

# WIND TURBINE BEARING SOLUTIONS

INSTILL PERFORMANCE, GUARANTEE RELIABILITY



# Wind Turbine Bearing Solutions

Armed with synergy and feedback from NTN Corporation, NTN-SNR expertise is reflected in the design and manufacture of very high reliability bearings. Actively involved in the high-tech sectors and the most innovative applications, NTN-SNR is always ready for all major current and future industrial challenges. Driving forces behind decisive advances, its bearings have all the qualities **to instill performance at the heart of your wind turbines and sustainably fuel your development.**

Thanks to numerous projects developed in close collaboration with designers and wind turbine operators, we have acquired sound field experience and perfect knowledge of technical and economic priorities of the sector.

This global vision enables us to propose optimised solutions for each application: rotor, turbine gearbox, generator and slewing ring.

As an involved partner, we are committed at every stage of your project

- From the development of specifications, by looking for the technical and competitive solution that is best suited to your application.
- During product development, by defining the geometry and selecting the most appropriate materials, thanks to our proprietary simulation tools.
- During manufacture, where our ultra-modern equipment, our control of processes and the commitment of our teams guarantee an optimal level of flexibility and quality.

Do you have an on-shore or off-shore project to be studied? With unique expertise in engineering, manufacturing and quality assurance, our reliable and efficient bearings will support the success of all your projects.

NTN-SNR: Optimised solutions for every wind application

## Main Rotor Shaft

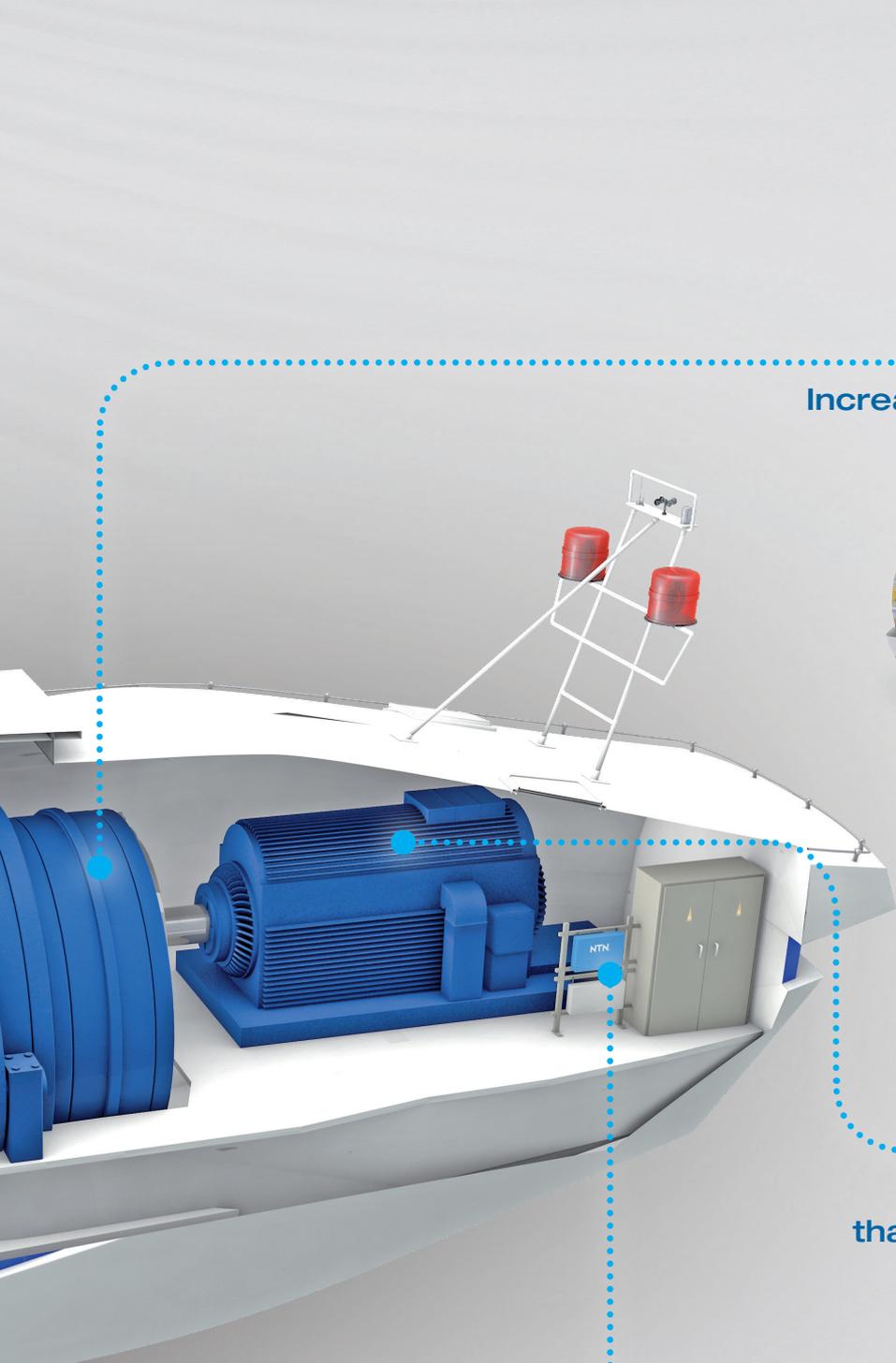
Optimise your turbine performance thanks to our unique expertise in bearings



