safety areas. At the same time, we work to prevent and minimize the environmental impact of our operations. This makes us different and well equipped to meet future challenges.
Less air pollution

While pollution from aircraft is currently less than three percent of total environmental pollution, increased air travel is likely to expand this share significantly in the future. To counter this, aerospace engineers are designing systems with improved efficiency.

Advanced primary flight control surfaces are now continuously activated to maintain safe aircraft control and flight operations. Signals are generated electronically to continually adjust the aircraft. Constant short-travel, high-frequency movements are known as dither strokes, which place unique demands on seals and seal components.

Typical operating pressures reach up to 20 MPa/3,000 psi, with some new platforms reaching 35 MPa/5,000 psi while temperatures range from −54°C to +135°C/−65°F to +275°F, and on the latest aircraft up to +163°C/+325°F.

Our proven sealing polymers and seal designs satisfy aggressive requirements for flight control sealing applications. Sealing systems provide leak-tight performance; ensuring fluids do not contaminate the environment. Sealing systems also provide low-friction performance, improving the overall efficiency and energy utilization of the aircraft.

Air conditioning fluid stays in its place

Ozone-friendly refrigerants and operator comfort are drivers of automotive air conditioning system design. Air conditioning lines are the arteries of the system, transporting refrigerant from the compressor to other system components.

Seals such as O-Rings and bonded seals are placed at every interface between the lines and system components, which need to be leak-free. Seals must withstand temperatures from −40°C to +140°C/−40°F to +284°F, in pressures from 0.2 to 2.3 MPa/29 to 333 psi and be resistant to refrigerant R134a and PAG oil.
Cleaner, more efficient fueling

Whatever happens in the development of alternative sources of energy for vehicles, the internal combustion engine will be with us for many years to come.

Effective sealing of fuel systems is vital to maximizing fuel efficiency and Trelleborg Sealing Solutions has led the way in sealing fuel systems for many years:

- **1970s** – Increasing adoption of fuel injection requires high volume production of fluorocarbon O-Rings.
- **1980s** – Quality expectations increase: tighter tolerances, zero defects.
- **1990s** – Winter leakage concerns are addressed with special low temperature fluorocarbon materials.
- **2000s** – With leaks all but eliminated, focus turns to reducing permeation of fuel through O-Rings as global regulations require drastic reductions in evaporative emissions.

Safer food and drink

To food, beverage and pharmaceutical processors, Trelleborg supplies engineered sanitary gaskets that contribute to health and safety. Engineered sanitary gaskets are replacing standard gaskets as the processing methods become more vigorous, thus ensuring improved performance.

Metal detectable materials provide safer production by detecting contaminated product, preventing it from reaching the consumer. Anti-microbial materials and seal designs such as Turcon® Variseal® Ultra-Clean™ prevent bacteria from growing in dead space within piping systems and equipment. High-performance materials also provide better sealing of harsh chemicals, preventing them from entering the atmosphere.

Electro-mechanical Actuators (EMAs) help reduce environmental hazards associated with hydraulic cylinders. EMAs use electronics to control movement. Smaller and more compact than traditional hydraulic actuators, they save space and reduce weight. Using significantly less hydraulic fluid, leakage is kept to a minimum, reducing the potential environmental hazards associated with hydraulic cylinders.

EMAs are energy efficient and ideal for clean room manufacturing in semiconductor, life sciences and pharmaceutical industries. They are also used extensively in the aerospace industry.

Trelleborg Sealing Solutions provides complex sealing systems that eliminate leakage, prevent contamination from entering the system and side loading. These systems include: wipers, scrapers, Excluder®, thermoplastic bearings, gaskets and subassemblies.

Less wasted energy

Originally Plate Heat Exchangers (PHEs) were used in the sterilization and pasteurization of dairy products, mainly milk. Now though you’ll find them on ships, feeding heating systems for buildings and in almost every processing plant.

Trelleborg Sealing Solutions provides industry-leading PHE gaskets that prevent liquids within PHEs from leaking or mixing. These operate at extremes of temperature from –45°C to +200°C/ –49°F to +392°F in chemicals that are some of the most aggressive processed. As the liquids are pushed through a large PHE with maybe 200 plates, pressures are also high. These are generally between 0.5 and 1.5 MPa/ 72 and 218 psi but sometimes even up to 3.5 MPa/ 508 psi.

