Koyo®

Products for Wind Turbine Generators

JTEKT

JTEKT CORPORATION

JTEKT Koyo TOYODA

CAT. NO. B1002E-4

For the Environment…

Wind turbine generators efficiently turn one of the elemental forces of Nature into a stable supply of electric power. JTEKT has used their 90+ years of friction management experience to developing world leading bearing, sealing and other technologies to the rapidly advancing field of renewable power generation thus enabling Wind Turbines to achieve an operation life of 25 years or more.

Main shaft bearings

Gearbox bearings

Generator bearings

Products for peripheral equipment

1

2

Main shaft bearings

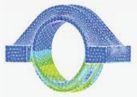
Main shaft bearings of various types and sizes are required to support the diverse wind turbine designs and the ever increasing size of both onshore and offshore wind turbines.
JTEKT is committed to answering the needs of its customers through high reliability and speedy development.
(Main shaft: An important component that supports the wind load applied by the blades and transfers the rotational torque to the gearbox.)

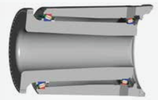

Tapered roller bearings


Spherical roller bearings

Supporting market demands for smaller, lighter and more reliable bearings, JTEKT is leveraging new technologies to develop and mass produce industry leading tapered roller bearings.

- **Utilizing advanced roller movement stabilizing technology in our spherical roller bearings and low-torque design technology of tapered roller bearings JTEKT has extended the service life of the main shaft bearing grease by reducing bearing temperature increases.**


FEM analysis model


Main shaft configuration

At JTEKT's Kokubu Large-Size Bearing Engineering Development Center, we have validated our FEM analysis results with full size test equipment. This allows us to confidently optimize the internal and external geometry of the bearings based on the mathematical analyses of the entire Wind Turbine drivetrain and structure.

Certified by DNV-GL*

The high quality of JTEKT bearing materials has been evaluated and consequently received certified approval from DNV-GL to increase our published load ratings by 25%. This allows for more accurate life predictions and the confidence to use optimally sizes bearings.

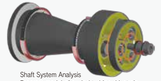
* Certification acquired November 2015

Large-Size Bearing Engineering Development Center

A new testing facility has been installed in our Large-Size Bearing Engineering Development Center to evaluate actual wind turbine drivetrains allowing for higher reliability and shorter customer development periods.

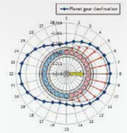
JTEKT's proprietary Shaft System Analysis Program

In addition to analytical techniques such as FEM, JTEKT has developed a bearing analysis system that enables detailed calculations of bearing life considering rigidity of peripheral components and lubrication conditions during operation. With this system, reliable and speedy technical verification is possible, thereby ensuring optimal bearing selection.

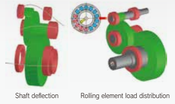

Shaft System Analysis
Program model of a wind turbine drivetrain.


Main shaft bearing rolling element load distribution (front)

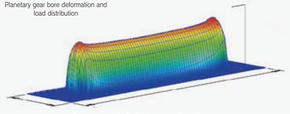

Main shaft bearing rolling element load distribution (rear)



Planetary gear bore deformation and load distribution


Shaft deflection

Rolling element load distribution


Contact stress distribution between roller and raceway

Gearbox bearings

Gearbox bearings vary greatly in regards to type, load capacity and rotational speed depending on where they are used in the gear train.
JTEKT responds to diversified customer requests by ensuring optimal designs based on strict calculations.
(Gearbox: Mechanism that increases the rotational speed transmitted via the main shaft up to a speed where electric power can be generated.)


double-row cylindrical roller bearing for planetary gear

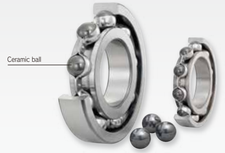

double row tapered roller bearing with integrated planet gear

Responding to market needs, JTEKT uses special carburized steel and surface treatments help us to achieve higher reliability under severe lubrication conditions and high-rotational speed variations.


Bearing with special surface treatment minimize roller slippage and improves lubricity

Generator bearings

Electric pitting is a common cause of bearing failures in wind turbine generators due to stray electrical currents.
Insulated ceramic bearings eliminate electrolytic corrosion (commonly called fluting)and extend bearing life.
(Generator: The device that converts rotational energy into electrical energy.)