## Pitch / Yaw

Maximise energy output thanks to perfect pitch and yaw control in the long term





## Gearbox

Increase reliability with robust customized solutions



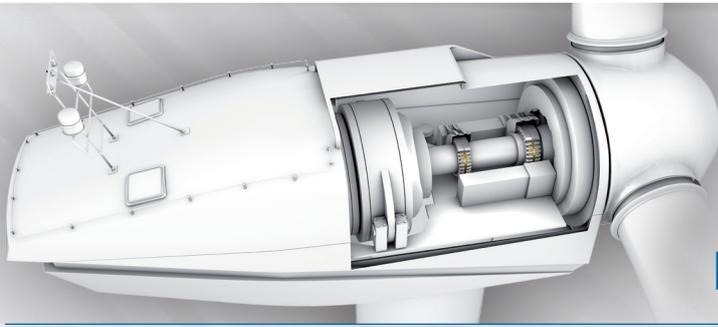
## Generator

Extend generator life thanks to current insulation



## Condition Monitoring System

Lower maintenance cost with online CMS certified by GL



## Main Rotor Shaft

NTN-SNR expertise in bearings will contribute to your turbine performance.

As the OEM supplier from one hundred kws to the latest multi megawatt-class turbines, NTN-SNR offers **world-class technical support** and a **vast product range**, creating an unmatched level of customization to suit the needs of any design. Our expertise in spherical, cylindrical, single and multi-row tapered roller bearings helps to **ensure optimal turbine performance**.

NTN's spherical asymmetrical roller design is commonly used in pairs at the rotor and generator side of the main shaft. By pushing the rollers into the center inner rib, our products allow for smoothly running bearings.

#### Benefits:

- Quieter, low noise level,
- Low heat generation,
- Longer life.

Our cylindrical roller bearings design minimizes roller skew under the variable load and speed conditions. Depending on the need, various cage configurations including steel, brass, resin, and full-complement can be implemented.

#### Benefits:

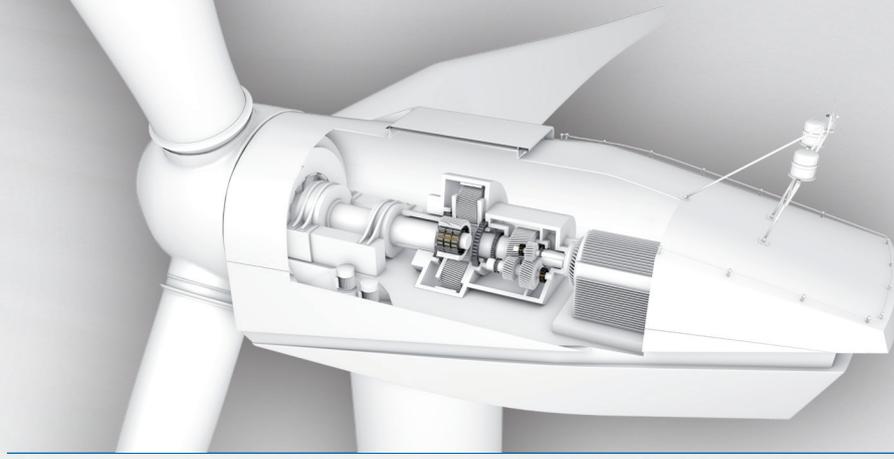
- Excellent temperature stability,
- Increased bearing service life.

