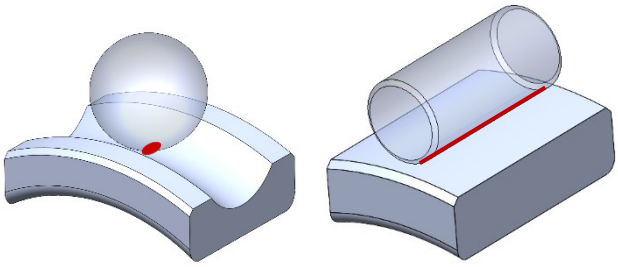
"Stress Inside the Bearing"

Subject: Bearing Operation

Just like any mechanical support, a bearing is stressed from the load it supports. If the stress is too great the bearing will either not perform properly or will not perform for very long. We all know that force applied over an area equals stress ($stress = \frac{F}{A}$). So logically if the area is increased the effect of the force will be lessened or in other words the stress will be reduced. As a result, it is often the choice to simply increase the size of the bearing if a load is creating too much stress. But as bearing engineers, the internal geometry can also be shaped and designed to handle a load better without increasing the size of the bearing.

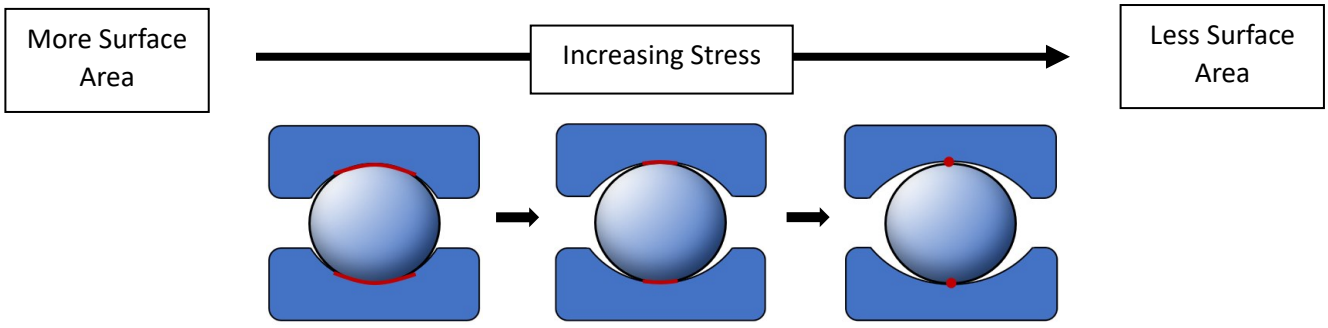
Hertzian Stress



Hertzian stress is a term used to describe the contact stress that occurs between two curved surfaces, such as in the case of ball or roller bearings. It is named after Heinrich Hertz, a German physicist who made significant contributions to the understanding of contact mechanics. Hertz's equations assume elastic deformation and Hertzian contact theory. Hertzian stress is influenced by factors such as the radial and axial loads, the geometry of the rolling elements and raceways, operating speed, and the material properties of the bearing components. The goal in bearing design is to ensure that the Hertzian stresses remain within acceptable limits to prevent excessive deformation, component damage, heat generation, lubricant degradation, and reduced bearing life. Hertzian stress calculations provide valuable insight into the contact mechanics and plays a crucial role in the bearing engineer's decision-making process for optimizing bearing design to achieve reliability and efficiency objectives.

Effect of Curvature and Size

In ball bearings, raceway curvature is the ratio of the ball radius to the cross-raceway radius. So, when the ratio is small, as seen below on the left, the race will tightly conform to the ball, as opposed to the bearing on the far right which loosely conforms to the ball radius. A similar effect happens with increasing the ball size, which will increase the load carrying ability of the bearing. This must be weighed against increased friction and centrifugal loads. Bearing designers along with high precision bearing manufacturing capability can vary and control these relationships to adjust stress and optimize performance.



Contact NES

Designing the right bearing and determining the stress level appropriate for an application requires an in-depth knowledge of the bearing requirements and the system that it operates in. For more information on this topic contact Bearing Engineers, Andrew Hvizdzak (ahvizdzak@nesbearings.com) or Tim Asquith (tasquith@nesbearings.com).