Biodegradable hydraulic fluids are becoming more popular because of increasing environmental regulations. Such fluids are available within the flame retardant HFC group, which for years has been the preferred fluid in mining and steel works. With the excellent tribological properties of HFC, new environmentally-friendly versions of hydraulic equipment, which traditionally used mineral oil, can now benefit from using this water-based fluid.

The specific adhesiveness of HFC to metal surfaces requires a firm sealing edge and the secure feed-back of fluid to obtain leak-free performance. Recent in-house testing not only revealed a preferred Turcon® seal material, but also verified a significantly lower leak rate and reduced friction contribution in the biodegradable HFC fluid compared with standard mineral hydraulic oil – resulting in a “win-win” situation. Turcon® Stepseal® 2K is an optimum choice for these applications.

If you would like to know how you can add more green value to your products and improve and grow your business, talk to us! To find your local Trelleborg Sealing Solutions marketing company go to www.tss.trelleborg.com/worldwide
In short...

- Handling devices are required for the latest thinner semiconductor wafers
- AP&S has developed the unique Cyclop Sealing™ capsule
- Trelleborg Sealing Solutions jointly developed a sealing system with AP&S for this capsule
- In lifetime testing the sealing system is proven to give virtually zero leakage
Recently developed device packaging schemes such as “chip-sized packages” used in miniaturized products and Systems in a Pack (SiP) using chip stack methods, are significantly smaller than conventional packages,” says Michael Sowa, Chief Marketing Officer of AP&S, a company based in Donaueschingen, Germany that specializes in wet process solutions for the semiconductor industry. “These new technologies require thinner semiconductor devices that are significantly more difficult to handle than thicker wafers.”

Unique Cyclop Sealing™ capsule facilitates processing of thin wafers

Conventional techniques for handling semiconductor wafers during processing, and in particular for transferring wafers between processing tools, typically involve standard-sized cassettes which hold a number of wafers at a time. This handling technique was developed for wafers that are rigid with thicknesses of about 250 μm or greater. The latest delicate
thinner wafers, which are only about 100 μm and can even be down to 50 μm, need to be fitted to a rigid carrier to be handled.

AP&S has developed the Cyclop Sealing™ capsule, a one-size fits all media-tight carrying system for thin wafer processing.

“Our unique Cyclop Sealing™ capsule can be simply installed with only minor modifications within any existing semiconductor fabrication line and allows thin wafers to be run in processes otherwise thought impossible,” continues Michael Sowa. “Most importantly it avoids the need for major expenditure on new equipment for processing thinner wafers. Obviously this is a real benefit for our customers, who are finding the Cyclop Sealing™ capsule is making thin wafer processes more stable and ultimately more profitable.”

Patented sealing system gives virtually zero leakage

Vital to the capsule’s function is its patent-pending sealing system jointly engineered with Trelleborg Sealing Solutions. This system protects the substrate from unwanted process influences and also any damage caused by forceful closing of the capsule.

“The sealing system is proving highly effective,” says Peter Krass, the Trelleborg Sealing Solutions Key Account Manager who worked on the project with AP&S. “In tests it is proven to have a leakage rate below 0.1 percent even after lifetime testing of opening and closing cycles.”

About AP&S

AP&S is an international company headquartered in Donaueschingen, near Stuttgart, Germany, with wholly-owned offices in China and Singapore and representatives in other parts of Asia and Europe.

It is the policy of AP&S to offer its customers the most cost-effective process plants worldwide, equipped with innovative components and featuring process performance which exceeds the requirements of the semiconductor industry.

The company specializes in wet process solutions for the semiconductor industry. It designs and produces wet benches and wet chemical equipment for surface treatment of substrates under cleanroom conditions, offering both standard equipment and customized solutions.
Substantial research has been undertaken on the Cyclop Sealing™ capsule to make sure that it and its sealing system meet industry requirements. This included tests to evaluate:

- **Surface tension optimization**
- **Temperature change stability**
- **Mechanical stress due to media flow and relative movement**
- **Influence on impermeability of structures on the substrate**
- **Reliability over lifetime opening and closing cycles**

In all tests the Cyclop Sealing™ capsule performed well and met all the test criteria. Specifically in the opening and closing tests the capsule underwent 2,600 automated opening and closing cycles without breach of the seal.

---

**Unique Cyclop Sealing™ capsule’s patented sealing system**

The Cyclop Sealing™ capsule consists of six components: the front ring, rear plate, locking ring and, making up the sealing system, three gaskets manufactured of specially developed sealing materials that are compatible with media commonly used in semiconductor processing. The gaskets are proven to give a leakage rate below 0.1 percent within the demanding environment of the capsule, operating at temperatures between +20°C and +90°C/ +68°F and +194°F and in pressures from 0.5 to two bar/ seven to 29 psi.

