

# Wind Power

## Sealing Solutions



**Your Partner for Sealing Technology**



## Trelleborg Sealing Solutions In General

### Product and material range

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.

### Manufacturing capabilities - A Worldwide presence

Uniquely placed to offer dedicated design and development, Trelleborg Sealing Solutions globally serves, supports and supplies customers through an unrivalled international network.

- Over 80 facilities worldwide
- More than 20 manufacturing sites
- Seven strategically positioned materials and development laboratories
- Internationally linked design and application centers

### Online services and tools at the click of a mouse

Trelleborg Sealing Solutions offers a range of cutting-edge online services and tools on our website.

- Full range of Catalogs and Brochures
- Sealing Solutions Configurator
- CAD Service
- O-Ring Calculator



**Read the book – see the movie**

**Now you have the brochure why not check out our wind power film on YouTube!**

[www.tss.trelleborg.com/films](http://www.tss.trelleborg.com/films)





## **A dynamic industry**

Worldwide, wind power is the most developed alternative energy source. Growth has been stimulated by rising oil prices, a greater concern with the environment and a growing need for energy.

In recent years, the wind industry has installed over 38 GW of new wind power capacity globally. While more mature markets within Europe and North America remain strong, for the first time the majority of that power was situated in developing economies. The largest increases were witnessed in India and China, with substantial growth in Latin America.\*

## **Leading sealing solution provider**

Trelleborg Sealing Solutions is a leading global supplier of high quality sealing solutions. With over 60 years of experience providing seals to a variety of industries, we have been involved in the wind power industry from the beginning.

As a rapidly evolving industry, wind power is subject to constantly innovating technologies, and at Trelleborg our philosophy is the same. Whether your company is small or large, we can support you in providing a solution for your application needs. Product reliability and customer focus are paramount.

## **Optimizing performance**

Our sealing expertise and solutions can accelerate the time to market, improve the efficiency of existing applications and lengthen maintenance intervals. All of which can contribute to decreased downtime and increased yield.

Having worked on so many major projects worldwide, our experience and ingenuity is key in providing the optimal sealing solution for your application. Trelleborg Sealing Solutions possesses the necessary engineering resources globally to provide the right solution for any sealing application. Using the latest Finite Element Analysis (FEA) techniques, we can rapidly go from design stage to manufacturing within the virtual world.

## **Innovation and service**

Our innovation is a key to your success. Solving sealing and bearing challenges, using pioneering techniques, we deliver better performance and overall profitability for our customers.

Operations run 24 hours a day, 365 days a year, and our international logistics network can meet your scheduling requirements. Wherever a product is originally designed, our global manufacturing capabilities allow us to produce our sealing solutions to the same specification and quality standards at any Trelleborg facility throughout the world. That means we can follow your production as it expands globally.

\*GWEC 2010

## Application Overview

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.

### Trelleborg as a whole serves the wind power industry

Other parts of the Trelleborg Group supply advanced polymer solutions for wind power and some are featured in this breakout.

For more information on these products:

[www.trelleborg.com/IndustrialAVS](http://www.trelleborg.com/IndustrialAVS)

[www.trelleborg.com/IndustrialHose](http://www.trelleborg.com/IndustrialHose)

[www.trelleborg.com/Infrastructure](http://www.trelleborg.com/Infrastructure)

### Seals for Main Gear

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

**Trelleborg products:** rotary seals

### High Performance Mounts



RA/RAEM and XK mounts have become the preferred solution of the major players in the wind power industry. They are designed to have a high-degree of

isolation, to be easy to install and to demonstrate extreme durability and service life.

### Seals for accumulators



Act as hydraulic power batteries for safety and energy saving.

**Trelleborg products:**

piston seals, wear rings, static seals

### Flexible hoses for cooling and Filter Systems

Large diameter, flexible hoses are used in oil cooling and filter system for turbine gearboxes.

