INNOVATIONS OF GREAT VALUE

ZF TECHNOLOGY IN WIND TURBINES

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ENABLING THE POWER OF WIND.

For centuries, people have used the power of wind for sailing ships, milling grain and pumping water. More recently, wind turbine technology has enabled us to harness this energy source for generating electricity.

 Integrated Technology Leaders

Increasing global electricity consumption in parallel with expected exhaustion of fossil fuel sources are inciting a new era of environmental awareness thereby setting pathways to employ renewable energy sources such as wind energy.

ZF Wind Power is a globally established designer, manufacturer, and supplier of tailor-made gearboxes for wind turbines. The business unit is part of the Division Industrial Technology within the ZF Group and the result of a successful integration between two technology leaders. The merger between ZF, one of the world’s leading automotive industry suppliers, and the former Hansen Transmissions, one of the major players in wind turbine gearboxes, is propelled by a combination of experience, expertise, efficient production, and innovation. As one of the world leaders in the sector of high precision and high performance gearboxes for wind turbines, ZF Wind Power aims at establishing interactive partnerships with customers, embracing design, manufacturing and customer services, thereby bringing mutual benefit.

A proven track record

Drawing upon a proven track record and expertise as an industrial gearbox manufacturer since 1923, ZF Wind Power became an early entrant into the wind power transmission business in the late 70s, when large-scale wind power development was still in its infancy. Since then, the company has consistently confirmed its pioneering role at the cutting edge of wind power transmission technology. Over decades, ZF Wind Power has carved out a reputation as a top-tier global supplier of innovative and durable gearboxes to about all of the world’s leading gear-driven wind turbine manufacturers. Ever since ZF Wind Power first entered the wind turbine market in the late 1970s, its manufacturing plants have shipped more than 25,000 gearboxes.

Hansen Transmissions: It all started in 1923...

...with the founding of „La Mécanique Générale“, a small workshop in Antwerp producing spare parts for gear units. Under the influence of the visionary engineer David Hansen, the company’s activities gradually shifted towards the production of customized gear units. The breakthrough came in 1950 when David Hansen invented the concept of „gear unit standardization“, patented worldwide as the „Hansen Patent“. After successful patent application Hansen founded its subsidiary “MGIH” (Machinery & Gear Hansen), soon acknowledged as innovation leader in industrial power transmission technology. In 1966, La Mécanique Générale and MGIH merged and in 1972 the name was changed into „Hansen Transmissions“. In 2011, ZF acquired 100 % of Hansen Transmissions.

A Bright Future ahead with ZF

As a leading worldwide automotive supplier for Drive-line and Chassis Technology ZF can look back over 100 years of experience in developing and building transmissions. The combination with more than 30 years of experience of former Hansen in wind energy and overall almost 90 years of experience in transmissions for all kinds of industrial applications makes ZF Wind Power a knowledgeable partner. Literally two centuries of experience are combined through ZF and Hansen Transmissions. The designated expertise enables the company to supply major manufacturers of gear driven wind turbines with gearboxes ranging from 1.5 to 6.15 MW power capacity.
Delivering custom-built solutions

The prevailing trend within the wind industry towards ever more powerful, reliable, and available turbines in challenging operating conditions requires far-reaching customization of all vital components.

Producing multi-megawatt gearboxes efficiently in serial production with a consistent high level of quality and reliability requires excellence in manufacturing, logistics, assembly and testing. ZF Wind Power is continuously investing to excel in its core activities of heat treatment, gear grinding and housing machining, resulting in state-of-the-art gearboxes. These critical activities are all performed in-house.

Over three decades of knowhow in the wind industry and long-term partnerships with the world’s leading wind turbine manufacturers and operators, have enabled ZF Wind Power to confidently meet any challenge customers may address – from highest efficiency standards, sustained durability, reliability and extended longevity of gearboxes to weight-reduced gearboxes with low-noise performance. Gearboxes are co-designed, co-developed and custom-built to precise specifications from customers worldwide. ZF ensures maximum control over quality and provides at the same time a high level of flexibility.