For drivetrain designs that require higher stiffness like direct drive architecture for instance, double-row tapered roller bearings provide the necessary radial and axial loading characteristics. Versatile features including integrated sealing solutions, bolted rings can be proposed.

#### Benefits:

- Easier installation,
- Improved serviceability,
- Increased reliability,
- Reduced nacelle weight.





## Gearbox

### Increase reliability and reduce overall life costs with robust NTN-SNR customized solutions

Wind turbine gearboxes operate under a wide range of complex conditions ; strongly varying loads, speeds, and temperatures present great challenges for rolling bearings.

NTN-SNR specialized designs (\*) provide both **high-speed and high-load-carrying capabilities** while maintaining the **high level of reliability** that NTN is known for.

(\*) Optimum load distribution, new material, high steel cleanliness and improved heat treatments increase bearing service life.

In addition to standard cylindrical roller bearings, NTN has developed technology that combines the high-load capacity of a full complement bearing with the high rotational speed capabilities of a caged design.

#### Benefits:

- **Increased load capacity,**
- **Lower friction and energy consumption,**
- **Extended life duration (x1.5 longer than conventional design),**
- **Quick and easy to fit.**



Our high performance taper roller bearings feature optimised rollers and raceway profiles, combined with reduced tolerances and improved surface finishing.

#### Benefits:

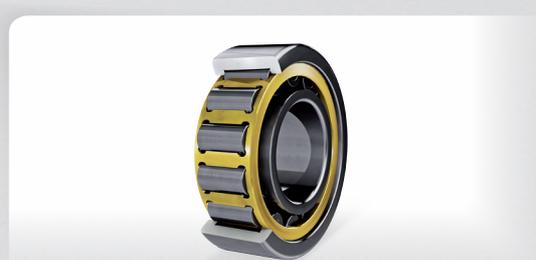
- **Reduced friction,**
- **Lower operating temperature,**
- **Improved gearbox reliability,**
- **Easy mounting / dismounting.**

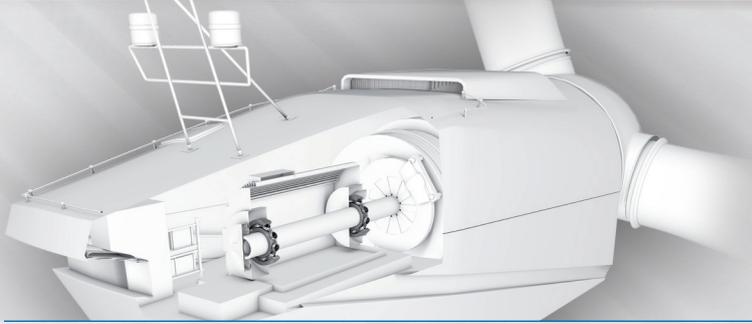


When required, NTN-SNR can apply black oxide treatment to the bearings.

#### Benefits:

- **High resistance to stress,**
- **Strong anti-corrosion protection,**
- **Improved smearing resistance,**
- **Minimised fretting and micro-pitting risks.**





## Generator

Extend generator life and reduce operating costs thanks to NTN-SNR advanced technology

**Insulated** rolling bearings, specifically developed for generators in wind turbines, can prevent raceway damage from any stray electric current while providing **outstanding performance**.



**Hybrid deep groove ball bearings:**  
the highest reliability for the most severe applications.

Ceramic hybrid bearings feature unique design with steel inner/outer rings and silicon-nitride rolling elements. Their unique properties provide outstanding electrical insulation while reducing rotating mass, improving heat dissipation and decreasing operational temperature. Their longer grease life extends maintenance intervals hence reducing life cycle costs.