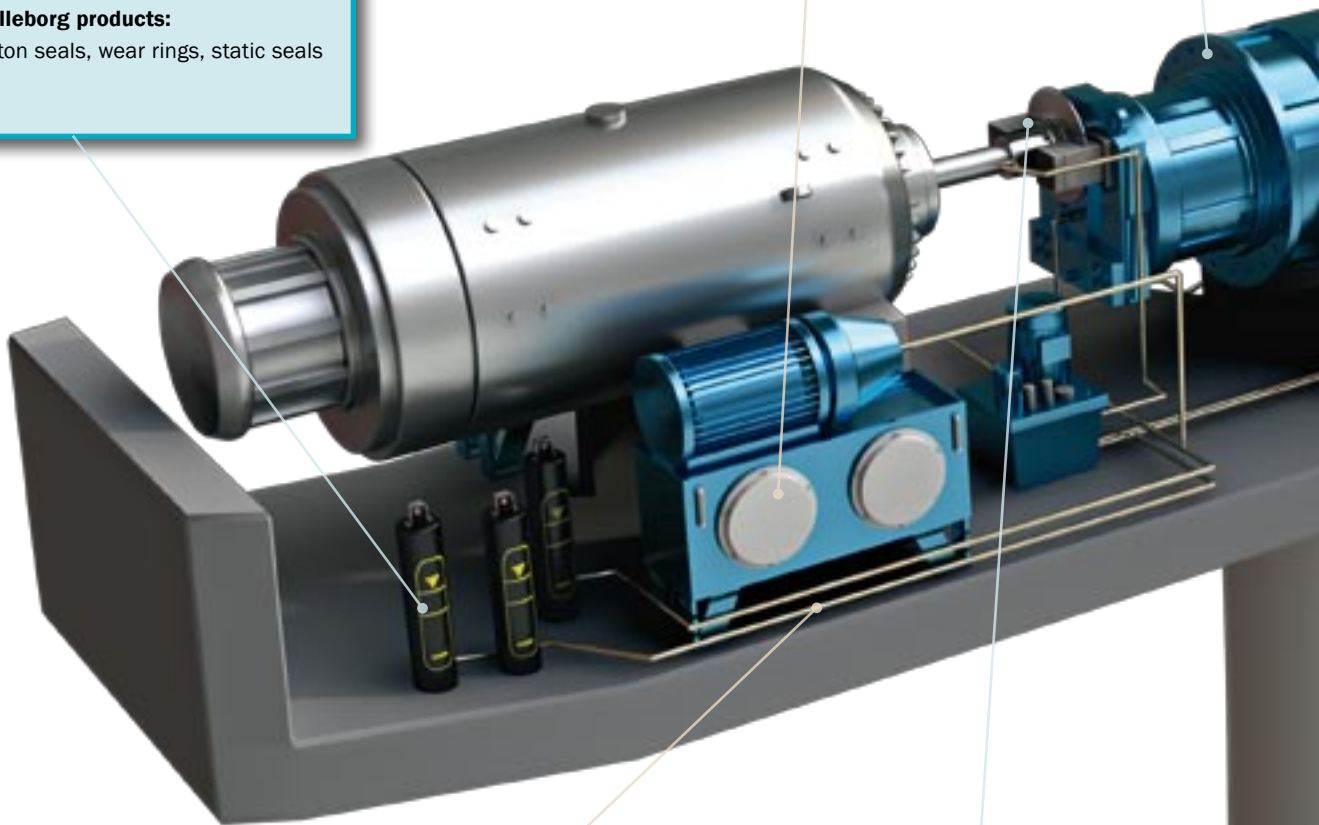


### Seals for Main Brake

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

**Trelleborg products:**

scrapers, rod seals, wear rings



### 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 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 Main Bearing

Holds the main shaft in position.

**Trelleborg products:** rotary seals



### 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.



### 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



### Offshore Solutions

Offshore wind power turbines usually rest on a monopile 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 for offshore installations.

# Sealing in Pitch Actuators



## Description of Application

Pitch actuators, responsible for pitching the rotor blades against the wind have critical functions in the wind turbine. Seals are a vital part of the system withstanding millions of strokes and ensuring reliable functionality 24-7 for many years. Being involved in sealing of pitch actuators since their technology began, our expertise has grown as the market has developed. Durability, reliability and life expectancy of seals are of primary importance in pitch actuator applications.