The development of a new product starts from proven and approved technology, which reduces the product validation process to the validation of the specific application of the technology. In addition, new products are conceived based on proven drive train concepts. In this way, ZF Wind Power’s product portfolio is developed in a matrix of torque scale versus drive train concept, where every specific customer concept is covered – from medium to high speed and from conventional to integrated design. This approach minimizes the time required for conceptual design and guarantees the exclusive use of known and proven concepts, which in turn ensures functionality, quality, and suitability for the ZF Wind Power manufacturing environment.

Medium speed solutions

ZF is one of the industry leaders when it comes to integrated medium speed drives for wind turbines, with the prototype of our medium speed gearbox already introduced in 2009. ZF medium speed gearboxes operate already for more than two years in the field. With this experience, and following the growing market interest in wind turbines with medium-speed generators, ZF Wind Power is the ideal partner for developing new medium speed drives in the multi-megawatt class. This starts from the concept phase exploring opportunities for cost of energy reduction dedicated to the specified market conditions. Here, these hybrid solutions can offer an attractive balance between cost, reliability, complexity and efficiency. ZF Wind Power can furthermore realize (from the development phase) the complete testing phase at their in-house test facilities to achieve premium product quality in line with conventional designs. Both conventional and medium speed solutions have their advantages, as each offers the opportunity to reduce cost of energy, when employed in the right market conditions.

High speed solutions

With its product range for high speed drive wind turbines ZF Wind Power banks upon proven design concepts in typical configurations. This ZF product range in combination with the widely used Doubly Fed Induction Generators (DFIG), offer an overall drive train that is both proven in the field as well as cost optimized.

High-tech

High-precision manufacturing and careful handling during assembly and pre-testing are mandatory for smooth and reliable operation in field conditions.
With a long tradition of innovation, ZF Wind Power seeks to differentiate itself in the marketplace by means of quality and reliability in customized solutions for different concepts used by its customers in their markets: Integrated, Conventional, High Speed and Medium Speed.

ZF product designs combine planetary and helical gear stages, with optimized dimensioning of bearings and shafts and continuous oil circulation through the bearings. These technologies ensure excellent strength and torque capacity, surface durability and low noise performance as well as optimum bearing life under specified loads, thereby contributing to the gear unit’s long, trouble-free working life.

A proven track record
ZF Wind Power invests in core manufacturing activities such as assembly, testing, heat treatment, gear grinding and housing machining. We use dedicated and fully integrated production facilities, building on 90 years of experience in gear and gearbox manufacturing in all kinds of industrial applications and almost 35 years in wind turbine gearboxes. Performing all critical activities in-house allows us to have full control over quality at all stages of production. We believe this is an essential prerequisite to delivering the high-quality serial products with constant performance characteristics required by the world’s leading wind turbine manufacturers.

Look into a high tech gearbox of ZF Wind Power and watch the animation on your smartphone.
SERVICE OFFERING

Wind energy plays a key role in the carbon-free energy mix of the future. Worldwide, an increasing number of wind farms are being developed onshore and offshore. As a reliable partner on all continents, ZF supports its customers with a comprehensive service portfolio for the maintenance and repair of wind turbine gearboxes.

ZF – your specialized service partner

ZF understands the customers’ need of total reliability for maximum productivity. ZF offers fast and individual solutions for ZF and non-ZF mechanical drivetrain repair and service. As a leader in wind turbine gearbox design and development, ZF wants to ensure that our customers and partners gain maximum benefit from their investment in renewable energy. Therefore, in addition to producing the world’s most innovative and reliable gearboxes, ZF does everything to keep them operating at the highest possible efficiency level – 24/7.

Serving your needs

ZF stands for customer-oriented and flexible service of the complete mechanical drivetrain for wind turbines based on a number of specific solutions for repairs, upgrades and extensive support programs. Low lifetime cost combined with high availability and minimum downtime is the key to a short payback of investments in wind power in the wind energy business.

ZF integrates the advantage of using genuine ZF parts for repairs at our specially equipped regional wind service centers and by our global field service teams. Since 1979 ZF offers a wide range of options to best suit your specific requirements and as an expert to advise you on the service you need. ZF builds on many years of experience and on the know-how and technological expertise developed in our company over the decades.

Since 2007, ZF increased its existing service portfolio by offering repairs and services for a variety of gearboxes including gearboxes from other manufacturers, as well as offering repairs on main shafts and yaw/azimuth gearboxes.