**Benefits:**

- Excellent protection against current passages,
- Reduced life cycle cost,
- Extended greasing intervals,
- Good operating behavior even under poor lubrication,
- Easy to interchange with existing standard bearings.

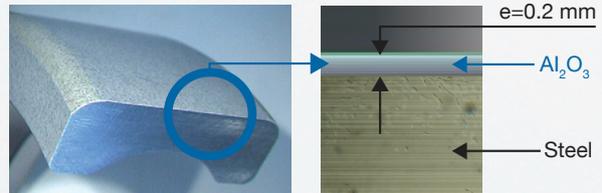


**MEGAOHM™ bearings:**  
the economical solution against stray electric currents.

MEGAOHM™ bearings have a highly crack-resistant ceramic coating applied on the outer surface and side faces of the outer ring.

**Benefits:**

- Economical insulating option,
- Breakdown voltage 3 000 Volts,
- Lower life cycle cost.





## Pitch/Yaw

Take full advantage of available wind and maximize energy output of your turbine thanks to NTN-SNR bearing precision which remains constant over time.

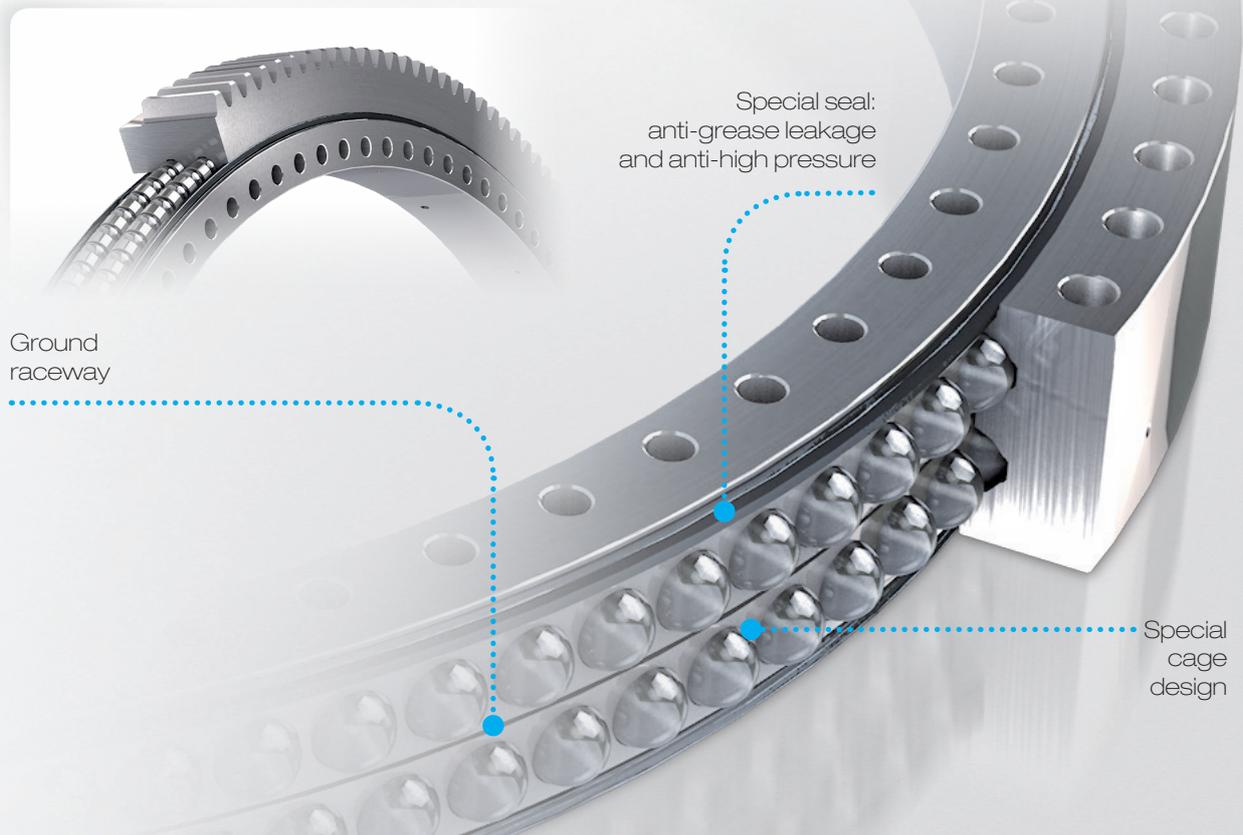
NTN-SNR's excellent design and quality level will ensure **optimal maneuverability in the long term**, and adjust perfect blade angle and nacelle position under all operating conditions.