## Requirements for Sealing of Pitch Actuators

- Service Life
- Leakage Control

Sealing of pitch actuators has an overall goal of maximizing service life and at the same time to provide perfect leakage control.

Trelleborg Sealing Solutions provides sealing solutions that:

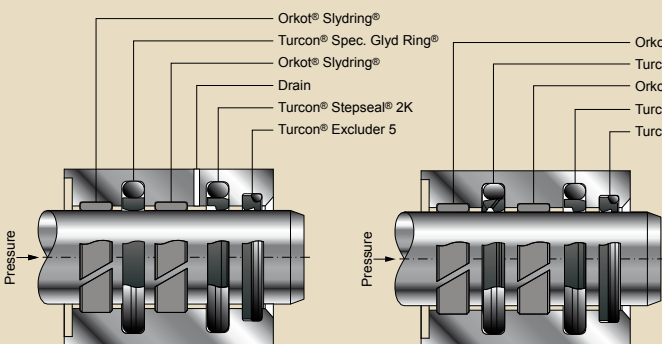
- Offer longest possible service life - industry target is 20 years
- Withstand hundreds of millions of strokes
- Operate in extremes of temperature, both high and low
- Withstand the required pressure, typically up to 30 MPa / 4,350 psi
- Work with the lowest friction and wear possible
- Facilitate different dynamic conditions including short stroke/high frequency operation



To design a solution for your specific needs contact your local Trelleborg Sealing Solutions marketing company

## Typical sealing solutions

### Rod sealing in pitch actuators



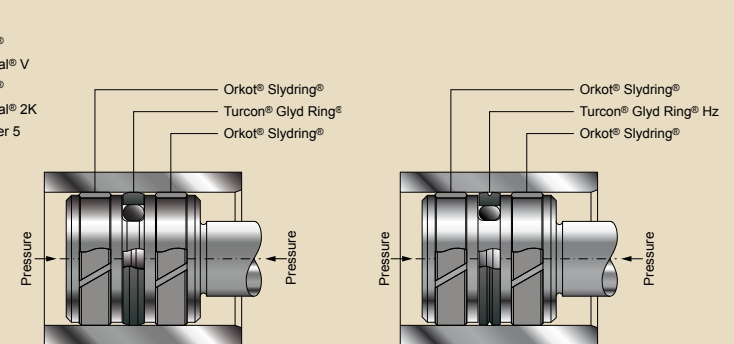
### Long life expectancy for rod sealing

This sealing configuration provides a well proven, reliable and long life-solution for pitch actuators. A special Glyd Ring® ensures constant lubrication and low friction.

For actuators with no drain, Stepseal® V and Stepseal® 2K in Turcon® M12 are ideal, again providing low friction and long lasting seal configurations.

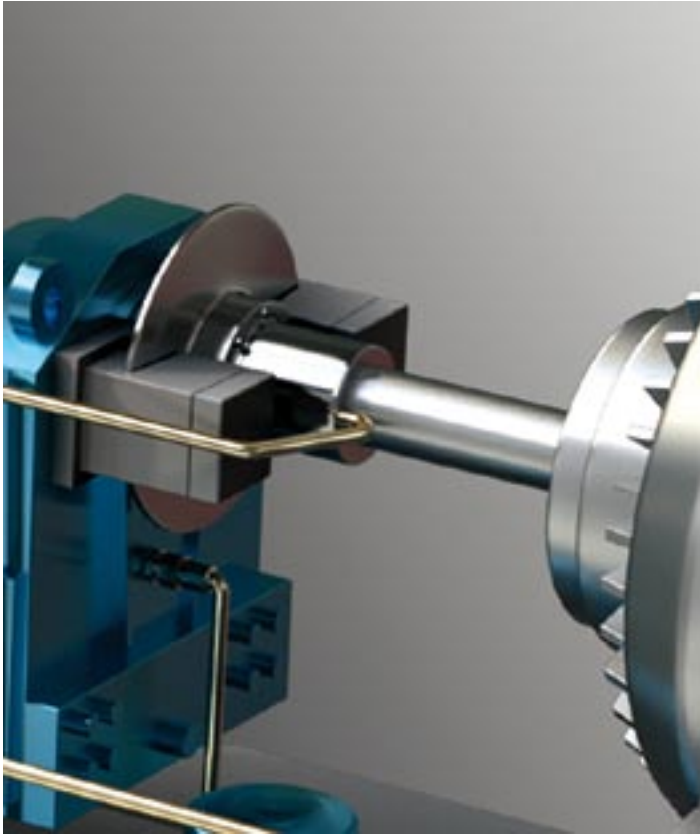
For arctic conditions, O-Rings are available in materials specifically engineered to demonstrate outstanding cold temperature capabilities. Orkot® Slydring® in C320 offers guidance with low friction and minimized wear. Turcite® "ingestion rings" can be added to embed any potential impurities in the oil.

