

# TURBOMACHINERY

## Auxiliary Rolling Bearing Solutions for Active Magnetic Bearings

In fast spinning rotary systems Active Magnetic Bearings (AMBs), which work on the principle of magnetic levitation, are used to suspend shafts contactless and wear-free. AMBs often operate in turbo molecular pumps, blowers, turbo compressors, gas expanders but also in machine tool spindles. In case of an AMB failure or temporary electrical power loss, auxiliary bearings will catch the shaft before the rotor is touching the stator. In case of a shaft drop the auxiliary bearings are accelerated from zero to operating speed within a split second. CEROBEAR aux bearings have successfully proven their capabilities at speed factors ( $n \times dm$ ) of up to 3.2 Mio mm/min. Due to their customized geometry they can control shafts even at the highest radial and axial shock loads.

*Customers can choose from different aux bearing specifications.*

According to their preference, customers can choose from different aux bearing specifications. State-of-the-art are superduplex bearing designs, which feature a one-piece, double row inner ring in combination with an axially split outer race. The advantage of the superduplex configuration is the more uniform load distribution to both ball rows, which leads to lower Hertzian stress in the rolling contact. For less demanding applications CEROBEAR also offers pairs of single row angular contact ball bearings. Both specs are available for spring- or hard preload, for the latter one CEROBEAR offers an extremely precise bearing matching, the gap between the outer races is tolerated to  $\pm 2.5$  microns.

On the material side CEROBEAR offers a variety of superior



*CEROBEAR Superduplex Auxiliary Bearing Design*



*Customized Internal Geometry for better Bearing Performance*

choices compared to standard bearing steel. Heart of every aux bearing are silicon nitride ( $\text{Si}_3\text{N}_4$ ) balls.  $\text{Si}_3\text{N}_4$  is an inert and very hard (1550 HV) ceramic material, which provides a 60% lower density and a 40% reduced coefficient of friction compared to standard bearing steel. Due to their low density it needs less energy to rotate ceramic balls, hence ball skidding is suppressed. And even in the case of skidding there is no adhesive wear between races and balls because of the inertness of  $\text{Si}_3\text{N}_4$ . CEROBEAR matches the  $\text{Si}_3\text{N}_4$  balls with bearing races made from High-Nitrogen-Steel (HNS) or M50 tool steel. Due to the advanced corrosion resistance of high-nitrogen-steel the auxiliary bearings can even operate in aggressive process medias like  $\text{H}_2\text{S}$  (sour gas). In combination with a customized cross section, curvatures and contact angle this leads to superior bearing load capacity and service life.

CEROBEAR aux bearings normally operate cage-less, in full complement arrangement, but are also available with a segmented cage. The segmented cage avoids the ball to ball contact and hence allows more drops at high speed without having wear on the balls.

In applications in which the bearings are directly exposed to process gases the aux bearings have to perform without oil or grease lubrication. For these conditions CEROBEAR offers coatings, e.g. silver or  $\text{WS}_2$ , which act as a solid lubricant. The solid lubricant reduces not only the rolling friction but also the friction between the shaft and the inner ring, which helps to prevent shaft whirl situations.