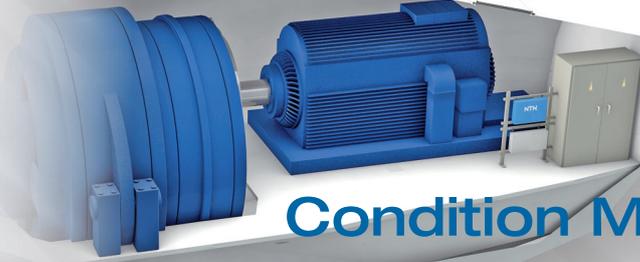
### Features:

- Single or double row 4-point contact ball bearing,
- Special cage design for large size ball,
- With internal or external gearing,
- Aluminium coating for corrosion protection.

### Benefits:

- Slight preload for extra reliability,
- Perfectly sealed,
- Long lasting corrosion protection,
- Low maintenance need.





## Condition Monitoring System

Lower your maintenance costs and improve your profitability with NTN-SNR online condition monitoring system.

NTN Wind Doctor provides you **all the NTN bearing manufacturer knowledge expertise and experience** for most efficient predictive maintenance. Certified by GL.

NTN Wind Doctor CMS is among the world's smallest data acquisition module (250 x 290 x 108 mm). Highly water and dust-proof (IP65), it can operate under wide temperature range (-20°C / + 60°C).

### Benefits:

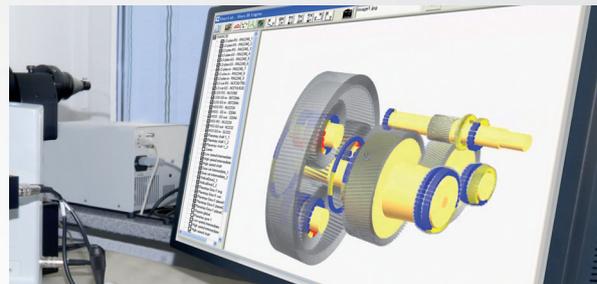
- Adapted to a large variety of wind turbine environments, including offshore locations,
- Early and highly reliable diagnosis,
- Performance / cost ratio adapted to your need.



NTN Wind Doctor has been certified by Germanischer Lloyd  
N° TC-GL-008A-2012

## High added-value services

NTN-SNR works with our customers at all stages of their projects, providing them with the mix of services that they need.



### Design and calculation

During product development, an engineering team, consisting of experts in wind applications, calculation and design of bearings, is fully dedicated to support the customer's project. Thanks to proprietary simulation software "Sharclab", NTN-SNR performs full-flexible calculation of complete gearboxes or main shaft models taking into account interactions with all surrounding components. This modelling, close to real behaviour of mechanical elements, allows fine dimensioning of wind-turbine bearings..

### Testing

NTN-SNR laboratory is equipped with a wide range of test benches, able to accept all bearing types and dimensions, up to 3.5 meters. They aim to check that bearings selected by engineering department fulfill customers specifications (life duration, lubrication conditions, temperature, lubrication conditions, temperature...) and help to better understand specific challenges of the application.

### Supply chain

Thanks its strong and long experience NTN-SNR has selected and validated the best in class partners able to supply the top quality level for the Wind market. Our state of the art assurance quality process supports our supply chain to meet your most demanding specifications from the prototype to serial production.

### Bearing analysis

Experts of our technical support department can perform complete analysis of bearings after operations on wind-turbines.

This analysis (visual inspection, molecular and electron microscope analysis) helps the engineering department to tune their design, and improve bearing reliability.

### Training

The oretical and practical technical training modules are available for our customers who need to get a better understanding of bearing design, assembly, and working conditions.

### Customer support

Thanks to the experience and skills of our engineering teams, we are able to provide dedicated support to customers on each project, from the early development to the complete life cycle of products.



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