### Piston sealing in pitch actuators



### Piston sealing

Special Glyd Ring® in Turcon® M12 on the piston ensures low friction and wear, and long service life. In case of short stroke and high frequency, Turcon® Glyd Ring® Hz is the optimal choice.



## Description of Application

Main brake, yaw brake and the rotor locking system have critical safety related functions within the wind turbine. Inside, the sealing solutions must provide an absolute reliability of function over years of operation - be it in cold climates or in the heat of the desert.

## Meeting braking and locking system challenges

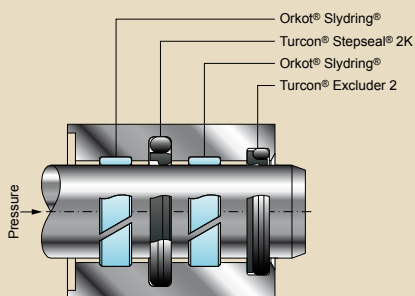
Seals must:

- Demonstrate reliability, durability and perfect leakage control
- Operate at pressures up to 30 MPa / 4,350 psi
- Provide temperature resistance in extremes of temperature, both high and low
- Work with the lowest friction and wear possible
- Offer longest possible service life - industry target is 20 years



To design a solution for your specific needs contact your local Trelleborg Sealing Solutions marketing company

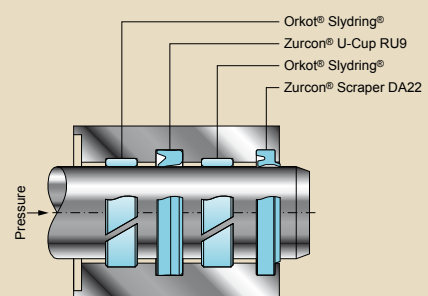
## Low-friction sealing in braking systems



### Low friction guaranteed

Sealing solutions focus on the lowest possible friction, with no stick-slip effect and long service life, for high and low temperature performance. Stepseal® 2K in Turcon® M12 provides state-of-the-art performance. For arctic usage, O-Rings are available in materials specifically engineered to demonstrate outstanding cold temperature capabilities. Orkot® Slydring in C380 or C320 offers secure low friction guidance to avoid metal-to-metal contact.

