American Gear Manufacturers Association

Technical Resources

American National Standard

Power Rating of Single and Double Helical Gearing for Rolling Mill Service

ANSI/AGMA 6015-A13

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ABSTRACT

This standard specifies a method for rating the pitting resistance and bending strength of herringbone, double helical, and helical involute gear pairs as applied to metal rolling mills.

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Foreword

[The foreword, footnotes and annexes, if any, in this document are provided for informational purposes only and are not to be construed as a part of ANSI/AGMA Standard 6015-A13, *Power Rating of Single and Double Helical Gearing for Rolling Mill Service*.]

The first AGMA standard for rolling mill gearing was AGMA 323.01, October 1969, *Helical and Herringbone Gearing for Rolling Mill Service*. The first draft of this standard was prepared in December 1967. It was approved by the AGMA membership and became an official AGMA Standard in August 1969.

In February 1979, the Mill Gearing Committee was reorganized to review the Standard and revise it in accordance with a proposed new standard for *Rating the Pitting Resistance and Bending Strength of Spur and Helical Involute Gear Teeth*. This new standard became AGMA 218.01 in December 1982. With AGMA 218.01 as a guide, the committee submitted the first draft of ANSI/AGMA 6005-B89 in 1984. It was approved by the AGMA membership in February 1989 and supersedes AGMA 323.01, *Helical and Herringbone Gearing for Rolling Mill Service*.

In 2002, AGMA 6005 was withdrawn to facilitate the creation of an update based on the then current standard *Rating the Pitting Resistance and Bending Strength of Spur and Helical Involute Gear Teeth*, ANSI/AGMA 2001-C95.

The purpose of ANSI/AGMA 6015-A13 is to provide a method for determining the power rating of gear sets used in main mill drives, pinion stands, and combination units for metal rolling mills. This standard was written to address the fundamental differences between typical enclosed drive applications and rolling mill applications.

In June 2005 the Mill Gearing Committee began work on ANSI/AGMA 6015-A13 derived from ANSI/AGMA 2001-D04 and ANSI/AGMA 6005-B89. Changes to the standard include a method by which different gear tooth designs can be rated and compared at the extended life cycles typical for these applications. Face widths in excess of the 40 inches limitation contained within previous standards are also accommodated, as is a calculation method for load distribution factor, K_m, at these extended face widths. The standard addresses the range of load spectra experienced by these drives and defines load sharing for two and three high mill pinion stands.

The stress cycle factor for pitting resistance, Z_{NR}, consists of a single curve above 10^7 cycles, and its value has been modified based on current practice. The stress cycle factor for bending strength Y_{NR}, consists of two curves above 10^7 cycles, one for gears with shot peened roots, and the other for gears with untreated roots. Below 10^7 cycles, both Z_{NR} and Y_{NR} are assigned value of unity. In addition, the surface condition factor for pitting resistance, C_{fR}, is assigned values other than 1.00 depending on the composite surface finish of the tooth flanks of both mating elements, and a new surface condition factor for tooth root bending, K_{TRF}, has been created and is assigned values depending on the surface finish for the tooth root fillets of the gear in question.

Annexes are included in this standard to give guidance on service factors, shaft design, blank configuration and others.

This AGMA Standard and related publications are based on typical or average data, conditions, or applications. The Association intends to continue working to update this Standard and to incorporate in future revisions the latest acceptable technology from domestic and international sources.

The first draft of ANSI/AGMA 6015-A13 was made in January 2009. It was approved by the AGMA membership in August, 2013. It was approved as an American National Standard on September 23, 2013.

Suggestions for improvement of this standard will be welcome. They may be submitted to tech@agma.org.

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American National Standard -

Power Rating of Single and Double Helical Gearing for Rolling Mill Service

1 Scope

This Standard provides a method for determining the power rating of gear sets used in main mill drives, pinion stands, and combination units used for the reduction of material size in metal rolling mills.

1.1 Applicability

Applications include but are not limited to, hot mills and cold mills, roughing and finishing stands: reducing, increasing, and 1:1 ratio sets. Auxiliary drives, including drives listed in ANSI/AGMA 6013-A06, such as bridles, coilers, uncoilers, edge trimmers, flatteners, loopers (accumulators), pinch rolls, scrap choppers, shears, and slitters are not covered by this document.

This standard includes a method by which different gear tooth designs can be rated and compared at extended life cycles typical for these applications, up to 175 000 hours.

Extended face widths in excess of the 40 inch limit contained within ANSI/AGMA 2001-D04 and ANSI/AGMA 6013-A06 are accommodated. Single helical designs with face widths as large as 60 inches and double helical designs with effective face widths as large as 90 inches are not uncommon in these applications. A calculation method is included for the load distribution factor, K_m, using a modification to the factors defined in ANSI/AGMA 2001-D04 for these extended face widths.

The standard addresses the range of load spectra experienced by these drives and defines load sharing for two and three high mill pinion stands.

1.2 Rating formulae

The formulae included determine the allowable fatigue ratings for pitting resistance and bending strength of steel gears with machined single or double helical external involute gear teeth only. Use of these formulae does not assure the performance of assembled gear drive systems, as numerous other design and operational factors are involved that are beyond the scope of this document.

The formulae evaluate gear tooth capacity as influenced by the major factors which affect gear tooth pitting and gear tooth fracture at the root fillet, when operating within design criteria for alignment and lubrication.

Where empirical values for rating factors are given by curves, curve-fitting equations are provided to facilitate computer programming. The constants and coefficients used in curve fitting often have significant digits in excess of those inferred by the reliability of the empirical data. Experimental data from actual gear unit measurements are seldom repeatable within a plus or minus 10 percent band.

This standard is intended for use by experienced gear designers capable of selecting reasonable values for the rating factors. It is not intended for use by the engineering public at large. Values for factors assigned in other standards are not applicable to this standard nor are the values assigned in this standard applicable to other standards. Mixing values from other standards with those from this standard could lead to erroneous ratings.

The gear designer or manufacturer is not responsible for the total system unless such a requirement is clearly identified in the contractual agreement.

It is imperative that the overall system designer be satisfied that the system of connected rotating parts is compatible, free from critical speeds and from torsional or other vibrations within the specified speed range, no matter how induced.