---

**The Cyclop Sealing™ capsule**

The Cyclop Sealing™ capsule is a media-tight capsule specifically designed to protect wafers from the grueling mechanical and process effects to which they are commonly exposed.

- **Applications:** E-less plating, Etching, Cleaning, IPA dryers etc.
- **Suitable for:** 150 mm/ six inch, 200 mm/ eight inch and 300 mm/ 12 in substrates as well as many special purpose substrates
- **Ideal for:** 50 μm to 1000 μm thickness
- **Precision-engineered sealing and opening mechanism**
- **Can be adapted to customer-specific requirements**
Aerospace

Fly-By-Wire and Electro Hydrostatic Actuators are changing the design of hydraulic flight controls in aircraft. Sealing within these new systems is becoming more challenging. Trelleborg Sealing Solutions is successfully supplying sealing systems to meet these more difficult demands.

In short...

- Fly-By-Wire and Electro Hydrostatic Actuators are changing the design of hydraulic flight controls in aircraft.
- Sealing within these new systems is becoming more challenging.
- Trelleborg Sealing Solutions is successfully supplying sealing systems to meet these more difficult demands.
The developments of civil and military aircraft go hand in hand,” says Torben Andersen, Global Aerospace Segment Manager. “One of these, which has triggered a revolution in aircraft hydraulic systems, is Fly-By-Wire (FBW) technology where mechanical links or wires are replaced by electric wiring.”

Fly-By-Wire affects hydraulic system design

FBW opens up completely new possibilities for aircraft design. Whereas older aircraft had to be designed with a high degree of static stability to reduce the workload on the pilot, FBW allows the design of aircraft with artificial stability leading to increased maneuverability. The on-board computers and the FBW actuators fly the aircraft in a straight line or preprogrammed route from A to B. The pilot only controls deviations from this artificially stable situation.

“Instead of receiving occasional corrections to the flight path from pilot input, in the FBW’s artificially stable environment, electrical impulses make constant minute corrections from a digital system,” continues Torben. “This increases the number of movements within the actuator by several orders of magnitude, resulting in rapid stroke and extended travel of piston rods. The high frequency of movements also increases temperatures locally where the seals are positioned and there is less cooling of hydraulic fluid due to reduced circulation.

“To provide acceptable life, seals must demonstrate exceptional friction characteristics and outstanding resistance to wear, as well as the ability to operate at elevated temperatures and in contact with high temperature media.”

The introduction of Fly-By-Wire and Electro Hydrostatic Actuators has changed the design of hydraulic flight controls. Resulting increases in stroke frequency and compact design envelopes, combined with service-life demands, makes sealing in modern aircraft more challenging. Trelleborg Sealing Solutions has had to respond with enhanced sealing materials and optimized seal designs.
Electro Hydrostatic Actuators are beginning to take over from traditional hydraulic servo-actuators

Another new technology that is having an effect on hydraulic design is the Electro Hydrostatic Actuator (EHA). Traditional hydraulic servo-actuators, where oil is supplied from a centrally located pump at high pressure and distributed out to hydraulic actuators through pipes, are now being replaced by EHAs. These contain all the components of a traditional hydraulic system, reservoir, motor, pump, accumulator and manifold, in an individual unit. They operate without hydraulic lines, lowering the risk of damage to the hydraulic system. Energy savings are achieved through weight reduction and because the output of the unit can be suited to the aircraft’s needs.

“For safety reasons larger aircraft have three separate hydraulic systems,” says Torben. “Two of them operate the control surfaces under normal conditions and the third system can be used in an emergency. Utilizing this new EHA technology Airbus has replaced the usual three hydraulic systems with two hydraulic systems and two electrical systems on the A380, giving weight savings of more than 1,000 kilograms/ 2,205 pounds.”

Designing a sealing system for the EHA is more challenging than for traditional hydraulic systems. The design envelope of the compact unit is small, the temperatures and pressures are high within it, while dynamic movement is rapid over a short stroke.

Sealing is becoming more challenging in today’s aircraft

Other factors are also making sealing within modern aircraft more difficult. The demand for greater efficiency and more reliable systems with less downtime has resulted in a vastly increased service life requirement for hydraulic actuators. This has quadrupled from 12,000 flight hours expected for the Boeing 737 originating in the 1960s to 48,000 hours, representing five and a half years of continuous work, for the recently launched Airbus A380.