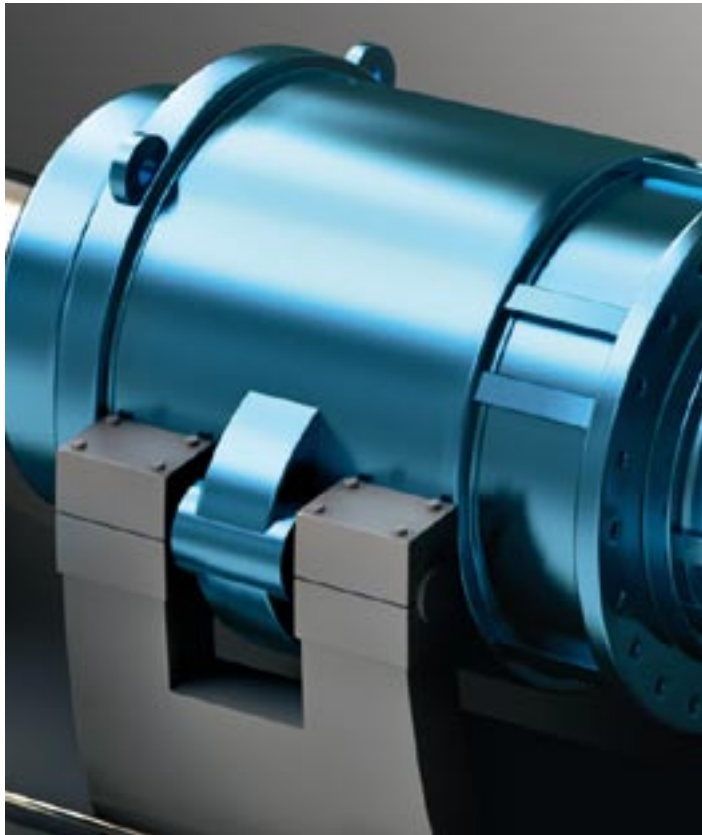
## Outstanding service life



### Unsurpassed wear-resistance

A sealing configuration based on our durable polyurethane material, Zurcon® Z20. This solution provides outstanding service life and unsurpassed wear resistance. Zurcon® Z22 is available if a low temperature capability is needed.

# Sealing in Transmissions



## Description of Application

A critical application within wind power, the transmission provides the link between the blades of the wind turbine and the generator. The efficiency and low maintenance of this system are vital to the effectiveness of the wind turbine.

A planetary gear system transforms the relatively low speed of rotation of the turbine blades into the high speed needed for electricity production by the generator. The system of precision gears is oil lubricated. Both for environmental and functional reasons, it is of the utmost importance to prevent oil spill and ingress of air and dust into the gearbox. This is especially in the case of challenging operating environments such as offshore installations where reliability of seals is crucial for 24-7 care-free operation.

## Reliability in wind power transmissions

Seals must:

- Offer outstanding reliability
- Exclude contaminants
- Retain oil
- Operate in extreme weather conditions throughout the year
- Give low frictional power loss without compromising seal integrity
- Be compatible with advanced gear oils

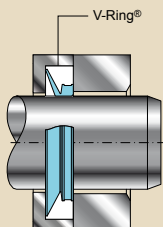
Product solutions include V-Rings, large diameter O-Rings produced using our unique FlexiMold™ technology and Radial Oil Seals.



To design a solution for your specific needs contact your local Trelleborg Sealing Solutions marketing company

## Typical sealing solutions

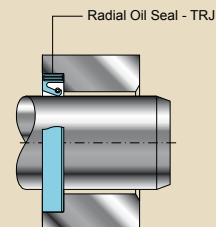
### Sealing with no stick-slip in transmissions



### Excluding contaminants

V-Rings in high quality elastomer compounds ensure no ingress of contaminants and retaining oil inside the transmission.

### Durable sealing in transmissions



### Long-term durability

Radial Oil Seals are ideal for sealing in transmissions. They consist of a single lip bonded to a metal support with a garter spring. There are many different variations of the Radial Oil Seal, both with and without an integral dust excluding lip. These dust lips can be positioned either within the seal width or beyond the seal base.

## Rotary Seals

Rotary seals are used in components with oscillating or rotating parts, and keep lubrication fluids in place while preventing the ingress of contaminants.

Trelleborg Sealing Solutions components are proven to improve the life and long term performance of your application, demonstrating superior low-friction properties and excellent resistance to wear.

Trelleborg offers one of the most extensive ranges of rotary seals on the market including Radial Oil Seals, the rubber V-Ring®, Mechanical Face Seals and the Turcon® Varilip® PDR.

Highlighted here are two of the most important seals for wind power applications. Full details of the rotary seal range can be found in the rotary seals catalog.

### V-Ring®



**A unique all-rubber seal for rotary shafts that is suitable for a wide range of bearing types.**

- Frictional losses and heat kept to a minimum
- Low contact pressure allows dry running in many applications
- Excellent wear characteristics
- Extended seal life
- Can perform even with certain amounts of run out, eccentricity and shaft misalignment
- Easy to install
- Can be installed over various other components without need for dismantling
- Can be vulcanized in situ

The V-Ring® is the perfect seal to prevent the ingress of dirt, dust, water or combinations of these media while positively retaining grease. It can also be used as a secondary seal to protect primary seals that do not perform well in hostile environments.

