American Gear Manufacturers Association

Technical Division

ANSI/AGMA 6014-B15

(Revision of ANSI/AGMA 6014-A06)

American National Standard

Gear Power Rating for Cylindrical Shell and Trunnion Supported Equipment

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[Revision of ANSI/AGMA 6014-A06]

[Tables or other self-supporting sections may be referenced. Citations should read: See AGMA 6014-B15, *Gear Power Rating for Cylindrical Shell and Trunnion Supported Equipment,* published by the American Gear Manufacturers Association, 1001 N. Fairfax Street, Suite 500, Alexandria, Virginia 22314, http://www.agma.org.]

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ABSTRACT

This standard specifies a method for rating the pitting resistance and bending strength of open or semi-enclosed gearing for use on cylindrical shell and trunnion supported equipment such as grinding mills, kilns, coolers, and dryers. This includes spur, self-aligning spur, single helical, double helical, and herringbone gears made from steel, ductile iron, and austempered ductile iron. Annexes cover installation, alignment, maintenance, combination drives, and lubrication.

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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 AGMA Standard 6014-B15, *Gear Power Rating for Cylindrical Shell and Trunnion Supported Equipment.*]

AGMA 321.01 was originally developed to cover gears used primarily for ball and rod mills, and for kilns and dryers. It was approved in October 1943, and later modified in June 1946. In June 1951, AGMA 321.03 was approved as a standard. Further changes and additions were approved in June 1959, and AGMA 321.04 was issued in March 1960. AGMA 321.05 was approved in March 1968 and issued in March 1970.

In February 1979, the Mill Gearing Committee was reorganized to review AGMA 321.05 and revise it in accordance with AGMA 218.01, *Rating the Pitting Resistance and Bending Strength of Spur and Helical Involute Gear Teeth*. With AGMA 218.01 as a guide, the committee submitted the first draft of ANSI/AGMA 6004-F88 in March 1984.

ANSI/AGMA 6004-F88 superseded AGMA 321.05, *Design Practice for Helical and Herringbone Gears for Cylindrical Grinding Mills, Kilns, Coolers, and Dryers*. It was approved by the AGMA membership in January 1988 and approved as an American National Standard on May 31, 1988.

ANSI/AGMA 6004 was not widely accepted by the industry and many continued to use AGMA 321.05. As such, the AGMA Mill Gearing Committee began work on ANSI/AGMA 6014-A06 in November 2001. Changes to the standard include a new dynamic factor analysis as a function of transmission accuracy number, revised allowable stress numbers, the use of the stress cycle factor in the rating practice, and ratings for gears made from ductile iron. Extensive discussions on new equipment installation and alignment, lubrication, and use of ausferritic ductile iron (ADI) were added to the annex.

The AGMA Mill Gearing Committee began work on AGMA 6014-B15 in February 2011. Changes to the standard, based on committee experience and field performance of gear sets, include:

- added load distribution factor for self-aligning pinions;
- modified values of s_t for ductile iron and ADI;
- reformatted graph of minimum effective case depth for carburized and induction hardened pinions, $h_{e\ min}$;
- moved austempered (formerly ausferritic) ductile iron from Annex H to the body of the standard;
- revised Annex D to include information taken from ANSI/AGMA 9005-E02 [8];
- changed references to extreme pressure (EP) additives to antiscuff (AS) additives in Annex D. Users are encouraged to transition their terminology away from the term extreme pressure, or EP, and toward antiscuff, or AS;
- updated material mechanical property information in Annex F;
- added Annex J to provide information on combination drives.

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. The ability to design gears, and the knowledge and judgment required to properly evaluate the various rating factors comes primarily from years of accumulated experience in gearing. The detailed treatment of the general rating formulas for specific applications is best accomplished by those experienced in the field.

The first draft of AGMA 6014-B15 was made in September 2012. It was approved by the AGMA membership in August 2015 and approved as an American National Standard on October 21, 2015.

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

PERSONNEL of the AGMA Mill Gearing Committee – 6014 Subcommittee

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American National Standard–

Gear Power Rating for Cylindrical Shell and Trunnion Supported Equipment

1 Scope

1.1 Applicability

This standard provides a method to determine the power rating of gear sets with spur and helical conventional pinions and spur self-aligning pinions for cylindrical grinding mills, kilns, coolers, and dryers. The formulas are applicable to steel, ductile iron (spheroidal graphitic iron), and austempered ductile iron (ADI) with machined spur, single helical, double helical, or herringbone gear teeth. Calculations determine the allowable rating for pitting resistance and bending strength of external involute gear teeth.

1.2 Rating formulas

This standard provides a method by which different gear designs can be rated and compared. It is not intended to assure the performance of assembled gear drive systems.

These rating formulas are applicable for rating the pitting resistance and bending strength of external involute gear teeth operating on parallel axes with adjustable center distances. The formulas evaluate gear tooth capacity as influenced by the major factors which affect gear tooth pitting and gear tooth fracture at the fillet radius.

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.

Rating formulas are valid only when components are installed according to gear manufacturer or original equipment supplier's recommendation.

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 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.

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. Calculated gear ratings are intended to be conservative, but the scatter in actual results may exceed 20 percent.

> **CAUTION:** Compliance with this standard does not constitute a warranty of the rating of the gear set under installed field service conditions.