Operating pressures of the hydraulic systems have increased substantially in order to handle larger loads, at higher speeds, all within a smaller design envelope to reduce system weight. Currently the 5,000 psi/ 35 MPa of the A380 and the new B787, seems to be the accepted limit. This puts very high demands on the sealing system, especially when combined with the increase in movement speed and frequency associated with FBW.

Integral sealing systems are expected to be maintenance-free

Another issue is the surface finish of rods. Hard chrome coatings have long been established in the industry. These are being superseded by even harder ceramic coatings due to environmental concerns and the need to extend the lifetime of rods. The A340 and the A380 use ceramic High Velocity Oxygen Fuel (HVOF) coated rods in several actuators with very good results. To meet life expectations seals must give exceptional wear resistance against these hard dynamic counterparts.

“On top of all of this,” continues Torben, “sealing systems have changed from something that was replaced regularly when a leak was discovered, to more complex sealing configurations that are an integral part of the EHA or FBW. They are expected to operate on the aircraft for many years without the need for service. Generally the initial value of the installed sealing system has increased. The need for spare parts and service hours has decreased, reducing the total cost for the operators.”

Hydraulics are likely to remain with us for many years to come

Looking to future designs it is questionable whether hydraulics will be on aircraft flight controls at all.

“Advances in electronics and electric power generation mean that for some applications electric actuators have become the preferred alternative to hydraulic components, especially on smaller aircraft and UAVs where the forces on the control surfaces are small,” says Torben. “Some of the most advanced Airbus flight control systems have electrical actuation as back-up for the hydraulics, thus further adding to flight safety by employing several dissimilar systems in parallel to carry out a given task. Even if in the future the electric flight control systems assume a greater role in larger aircraft, hydraulics and their complex sealing systems are likely to remain with us for many years to come.”

“To provide acceptable life, seals must demonstrate exceptional friction characteristics and outstanding resistance to wear, as well as the ability to operate at elevated temperatures and in contact with high temperature media.”
Trelleborg Sealing Solutions has been involved in the design and manufacturing of sealing systems for aerospace applications for over 50 years. Substantial research and development resources have been invested in engineering materials and seal geometries specifically engineered for the aerospace industry. Here are some examples of typical sealing configurations for aircraft.

Outstanding low-friction characteristics

- **Application:** Military aircraft with full FBW without any mechanical back up
- **Pressure:** Up to 4,060 psi/ 28 MPa
- **Service life:** 6,000 flight hours
- **Operating temperatures:** From −54°C to +135°C/−65°F to +275°F
- **Counter surface:** Hard chrome rod
- **Sealing configuration:** Includes Turcon® Plus Seal® used in tandem along with a pressure relieving primary seal. Energizers with Nitrile sealing elements are optimized for use in red oil according to Mil-P-25732 or Mil-P-83461.
### Unique back-pumping effect

- **Application:** Civil aircraft with full FBW without any mechanical back up
- **Pressure:** Up to 4,060 psi / 28 MPa
- **Service life:** 30,000 flight hours
- **Operating temperatures:** From -54°C to +135°C / -65°F to +275°F
- **Counter surface:** HVOF ceramic coated rod
- **Sealing configuration:** Includes Turcon® VL Seal™ in tandem. Energizers in ethylene propylene material are optimized for use in phosphate ester fluids such as Skydrol® or Hyjet®.
- **Back-pumping effect:** On the forward stroke of the shaft, an oil lubricating film is distributed under the seal. On the return stroke, the oil is back-pumped into the system, preventing leakage, reducing dynamic friction and breakaway force, even after extended periods of rest.

### Exceptional overall sealing ability

- **Application:** Civil aircraft with full FBW without any mechanical back up
- **Pressure:** Up to 4,060 psi / 28 MPa
- **Service life:** 38,000 flight hours
- **Operating temperatures:** From -54°C to +135°C / -65°F to +275°F
- **Counter surface:** HVOF ceramic coated rod
- **Sealing configuration:** Sealing configuration includes Back-up Rings in high modulus plastic. Within the rod sealing system it incorporates tandem Turcon® VL Seals at the same pressure and temperatures as the previous configurations. There is also a piston sealing system with a Turcon® Double Delta® seal.
**Turcon® Variseal® SA:**
the spring-energized option for aerospace applications

Sealing technology is likely to continue to develop with the demands from the aerospace industry. One such advance is in spring-energized seals that are often a preferred sealing option in other industries, as their very low coefficient of friction optimizes sealing load. This makes them ideal for the high frequency cycling of aerospace primary FBW flight controls especially as there is no need for an elastomer energizer which can limit media compatibility. The spring-energized seal’s jacket of PTFE based material and spring are capable of operating in extremes of temperature and are resistant to aggressive aerospace fluids such as synthetic hydrocarbon, petroleum base, phosphate ester and all types of aviation jet fuels.