Pressure: Up to 0.5 MPa / 72 psi  
Speed: Up to 12 m/s / 40 ft/s  
Temperature: -54 °C to +170 °C / -65 °F to +338 °F

### Radial Oil Seals



**Radial Oil Seals are available with metal or fiber-reinforcement.**

- Excellent chemical resistance
- Outstanding resistance to heat and low temperature
- Good resistance to ozone and weathering
- High resistance to wear
- Low friction and compression set
- Highly elastic
- To ease the mounting or in case of repair, a split version Radial Oil Seal is available

For more information on Radial Oil Seals see the Radial Oil Seals catalog.

Pressure: Up to 0.5 MPa / 72 psi  
Speed: Up to 30 m/s / 90 ft/s  
Temperature: -54 °C to +170 °C / -65 °F to +338 °F

## Hydraulic Seals

It is challenging to ensure seal life and performance in hydraulic applications. Not only must leak-free operation be achieved, but high pressures, temperatures and transverse forces must be sustained. Trelleborg offers one of the most extensive ranges of hydraulic seals on the market. Highlighted here are a few of the most important seals for wind power applications.

Full details of the hydraulic seal range can be found in the hydraulic seals catalog. Contact your local Trelleborg Sealing Solution marketing company for a printed version or download a digital copy from [www.tss.trelleborg.com](http://www.tss.trelleborg.com).

### Zurcon® U-Cup RU9



**Boasting long service life, high wear and extrusion resistance with low friction operation, the Zurcon® U-Cup RU9 is the preferred U-Cup seal for wind power applications.**

- Lower friction and heat generation than standard U-Cups
- High extrusion resistance and seal stability within the groove
- Back-pumping ability over the entire pressure range achieved by grooved profile
- Suitable for use with the Zurcon® Buffer Seal as secondary seal in tandem design

Pressure: Up to 40 MPa / 5,800 psi  
 Speed: Up to 0.5 m/s / 20 in/s  
 Temperature: -45°C to +110°C / -49°F to +230°F

### Slydring®



**Slydring® eliminates local stress concentrations and dampen mechanical vibrations. This simple non-metallic guide ring has decades of engineering behind it, offering major benefits compared to its traditional metal counterpart.**

- Simple closed groove, easy installation
- High load bearing capacity
- Wear-resistant, long service life
- Favourable friction behaviour

Load: Up to 100 N/mm<sup>2</sup>  
 Speed: Up to 15 m/s / 50 ft/s  
 Temperature: -60°C to 200°C / -75°F to +392°F

### Turcon® Stepseal® 2K



**The result of years of research into providing an all purpose fluid seal, revolutionizing fluid sealing in cylinder applications. The seal demonstrates high extrusion resistance and supports dynamic, high frequency operation.**

- Low-friction, increasing performance and working life
- Stick-slip-free starting, no sticking even after extended periods of rest
- High abrasion resistance
- Compatible with virtually all media
- Simple installation without seal edge deformation

Pressure: Up to 80 MPa / 11,600 psi  
 Speed: Up to 15 m/s / 50 ft/s  
 Temperature: -45°C to +200°C / -49°F to +392°F

### Turcon® Stepseal® V



**Engineered to meet continuously increasing demands. Offers a uniform, low friction characteristic, throughout its whole life with its distinctive hydrostatic ventilation function.**

- Check valve function eliminating potential build up of disruptive intermediate pressure between seals
- Hydrodynamic back-pumping
- Available for ISO 7425/2 groove
- Prolonged seal life
- Increased leakage control

Pressure: Up to 80 MPa / 11,600 psi  
 Speed: Up to 15 m/s / 50 ft/s  
 Temperature: -45°C to +200°C / -49°F to +392°F