Our field service teams and worldwide service centers are committed to execute repairs, maintenance and upgrades according to ZF’s specific solutions and high quality standards. Our dedicated support programs make sure our service teams can swiftly react to sudden demands. For example ZF offers replacement gearboxes and a dedicated stock of replacement parts, such as geared parts and bearing sets. Intensive cooperation with customers helps to continuously improving our service offer with the goal to minimizing turbine down-time.

ZF offers a complete and comprehensive range of services for the repair and service of wind turbine gearboxes, both onshore and offshore.

Global field service network
Failure analysis by video endoscopy
Service of main gear units
Repair and testing of mechanical driveline components
Repair of main shafts and yaw/azimuth gearboxes
Training in all matters relating to the gearbox

Learn more about
the ZF portfolio in the
field of wind energy technology.
UNRIVALLED SIMULATION AND TESTING CAPABILITIES

ZF offers a variety of test rigs — for inhouse testing and companies worldwide. Decades of experience and know-how are the base for high performance development and series test rigs.

ZF Test Systems, the independent system supplier for advanced test systems, offers test rigs for nacelles, drive trains and other wind turbine components as turnkey facilities with CE-marking, thus obviating any safety risks and customers need for expensive interfaces. The provided test rigs from 0.5 MW to 18 MW are used for research and development as well as for series production and service of wind power gearboxes and nacelles. They offer the following testing functions: endurance strength, overload behavior, efficiency, service life and wear, temperature behavior, structure-borne noise, air-borne noise, function, run-in test under load application, noise and cleaning of oil circuit.

**13.2 MW dynamic gearbox test rig**
ZF Wind Power’s dynamic gearbox test rig is one of the world’s largest test facilities in its kind matching the continuously increasing wind turbine power in the market. By means of this test rig ZF Wind Power is able to test gearboxes under representative wind turbine loading conditions, i.e. wind turbine operational conditions are reproduced by means of a set of dedicated and parameterized load cases. These test rig allow enabling accelerated life testing to identify potential technical risks upfront and, consequently, further improve gearbox reliability.

**ZF dynamic bearing test rig**
This test rig is the most advanced facility of its kind to test real size bearings in their actual arrangement as built in the gearbox, under representative wind turbine loading and environmental conditions. The flexible test rig design reproduces the same shaft and housing deflection as the real gearbox and enables the verification of bearing behavior and loadability of bearing assemblies.

**DORoTe: unveiling the unexpected**
ZF’s “Design Operational Robustness Test” philosophy – DORoTe – has been developed to assess the robustness of a new gearbox design with respect to the operational conditions as specified by the customer. This test philosophy takes principles of accelerated life testing (HALT) one step further by incorporating dynamics and transients of wind turbine applications.

**TESTING COMPETENCE**
Over the years ZF Wind Power has invested in cutting-edge test infrastructure, simulation models and test algorithms such as DORoTe to prove gearbox robustness.
Meeting the individual needs of the global wind energy market.

With state-of-the-art manufacturing plants and worldwide service locations, ZF is dedicated to delivering custom-built solutions and services on a global scale.

Customer satisfaction with the products and services provided by ZF is the topmost objective in all company activities. All services integrated into the product cycle, ranging from development and consultancy to aftermarket service, are derived from this. Thus, proximity to international customers is of great significance to ZF.

ZF Global Footprint
ZF Wind Power currently operates 4 state-of-the-art manufacturing plants with an annual output capacity of approximately 10,000 MW. The business unit has a global footprint with a manufacturing presence in Belgium, India, China and the US, worldwide sales and service operations and a more than 1,500 strong workforce. Worldwide, the ZF Group has 122 production companies in 26 countries and eight main development locations. In addition to that, ZF has 52 service companies as well as 650 service points. This enables ZF to provide a dense network of highly qualified contacts close to international customers at all levels and in all regions.

Globally present, locally anchored ZF delivers original spare parts for wind turbine gearboxes paired with fast, comprehensive services, upgrade and maintenance support embedded in a seamless network of contracting partners and owned subsidiaries in order to maximize turbine operational availability and overall wind farm operating efficiency, minimize downtime for repairs, maintenance and servicing.

GLOBAL TESTING CAPACITY ZF is able to test and validate all prototypes and serial gearboxes in all its production plants. ZF has a unique global load testing capacity of almost 60 MW.