*Specially designed for a solid seal groove*

Despite these advantages, spring-energized seals are not commonly used in aircrafts as aerospace engineers favor use of a solid seal groove cut into component hardware to simplify installation. During installation into the groove seals need to be compressed substantially. The lip configuration means that the spring energizer within the seal tends to flare its jacket outwards, making installation very difficult without a split seal groove, especially in smaller diameter housings. This problem is solved with Turcon® Variseal® SA from Trelleborg Sealing Solutions.

The unique Slantcoil® spring of Turcon® Variseal® SA is not susceptible to compression set and can accommodate more deformation than other springs during installation. While providing all the inherent capabilities of a Turcon® Variseal®, the Turcon® Variseal® SA is suited for fitment in even the smallest diameter Mil-G-5514F grooves. Several projects are now successfully using this design of seal in flight control systems.

“The need for spare parts and service hours has decreased, reducing the total cost for the operators.”
Current industry buzz is all about improving seal performance by using nanoparticles as fillers for polytetrafluoroethylene-based sealing materials. Always trying to enhance our materials, Trelleborg Sealing Solutions decided to research and compare the wear-reducing ability of our traditional Turcon® additives to nanoparticles as additives.

We tested PTFE filled with the following nanoparticles: carbon nanotubes (MWCNT), alpha Aluminum Oxide (Al₂O₃, alpha), beta Aluminum Oxide (Al₂O₃, beta), Tin Oxide (SnO₂), Copper Oxide (CuO), Zinc Oxide (ZnO) and Iron Oxide (Fe₂O₃) in all cases at 1wt%. Performance was compared to both virgin PTFE and Turcon® T05.

The results demonstrate that different types of nanoparticles have different effects on the wear resistance of PTFE, going from virtually no effect to wear reductions beyond a factor of 50. For some nanoparticles performance depended on whether systems were running dry or lubricated. For instance, MWCNT performed very well when dry-running but poorly in lubricated conditions while others, such as Al₂O₃ alpha, gave good overall performance. None of the nanoparticle filled materials though were capable of out-performing the wear resistance of Turcon® T05, dry-running or lubricated.

“Despite the results showing that our traditional additives outperform nanoparticles, Trelleborg Sealing Solutions will continue to work on sealing nanotechnology,” says Thomas Larsen, who headed up the test program. “Our Turcon® compounds are optimized for service conditions using traditional fillers and are generally difficult to beat. Even so, we will continue to investigate if improvements can be made using nanoparticles.”

In short...

It is believed that nanoparticles can improve the wear resistance of sealing materials.

Tests prove that traditional fillers used in most Turcon® materials from Trelleborg Sealing Solutions outperform nanoparticles as fillers.
A millionth of a millimeter

Within nanotechnology, researchers work with individual atoms, making it possible to move atoms, create new materials and change the properties of existing materials. An atom is about 0.2 nanometers in diameter and you get one nanometer if you divide one millimeter a million times. One nanometer has the same size in relation to a tennis ball as the tennis ball has to a globe.

The name nanotechnology was first used in the 1970s. A breakthrough was achieved in 1981 with the invention of the scanning tunnel microscope, which meant that it was possible for the first time to see the surface of atoms and to actually touch individual atoms.

Virgin polytetrafluoroethylene (PTFE) has very low wear resistance, and fillers are added to PTFE to increase its wear resistance in dynamic sealing applications. Nanoparticles, which have at least one dimension in the size range of one to 100 nanometers, offer an alternative to traditional fillers. These are currently receiving much attention as fillers for polymers and are promoted as improving mechanical and tribological properties at a low degree of fill as well as reducing the risk of abrasive action against mating counter surfaces.
Zurcon® material

Trelleborg Sealing Solutions supplies seals in a broad range of materials including elastomers, PTFE based Turcon® and our proprietary Zurcon® polyurethane. One type is not necessarily better than the other, but each represents the optimum choice in different applications. Here we look at the benefits of Zurcon®.