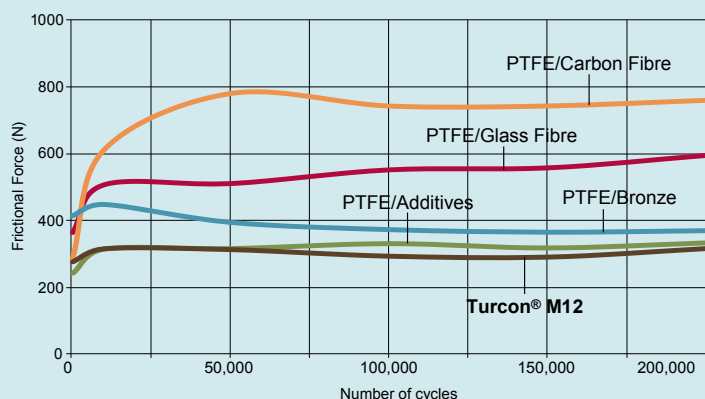
## Specialized Materials

Our extensive range of innovative seal materials and continuous material development helps us deliver exceptional sealing integrity. Any size of O-Ring (standard or custom) is available alongside custom molded seal designs and bonded products. These are available in materials ranging from basic elastomer grades to leading edge, high specification compounds. Our innovative sealing materials help reduce downtime and improve production efficiency by extending seal life.

### Turcon® M12

#### Stepseal® 2K in Mineral Oil

Frictional force for one seal after 200,000 cycles at 30 MPa (mean values)  
0.2 m/s, 60 °C



#### Excels in virtually all hydraulic applications.

Exceptional performance against the most important sealing characteristics; wear, friction and high pressure operation.

Turcon® M12 is a cost-effective material that provides customers with extended seal life, as well as a wide operating window in terms of temperature, pressure and velocity. It performs as well or better than other specialized compounds in each parameter.

- Resistant to virtually all media including a broad range of lubricants
- Outstanding wear resistance and friction characteristics
- Provides extended seal life
- Operates in wide temperature, pressure and velocity ranges
- Minimal abrasion of hardware, preventing damage to counter surfaces
- Robust for harsh environments
- Good resistance to extrusion
- Less environmental impact as it does not include bronze fillers

Other Turcon® materials are available, however, we recommend the Turcon® M12 as the optimum material for wind power sealing.

**For more information contact your local Trelleborg Sealing Solutions marketing company.**

Relying on decades of experience, working with leading equipment manufacturers and end users around the globe, we have developed a portfolio of materials suitable for the wind power sector. To ensure outstanding sealing performance, Trelleborg Sealing Solutions has invested heavily in research to identify the optimum compound for each application.

### Zurcon®

#### Exceptional wear characteristics

Zurcon® engineered polyurethane-based materials exhibit outstanding friction characteristics. That means they are ideal for reciprocating, very slow rotating and oscillating situations where high wear resistance is required.

Zurcon® Z22 outperforms old technology polyester and polyether materials in all critical properties. Continuous testing and outstanding field performance have shown leak-free performance, high abrasion resistance, low compression set, high extrusion resistance and a wide temperature range. Also no additional Back-up Ring is required in applications up to 40 MPa / 5,801 psi when Trelleborg Sealing Solutions installation recommendations are followed.

### Orkot®

#### Bearings for superior performance

Orkot® is a unique synthetic composite incorporating solid lubricants that is ideal for dry running situations, ensuring outstanding wear characteristics and long life. The material shows virtually no swell in sea water and has a very low thermal coefficient of expansion to provide dimensional stability in arctic or tropical conditions. Being non-metallic, the material does not corrode or promote corrosion of the housing and tolerates both edge loading and misalignment. Requiring no lubrication, it is also environmentally-friendly.

### Turcite®

#### Low-friction bearing strip

Turcite® is a low friction linear bearing strip that is dimensionally stable, maintenance-free and can be operated with or without lubrication.

