ANSI/AGMA 6004–F88
May 1988

(Revision of AGMA 321.05)

AMERICAN NATIONAL STANDARD

Gear Power Rating for Cylindrical Grinding Mills, Kilns, Coolers and Dryers

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ABSTRACT

This Standard specifies a method for rating the pitting resistance and bending strength of open or semi–enclosed spur, single helical, double helical, and herringbone gears for cylindrical grinding mills, kilns, coolers and dryers.

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FOREWORD

[The foreword, footnotes, and appendices, if any, are provided for informational purposes only and should not be construed as part of American Gear Manufacturers Association Standard 6004–F88, *Gear Power Rating for Cylindrical Grinding Mills, Kilns, Coolers and Dryers*.]

Tentative standard 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 a proposed new standard, *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 6004–F88 in March 1984.

The format of this Standard was revised to conform with the ANSI (American National Standard Institute) style manual. The values for Life Factors, C_L and K_L, Dynamic Factors, C_v and K_v, Hardness Ratio Factor, C_H, Reliability Factors, C_R and K_R, Allowable Stress Numbers, s_{at} and s_{ac}, and Load Distribution Factors, C_m and K_m, have been revised in this Standard. The Overload Factors, C_o and K_o, has been replaced by a redefined Application Factors, C_a and K_a, and the Service Factors, C_{SF} and K_{SF}, have been defined and introduced.

The grouping of the variables into C_1, C_2, and C_3 factors in the pitting resistance formula and K_1, and K_2 factors in the bending strength formula has been dropped. Another change made is the addition of separate service factors for bending strength and pitting resistance. A speed limitation has also been added. Values for factors assigned in previous standards are not applicable to this Standard, nor are the values assigned in this Standard applicable to previous 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.

AGMA 6004–F88 supersedes 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.

Suggestions for the improvement of this Standard will be welcome They should be sent to the American Gear Manufacturers Association, 1500 King Street, Suite 201, Alexandria, Virginia, 22314.

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1. Scope

1.1 Applicability. This Standard provides a method to determine the power rating of gear sets for cylindrical grinding mills, kilns, coolers, and dryers. The formulas are applicable to steel gears with machined spur, single helical, double helical, or herringbone gear teeth commonly used for this purpose. Calculations determine the allowable rating for pitting resistance and bending strength of external spur and helical involute gear teeth.

1.2 Limitations.

(1) Rating procedures are limited to open or semi-enclosed gearing where the gear reaction forces are transmitted through a structure which provides independent bearing support for the gear and pinion. Open gears operate without any enclosure. Semi-enclosed gears operate with a guard that provides some degree of protection against contamination from dust or dirt and retains lubricant.

(2) Enclosed gear drives or speed reducers are expressly excluded from this Standard.

(3) This gear rating practice is limited to maximum operating speeds of 2000 feet per minute (10.2 m/s) gear pitch line velocity or 450 revolutions per minute of the pinion.

(4) When dual motors and pinions are used, each pinion will be designed for 60 percent of the total input power of both motors unless otherwise specified by contractual agreement.

(5) This Standard does not include gearing which has been surface hardened by nitriding or flame hardening. This gear rating practice is limited to through hardened gears operating with through hardened, carburized, or induction hardened pinions.

(6) Face contact ratio of helical gear sets must be greater than 1.0.

1.3 Metallurgy. The allowable stress numbers, s_{ac} and s_{at}, included herein are based on commercial steel making and heat treating practice. Hardness and tensile strength are the criteria for allowable stress numbers. Variation in microstructure will result in variation in gear capacity.

2. Responsibility

The users of AGMA design standards are expected to have acquired experience in the field of gear design and application. This will offer confidence in the selection of variables, and establish the ability to properly evaluate the gearing design.

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.

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

3. Symbols and Terms

The symbols used in pitting resistance and bending strength formulas are shown in Table 3-1. The terms used conform to the following standards:

AGMA 112.05-1976, *Gear Nomenclature, Terms, Definitions, Symbols, and Abbreviations*

AGMA 600.01-1979, *Standard for Metric Usage*

NOTE: The symbols and definitions used in this Standard may differ from other AGMA standards. The user should not assume that familiar symbols can be used without a careful study of these definitions.

SI units of measure are shown in parentheses in Table 3-1 and in the text. Where equations require a different format or constant for use with SI units, a second expression is shown after the first, indented, in smaller type, and with "M" included in the equation number.

Example:

$$P_d = P_{nd} \cos \psi_s \qquad \text{(Eq 4.6)}$$

$$m = \frac{m_n}{\cos \psi_s} \qquad \text{(Eq 4.6M)}$$