Polyurethane wearing well

Alberto Livi, Trelleborg Sealing Solutions Product Manager for our proprietary range of Zurcon® polyurethane materials and products, puts three seals in front of me. One is a black elastomer O-Ring, the other two in our hallmark turquoise color, look virtually identical. The one turquoise seal though, in Turcon® PTFE based material, is stiff, while the other in Zurcon®, our proprietary polyurethane, flexes to the touch like the O-Ring does.

Different types of sealing materials have benefits over others in specific environments

“Polyurethane has similar elasticity to an elastomer,” explains Alberto. "This O-Ring and the Zurcon® product are the same hardness, and as you see they deform to a comparable extent. Elastomers will range from 70 to 90 shore, while polyurethane goes from 85 to 98. At the lower end of the scale it behaves more like rubber and at the top, like PTFE.”

When specifying seals for applications different materials have benefits over others in specific environments. In hydraulic cylinders, wear and extrusion resistance are priorities, and polyurethane offers both of these.

Zurcon® is an optimum choice in challenging dynamic and high-pressure applications

“If an elastomer O-Ring is in a static situation or in an assembled object, where the only dynamic movement is a single push to fit onto a component, then elastomers are ideal,” says Alberto. “However, once there is significant dynamic movement of a rod and piston and especially where there may be some deformation of the seal within the application due to high pressure, then polyurethane comes into its own.”

Another important characteristic of polyurethane is that due to its higher tensile strength it demonstrates excellent extrusion resistance. This means that it can operate in higher pressures.

“An elastomer O-Ring will withstand pressures up to 10 to 15 MPa/ 1,450 to 2,175 psi but beyond that a Back-up Ring is needed,” continues Alberto. “In the same configuration the polyurethane seal will be functional to 40 MPa/ 5,800 psi. This can reduce the required design window. This is also the case when the Zurcon® seal is compared to Turcon® PTFE based seals. As these have no elasticity, they must always be activated by an elastomer seal or internal spring.”

Injection molding gives cost-effective high volume seal production

Alberto points out that polyurethane seals are produced by injection molding, which means very high volume production is viable. “PTFE based seals are machined with a lathe a single piece at a time. Trelleborg Sealing Solutions has this down to a fine art and machining of our Turcon® seals is totally automated and extremely rapid. However, due to the inherent nature of injection molding, for really high volumes it can prove exceptionally cost-effective.”
Features and benefits of Zurcon® seals

**Features**
- Excellent friction characteristics
- Broad operating temperature range from \(-50^\circ\text{C} to +130^\circ\text{C}\)/\(-58^\circ\text{F} to +266^\circ\text{F}\)
- Outstanding wear, extrusion and abrasion resistance
- Good elasticity
- Compatible with a wide range of chemicals including mineral oil
- Low compression set
- Ozone-resistant
- Produced by injection molding

**Benefits**
- Extended sealing life in challenging environments
- Superior dynamic performance
- No tendency to stick even after extended periods of rest
- Operates in pressures up to 40 Mpa/5,800 psi without a Back-up Ring
- Self-energizing
- Compact design window
- Effective sealing when in contact with harsh media
- Suitable for use in hydraulic media
- Seals and assemblies can be stored for a long time
- Cost-effective high volume manufacturing

When to specify Zurcon® seals
- In highly dynamic situations
- When external abrasive media needs to be excluded
- Where there is high pressure up to 40 MPa/5,800 psi
- If very high volumes are required
Molding allows Zurcon® polyurethane material to be formed into seals in a wide variety of different geometries. Though they may seem complex, each one is designed for a specific purpose based on expertise going back over 50 years. Here we examine the facts and explain the technologies behind those intricately shaped rings.

**It’s all in the geometry**

**Fact:** Zurcon® polyurethane seals are primarily used in hydraulic applications.

**Why?**
The target for seals in these applications is to keep the hydraulic cylinder leak-free for an extended length of time. Due to high levels of friction in these dynamic environments, no other type of seal comes close to the performance of Zurcon® seals.

**Fact:** On average three seals are used in a typical hydraulic application and in really complex ones there can be up to five.

**Why?**
Hydraulic cylinders are subject to linear movement in both directions and lubricant must be kept in the system. At the same time, media, often harsh and abrasive, needs to be kept out. It is impossible to do that with one or even two seals, so a group, or configuration of seals must be specified. These then interact with each other, so depending on the sealing requirements and conditions, specialized geometries give the best performance.

