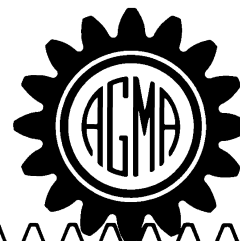


Development of a Gear Rating Standard – A Case Study of AGMA 6014-A06

by: F.C. Uherek, Rexnord Geared Products

American Gear Manufacturers Association



TECHNICAL PAPER

Development of a Gear Rating Standard - A Case Study of AGMA 6014-A06

Frank C. Uherek, Rexnord Geared Products

[The statements and opinions contained herein are those of the author and should not be construed as an official action or opinion of the American Gear Manufacturers Association.]

Abstract

The AGMA Mill Gearing committee recently released AGMA 6014 rating gears for grinding mill and kiln service. In the development of this standard, the committee took a different approach to determining the end result of the standard writing process. Through review of previous standards, the reluctance of the user community to support the street version of 6004, performance history for these long life (over 20 years) applications, and extreme size of this type of gearing, the committee achieved consensus on a new rating method derived from 2101 rating practice. A factor comparison between 6014 and 2101 is presented as well as their interaction to explain the goal of the committee to develop a document that reflects actual field experience of operating sets in service.

Copyright © 2006

American Gear Manufacturers Association
500 Montgomery Street, Suite 350
Alexandria, Virginia, 22314

October, 2006

ISBN: 1-55589-887-4

Development of a Gear Rating Standard – A Case Study of AGMA 6014-A06

Frank C Uherek, Rexnord Geared Products

Introduction

The AGMA Mill Gearing committee recently released AGMA 6014 rating gears for grinding mill and kiln service. In the development of this standard, the committee took a different approach to determining the end result of the standard writing process. Through review of previous standards, the reluctance of the user community to support the street version of the in place standard AGMA 6004, performance history for these long life (over 20 years) applications, and extreme size of this type of gearing, the committee achieved consensus on a new rating method derived from the AGMA 2001 rating practice. A factor by factor comparison between 6014 and 2001 is presented as well as their interaction to explain the goal of the committee to develop a document that reflects actual field experience of operating sets in service.

Explanation of gearing for grinding mills and kilns

Grinding mill and kiln service are an unusual installation for gearing when compared to traditional enclosed gear drive installations. But this application has been utilized for over eighty years. The grinding process, more accurately termed a tumbling process, uses horizontal rotating cylinders that contain grinding media and the material to be broken. The material moves up the wall of the drum until gravity overcomes centrifugal forces and it drops to the bottom of the drum to collide with the remaining material. This breaks up the particles and reduces their size. Kilns rotate at far slower speeds to enable even firing of their contents. Power ranges from 100 to 20000 HP (75 to 15000 kW) in either single or dual motor configurations.

The pinion is mounted on pillow blocks driven by a low speed motor or a motor and enclosed reducer. For mill applications, the gear is mounted on the mill using a flange bolted connection. See figure 1 for one type of installation. For a kiln, various types of spring plates are used. Both the center distance and alignment are adjustable either by shimming the pillow blocks or moving the mill. Lubricant is typically either high viscosity oil (1260 cSt @ 100 °C)

sprayed on the gear in 15 minute intervals or a lower viscosity oil or grease product sprayed on the pinion every few minutes. Alternately, lubrication can be applied by continuous spray or dip immersion methods.



Figure 1. Grinding Mill Installation

Gear sizes can range up to 46 feet (14 meters) in diameter with face widths approaching 50 inches (1.2 meters). Typical tooth sizes range from 20 to 40 module (1.25 DP to 0.64 DP). Single stage reduction gears range from 8:1 to as much as 20:1. Gear materials are typically through hardened cast steel, fabricated rolled steel or spheroidal graphic iron. Pinions are carburized, induction hardened, or through hardened steels. For small installations, either a one or two piece design is used with the split joints located in the root of a tooth. Four piece designs are also made when weight or pouring capacity becomes an issue.

How to Develop a Gear Standard

The daily life of a gear engineer involves many activities. A large amount of time is spent designing gears sets for specific applications and comparing these designs to standard practice. The engineer needs to balance reliability, manufacturing, installation, and cost against “good design practice”. One indicator of good design practice is an industry gear rating standard. This is a consensus driven document that strives to use a best practice commensurate with material capacity, installation skill, lubrication, quality, and analysis to indicate how well a specific design meets the industry and end user expectations.