

## Reliable main and blade bearing technology

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### Summary

Wind turbine generator sets for multi- MW applications become larger and larger. Further reduction of LCOE is closely linked to an increase of per unit size and an outstanding reliability of components used. Within the past 35 years, Rothe Erde developed and produced blade, yaw and main bearings for nearly all major turbine manufacturers. Based on this outstanding experience, the strategy to meet the enhanced requirements of tomorrows wind industry is further strengthened.

This publication describes how research and development including testing and analysing capabilities are aligned in order to meet the above listed requirements. Special focus is given on testing capabilities and results for bearing applications of Multi- MW- applications.

### 1. Experience

Rothe Erde supplies bearings for wind energy turbines for more than 35 years. More than 300.000 blade & yaw bearings and more than 2000 induction hardened main bearings have since been delivered. Many of those operational in off shore conditions.

Main bearings supply started in 1989. Until today, nearly all common main bearing designs have been produced. Different kinds of hardening technologies have been applied. Based on an enhanced induction hardening procedure without soft spot, application dependent design characteristics even for very large main bearings can be realized. Early failures like white etching cracks are not known with this technology.



Fig. 1: tk Rothe Erde main bearing track record (<2015)

### 2. Calculation and analyses

Starting in the early 90ies, Rothe Erde developed and continuously optimized the internal bearing analyses code called REBA. This calculation procedure allows analysing the non- linear bearing characteristics taking all relevant boundary conditions into account [1]. This procedure has been thoroughly

checked and benchmarked by an independent external expertise [2]. This publication gives further insights in the independent third party benchmarking and latest developments targeting to meet the requirements of tomorrows wind industry.

### 3. R&D including testing

Testing of large bearings and there components may have different targets. On the one hand, understanding and evaluating of physical phenomena or product characteristics might be matter of investigation. On the other hand, life time and permissible values for prior mentioned calculation tools might be in the centre of interest. Both targets may lead to significant differences in testing strategy and setup.

This publication gives insights in a testing strategy and equipment, meeting both targets. Doing this, testing of blade and main bearings of wind turbines for more than 30 years, statistically firmed life time limits of large bearing technology are available.

An outlook is given for a rig, capable of testing 12MW+ bearings & Hub's as well as equipment to monitor it's bearings deformation & loads.

### 4. References

- [1] T. Handreck, D. Becker, et. al.: Determining the characteristics of large diameter ball and roller bearings; Conference for Wind Power Drives; Aachen; 2015
- [2] M. Neidnicht, T. Griggel, et. al.: Reliable calculation of slewing bearings for the industrial practice. Bearing World 2018, Kaiserslautern