**Fact:** Back-pumping makes seals in tandem arrangements work effectively.

**What is that?**
Back-pumping is a unique technology where on the forward stroke of the shaft, an oil lubricating film is distributed under the seal. On the return stroke, the oil is back-pumped into the system, preventing leakage and reducing dynamic friction as well as breakaway force, even after extended periods of rest.

**Fact:** Pressure-relief valves or channels are often designed into Zurcon® seals.

**Why?**
When seals are used together in a tandem arrangement or within a configuration, the interaction between them can cause pressure build-up. This is relieved through grooves or notches, some of which are of a patented design, molded into the seal.

**Benefits of all Zurcon® seals**
- Superior friction characteristics
- Excellent wear and abrasion resistance
- Very good extrusion properties
- Optimized pressure performance dependent upon application
- Wide operating temperature range
- Compatible with virtually all media including lubricants and mineral oil
- Low compression set
- Provide long service life
- Easy installation with most suitable for standard groove sizes
The latest software programs are used in the development of new Zurcon® seals. Finite Element Analysis (FEA) is vital in predicting the behavior of not only a single seal but more importantly a complete configuration within specific application parameters. Minor adjustments to sealing lips and relief valves can have major effects in terms of performance. This is tested in a virtual environment and can be proven in application using in-house prototypes, before commitment to a molding tool and series production.

Designing the best geometry

The popular Zurcon® choice

There are a wide range of seals available in Zurcon® polyurethane material. Here are some of the most popular.

**Zurcon® Dualseal**
- For static applications
- Ideal alternative to O-Ring and Back-up Ring combinations at high pressure
- Resists twisting
- Stable under pulsating pressures

**Zurcon® Buffer Seal**
- Heavy duty primary rod seal
- Withstands extreme pressures, avoiding risk of blow-by
- Constant lubrication of the rod across entire pressure range
- Pressure relief function

**Zurcon® Glyd Ring® P**
- Simple groove design makes a one-piece piston possible
- Excellent extrusion resistance
- Resistant against shock loads
- High wear resistant material ensures long service life

**Zurcon® Wynseal**
- Double-acting piston seal
- High static and dynamic sealing effect
- Excellent abrasion resistance
- Simple groove design making a one-piece piston possible

**Scraper DA24**
- Excellent scraping performance
- Double-acting
- Prevents ingress of external media and dirt
- Advanced friction characteristics

**Scraper DA24 Venting Version**
- Excellent overall performance
- One of the most efficient scrapers on the market
- Will not push out of the groove if there is over-pressure
- Pressure relief valves give improved stability in the groove

**Zurcon® WSP**
- Press fit allows fitment in a smaller design window
- High wear resistance
- Suitable for oscillating movements
- Sealing lip can be opened for re-lubrication of swivel bearings and spent grease can be drained

**Zurcon® Roto Glyd Ring® S**
- For applications with oscillating movements
- Double-acting
- Withstands high pressures from one or both sides
- Operates in slow sliding speeds and high pressures

Get more information on Zurcon® seals from our electronic catalog on our website

www.tss.trelleborg.com/electronic_catalog
Wind power

Only a few years ago, it seemed like a dream. Now large scale use of wind power is a reality.

By the end of last year, installed wind power turbines were generating one and a half percent of global electricity. With an estimated turnover of € 40 billion/ $ 59 billion in 2008 the industry is booming and according to the World Wind Energy Report it creates around 440,000 jobs worldwide.

Trelleborg has been supplying parts for wind turbines since the technology began. Numerous advanced seals from Trelleborg Sealing Solutions contribute to effective operation of hydraulics, withstanding rigors on land and the tough conditions of offshore installations. While on gearboxes, generators, and nacelles innovative antivibration systems from Trelleborg Industrial AVS, part of Trelleborg Engineered Systems, reduce noise and increase service life.

Seals for main brake
Assists the turbine in stopping at critical rotor speed or for maintenance.

Trelleborg products: scrapers, rod seals, wear rings

Seals for main gear
Converts the rotation of the blades into a speed suitable for the generator.

Trelleborg products: rotary seals

Seals for Accumulators
Act as hydraulic power batteries for safety and energy saving.

Trelleborg products: piston seals, wear rings, static seals

Versatile mounts
RA/RAEM mounts have become the preferred solution of the major players in the wind power industry. They are designed to obtain a high-degree of isolation combined with good vertical flexibility. This gives the advantage of horizontal stability. The mounts are mainly used under alternators and the turbine’s canopy.

