Asymmetrical Spherical Roller Bearings for Wind Turbine Main Shafts

Asymmetric design of left and right roller rows for longer operating life and better wear-resistance characteristics

Wind turbine main shaft bearings are subjected to axial loading caused by wind loads, in addition to radial loads from the weight of components including the rotors and blades. The use of spherical roller bearings for such applications results in the rear row (power generator side) being subjected to large loads while the front row is more lightly loaded (see Fig. 1). Additionally, spherical roller bearings have a characteristic of rolling and sliding due to inherent internal geometry. These conditions, combined with insufficient lubrication at the roller/raceway contact, lead to wear at the raceway surface in areas with a high PV value. As a result, damage might occur, particularly in the outer ring of the rear side.

Asymmetrical spherical roller bearings for wind turbine main shafts have an asymmetrical design of the internal left and right roller rows. This allows the left and right roller rows to distribute loads more evenly, giving the bearings a longer operating life and better wear-resistance characteristics compared to conventional spherical roller bearings.

Features
- **Asymmetric design of left/right roller rows:** Asymmetric bearing design with different length and contact angles between the rollers in the left and right rows
- **Increased wear-resistance:** Better wear-resistance characteristics due to a reduction in PV value of approximately 30%.
- **Extended operating life:** Approximately 2.5-times longer life when compared to theoretical life of the standard product.

Compared to conventional products, the contact angle of the developed product is smaller at the front row and larger at the rear row. Additionally, the length of the rear row is longer than the front row, allowing for more efficient support of axial loads from the wind on the rear row and better support of radial loading on the front row.

The asymmetric spherical roller bearing is designed with a central rib on the inner ring. The maximum diameter position of the roller is located towards the center of the inner ring to prevent roller skewing.

Solutions from NTN

**Solution 1**
An asymmetric spherical roller bearing design can be selected with the same boundary dimensions as the conventional product, resulting in longer theoretical operating life and better wear-resistance characteristics.

**Solution 2**
An asymmetric spherical roller bearing design can be selected with approximately 10% reduction in inner diameter and 30% reduction in weight to achieve a similar theoretical operating life as the conventional product.

Fig. 1 Axial load acting on wind turbine main shaft bearing