Bearing Selection to Improve Gearbox Reliability

Selecting proper bearings is critical to maximizing gearbox life, reliability and mill production. The heavy-duty requirements placed on mill gearboxes, and therefore their bearings, drive the need for highly detailed bearing selection. This article covers several types of gearboxes seen in steel mills and provides direction for selecting the optimum bearing types for the various mill gearbox applications.

Author

Cory Langhoff, Application Engineer, The Timken Co., North Canton, Ohio, USA
cory.langhoff@timken.com

Introduction

Gearboxes are critical pieces of equipment in metals processing facilities. Virtually every piece of equipment throughout the entirety of a mill is coupled to some form of gearbox. While the bearings contained within a gearbox may be less than 10% of the total cost, they can account for drastic production losses if premature damage removes a gearbox from service unexpectedly. The design of the gearbox and the gearing type play a large part in driving bearing selection. The many variables associated with varying designs all yield different challenges that some bearing types are better equipped to handle than others. This, coupled with the increased prevalence of advanced high-strength steel (AHSS), is continuously pushing the limits of not only gearboxes but all mill production assets, and drives the necessity for the proper bearing selection to maximize reliability and production. While the gearbox original equipment manufacturer (OEM) is responsible for the initial bearing selections, bearing types can often be changed by qualified gearbox rebuilders if the initial selections are not performing.

Discussion

Bearing Selection Criteria

Historically, gearbox OEMs have selected bearings based on achieving a minimum catalog life (L10) of 50,000 hours as recommended by ANSI/AGMA 6115-A13.[1] Catalog life (Eq. 1) is defined as the number of hours (or revolutions) that 90% of a group of (apparently identical) bearings will meet or exceed, under a given set of conditions, before fatigue damage occurs.[2]

$$L_{10,hrs} = \left(\frac{C_i}{P}\right)^{\frac{10}{3}} \times \left(\frac{i \times 10^6}{60 \times s}\right)$$

(Eq. 1)

where

C_i = bearing dynamic capacity based on 1 million (C_1) or 90 million (C_{90}) revolutions (lbf or N),

i = 1 or 90 based on corresponding bearing capacity,

P = dynamic equivalent radial load (lbf or N) and

S = speed (RPM).

Load is determined at the base motor rating and does not necessarily account for minimum load conditions when the gearbox is operating at idle speed in between production cycles, which can have a drastic effect on bearing performance. Evidence from industry has