Trelleborg products: RA/RAEM mounts

Flexible hoses for cooling and filter system
Large diameter, flexible hoses used in oil cooling and filter system for turbine gearboxes; able to be cleaned to ISO 18/16/13

Trelleborg products: hose

Further information
www.tss.trelleborg.com
www.trelleborg.com/engineeredsystems
Sandwich Mounts
Designed to provide a high compressive strength and low shear stiffness, SAW sandwich mounts have become a versatile high-performance solution. They are used mainly under gearboxes.

**Seals for main bearing**
Holds the main shaft in position.
*Trelleborg products:* rotary seals

**Seals for lock cylinder**
Locks the rotor blades in order to avoid rotation in strong winds or for maintenance.
*Trelleborg products:* piston seals, wear rings, static seals

**Seals for pitch cylinder**
Control the angle at which the rotor blades face the wind.
*Trelleborg products:* piston seals, rod seals, wear rings, scrapers, static seals

**Seals for yaw brake**
Keeps the nacelle in a steady position towards the wind.
*Trelleborg products:* rod seals, wear rings, scrapers

**Damping bearings**
Designed to accommodate torsional movements and axial and radial loads. Teater Bearings and UD bushes enable structures to be silent and vibration free. These mountings are mainly used in the main turbine shaft and blades.

**Offshore solutions**
Offshore wind power turbines usually rest on a mono pile or a tripod. During the installation, the tower is positioned over or in the pile and the space between the tower and the pile is sealed by a rubber seal from Trelleborg. In order to make this a solid connection that secures the vertical position of the tower, grout is injected from the top of the seal - the reason they are called grout seals. Trelleborg also produces special bearings and fenders, cable ancillaries, bend stiffeners and restrictors, J-tube centralizers and various buoyancy solutions.

Check out our movie on sealing in wind turbines
[www.youtube.com/TrelleborgSeals](http://www.youtube.com/TrelleborgSeals)
Renewable Sealing

Wind power is a technology that is becoming more and more sophisticated. Rapidly adapting established solutions developed for other industries has made Trelleborg Sealing Solutions the leading seal supplier to this market.

As a leading supplier to the fluid power sector, Trelleborg Sealing Solutions has the experience that means it is not troubled by any of the challenges faced in sealing wind turbine components. Take for example the hydraulic pitch cylinders that ensure a constant optimal blade angle against the wind.

“The pitch cylinder is a critical component within a wind turbine. It is a highly sophisticated, precision piece of equipment. At the end of the day though, it’s just a cylinder,” says Jan Winther, who along with being General Manager for Trelleborg Sealing Solutions Denmark is European Segment Manager for Wind Power. “Conditions within wind power applications are extremely arduous in terms of 24/7 operation, frequent movement and exposure to the elements. But in the other industries we supply, such demanding environments are common place.”

Trelleborg Sealing Solutions hit the ground running when first approached for sealing systems for wind applications, saving their customers considerable time in solution development.

“We’ve been involved in wind power since it began,” continues Jan, “and we like to feel that we have contributed in a small part to this renewable energy’s success.”

Sealing requirements within wind turbine applications:

- Provide long-life and reliability for 24/7 running with minimal maintenance
- Withstand significant pressures
- Operate in extreme temperatures
- Demonstrate low friction characteristics to maximize performance of constantly moving components
- Effectively exclude external media
- Function in difficult external environments

Read the book – see the movie

A movie is available from Trelleborg Sealing Solutions that explores a number of wind power applications. If you would like to see this, then visit the new Trelleborg Sealing Solutions channel on YouTube.com.

www.youtube.com/TrelleborgSeals
Some call it powerful. 
We call it Trelleborg.

- **Natural forces in action.** The wind turbine’s rotor blades turn slowly, but the gearbox in the hub increases the speed to the generator by 20-30 times. Gigantic two-meter seals from Trelleborg protect the gear wheels from the elements, while preventing the lubricating oil from leaking out.

Trelleborg is a global industrial group creating high-performance solutions that **seal, damp** and **protect** in demanding industrial environments, all over the world. Find out more about our world at [www.trelleborg.com](http://www.trelleborg.com).
A complete selection of the finest seals...

available from Trelleborg Sealing Solutions – your one-stop-shop.

Trelleborg Sealing Solutions offers an outstandingly comprehensive sealing portfolio – a one-stop-shop providing the best in elastomer, thermoplastic, PTFE and composite technologies; our solutions are featured in virtually every application conceivable within the aerospace, automotive and industrial industries.