Insulated (hybrid) ceramic bearing

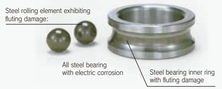
Rolling elements in insulated ceramic bearings are made from silicon nitride ceramic (Si_3N_4)
JTEKT was the first company in the world to develop and install insulated hybrid ceramic bearings in Wind Turbines.
The use of hybrid ceramic bearings contributes to the reduction of maintenance costs and improves operating efficiency.

Characteristic		Silicon nitride	High carbon chromium (bearing steel)
Heat resistance	℃	800	180
Density	g/cm³	3.2	7.8
Coefficient of linear expansion	1/℃	3.2×10^{-6}	12.5×10^{-6}
Vicker's hardness	Hv	1300 to 2000	700 to 800
Young' s modulus	GPa	310	210
Poisson's ratio		0.29	0.3
Magnetic property		Nonmagnetic	Magnetic
Electrical Conductivity		Insulator	Conductor
Material type		Covalent bond	Metallic bond

Comparison of ceramics and bearing steel properties

Eliminates electric corrosion and extends grease life

Compared to bearings with ceramic coated outer rings, hybrid ceramic bearings are not susceptible to insulation degradation due to handling damage. Additionally, ceramic balls lower the operating temperature of the bearings; extending both grease and bearing life.



Products for peripheral equipment

Bearings for yaw-drives

JTEKT supplies optimally designed tapered roller bearings and needle roller bearings that simultaneously provide high reliability and rigidity needed to withstand extreme wind gusts.

Technology to improve bearing robustness	
Larger rolling element design (R-type design)	Rated capacity improved **1.1 to 1.2 times**
Special heat treatment (KE treatment, SH treatment)	Fatigue life more than **doubled**
Optimized crowning	**Improved life under misalignment conditions**

Main Shaft Oil Seals

Full rubber seals (MS-type and MSA-type)

- Full rubber material makes installation easy
- Split MS-type seals also available as replacement
- MSA-type with dust lip available for environments with excessive dust


MS-type

MSA-type

HPI Hydraulic Pumps

HPI hydraulic pumps are highly efficient, lightweight and compact. They also have a long life and high reliability.

Hydraulic pump for pitch brakes

Used for pitch brake hydraulic power units.
The hydraulic power unit reduces the rotor speed using a disc similar to the way disc brakes are used to slow down an automobile.

Series 0

Model	Capacity (cc/rev)	Peak pressure (MPa)
0025	0.25	28.0
0050	0.5	28.0
0075	0.75	25.0
0100	1	25.0
0125	1.25	20.0
0150	1.5	15.0
0200	2	12.5

Hydraulic pump for pitch controllers

Hydraulic power is used to change blade pitch angle to insure operation at the turbine's rated speed.

Series 1

Model	Capacity (cc/rev)	Peak pressure (MPa)
1001	1.02	30.0
1002	2.05	30.0
1003	3.07	30.0
1004	4.09	25.0
1005	5.12	20.0
1006	6.14	15.0

Note: The body is made of aluminum alloy.
The photographs are for reference only.

Machine Tools

JTEKT also manufactures high performance Toyoda machining centers for the production gear boxes and other large wind power components.
Large, Fast and Strong – Top of the class in all three areas
Optimal horizontal machining center for large-size parts machining

FH1250SX
Large horizontal machining center

Quick rapid feed rate of 42m/min, fastest in its class

Max. workpiece range: ⌀ 2,400 x 1,800mm
Pallet load capacity: 5,000kg
Pallet size: 1,250 x 1,250mm


Large-torque spindle: 8,000min⁻¹
Max. spindle torque: 1,009N·m

FH1600SW5i
Large horizontal machining center

Equipped with TOYOPUC-Touch, a new CNC incorporating smartphone-inspired operability

Max. workpiece range: ⌀ 3,200 x 2,200mm
High-rigidity quill spindle: ⌀ 150mm quill, ⌀ 200mm high-rigidity bearing

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