**Contact your local marketing company for further information:**

<b>Europe</b>	<b>Telephone</b>	<b>Americas</b>	<b>Telephone</b>
<b>AUSTRIA - Vienna</b> <small>(ALBANIA, BOSNIA AND HERZEGOVINA, MACEDONIA, SERBIA AND MONTENEGRO, SLOVENIA)</small>	+33 (0) 1 406 47 33	<b>AMERICAS - REGIONAL</b>	+1 260 749 9631
<b>BELGIUM - Dion-Valmont</b> <small>(LUXEMBOURG)</small>	+32 (0) 10 22 57 50	<b>BRAZIL - São José dos Campos</b>	+55 12 3932 7600
<b>BULGARIA - Sofia</b> <small>(BELARUS, ROMANIA, TURKEY, UKRAINE)</small>	+359 (0)2 969 95 99	<b>CANADA - Etobicoke, ON</b>	+1 416 213 9444
<b>CROATIA - Zagreb</b>	+385 (0) 1 24 56 387	<b>MEXICO - Mexico City</b>	+52 55 57 19 50 05
<b>CZECH REPUBLIC - Rakovník</b> <small>(SLOVAKIA)</small>	+420 313 529 111	<b>USA, East - Plymouth Meeting, PA</b>	+1 610 828 3209
<b>DENMARK - Copenhagen</b>	+45 48 22 80 80	<b>USA, Great Lakes - Fort Wayne, IN</b>	+1 260 482 4050
<b>FINLAND - Vantaa</b> <small>(ESTONIA, LATVIA)</small>	+358 (0) 207 12 13 50	<b>USA, Midwest - Hanover Park, IL</b>	+1 630 539 5500
<b>FRANCE - Maisons-Laffitte</b>	+33 (0) 1 30 86 56 00	<b>USA, Mountain - Broomfield, CO</b>	+1 303 469 1357
<b>GERMANY - Stuttgart</b>	+49 (0) 711 7864 0	<b>USA, Northern California - Fresno, CA</b>	+1 559 449 6070
<b>GREECE</b>	+41 (0) 21 631 41 11	<b>USA, Northwest - Portland, OR</b>	+1 503 595 6565
<b>HUNGARY - Budaörs</b>	+36 (06) 23 50 21 21	<b>USA, South - N. Charleston, SC</b>	+1 843 747 7656
<b>ITALY - Livorno</b>	+39 0586 22 6111	<b>USA, Southwest - Houston, TX</b>	+1 713 461 3495
<b>THE NETHERLANDS - Barendrecht</b>	+31 (0) 10 29 22 111	<b>USA, West - Torrance, CA</b>	+1 310 371 1025
<b>NORWAY - Oslo</b>	+47 22 64 60 80		
<b>POLAND - Warsaw</b> <small>(LITHUANIA)</small>	+48 (0) 22 863 30 11	<b>Asia Pacific</b>	<b>Telephone</b>
<b>RUSSIA - Moscow</b>	+7 495 982 39 21	<b>ASIA PACIFIC REGIONAL</b>	+65 6 577 1778
<b>SPAIN - Madrid</b> <small>(PORTUGAL)</small>	+34 (0) 91 71057 30	<b>CHINA - Hong Kong</b>	+852 2366 9165
<b>SWEDEN - Jönköping</b>	+46 (0) 36 34 15 00	<b>CHINA - Shanghai</b>	+86 (0) 21 6145 1830
<b>SWITZERLAND - Crissier</b>	+41 (0) 21 631 41 11	<b>INDIA - Bangalore</b>	+91 (0) 80 2245 5157
<b>UNITED KINGDOM - Solihull</b> <small>(EIRE)</small>	+44 (0) 121 744 1221	<b>JAPAN - Tokyo</b>	+81 (0) 3 5633 8008
<b>AFRICA REGIONAL</b>	+41 (0) 21 631 41 11	<b>KOREA - Seoul</b>	+82 (0) 2 761 3471
		<b>MALAYSIA - Kuala Lumpur</b>	+60 (0) 3 9059 6388
		<b>TAIWAN - Taichung</b>	+886 4 2382 8886
		<b>THAILAND - Bangkok</b>	+66 (0) 2732-2861
		<b>SINGAPORE</b>	
		<b>and all other countries in Asia</b>	+65 6 577 1778
		<b>MIDDLE EAST REGIONAL</b> <small>(WITHOUT GCC REGION)</small>	+41 (0) 21 631 41 11
		<b>MIDDLE EAST GCC REGION</b> <small>(BAHRAIN, KUWAIT, OMAN, QATAR, SAUDI ARABIA, UNITED ARAB EMIRATES)</small>	+91 (0) 80 2245 5157

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