American
Gear Manufacturers
Association

Technical Resources

Revision of ANSI/AGMA 6011–H98
Reaffirmed December 2008

American National Standard

Specifications for High Speed Helical Gear Units

ANSI/AGMA 6011–I03

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[Revision of ANSI/AGMA 6011–H98]

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[Tables or other self–supporting sections may be referenced. Citations should read: See AGMA AGMA 6011–I03, *Specification for High Speed Helical Gear Units,* published by the American Gear Manufacturers Association, 500 Montgomery Street, Suite 350, Alexandria, Virginia 22314, http://www.agma.org.]

Approved February 12, 2004

ABSTRACT

This standard includes design, lubrication, bearings, testing and rating for single and double helical external tooth, parallel shaft speed reducers or increasers. Units covered include those operating with at least one stage having a pitch line velocity equal to or greater than 35 meters per second or rotational speeds greater than 4500 rpm and other stages having pitch line velocities equal to or greater than 8 meters per second.

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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 6011–I03, *Specification for High Speed Helical Gear Units*.]

The first high speed gear unit standard, AGMA 421.01, was adopted as a tentative standard in October, 1943. It contained formulas for computing the durability horsepower rating of gearing, allowable shaft stresses, and included a short table of application factors. AGMA 421.01 was revised and adopted as a full status standard in September, 1947 and issued as AGMA 421.02.

The High Speed Gear Committee began work on the revision of AGMA 421.02 in 1951, which included: classification of applications not previously listed; changing the application factors from "K" values to equivalent *Service Factors*; revision of the rating formula to allow for the use of heat treated gearing; and develop a uniform selection method for high speed gear units. This *Uniform Selection Method Data Sheet* became AGMA 421.03A.

AGMA 421.03 was approved as a revision by the AGMA membership in October, 1954.

The standard was reprinted as AGMA 421.04 in June, 1957. It included the correction of typographical errors and the addition of a paragraph on pinion proportions and bearing span, which had been approved by the committee for addition to the standard at the October, 1955 meeting.

In October, 1959 the Committee undertook revisions to cover developments in the design, manufacture, and operation of high speed units with specific references to high hardness materials and sound level limits. The revisions were incorporated in AGMA 421.05 which was approved by the AGMA membership as of October 22, 1963.

The significant changes of 421.06 from 421.05 were: minimum pitch line speed was increased to 5000 feet per minute (25 meters per second); strength and durability ratings were changed; and some service factors were added. AGMA 421.06 was approved by the High Speed Gear Committee as of June 27, 1968, and by the AGMA membership as of November 26, 1968.

ANSI/AGMA 6011–G92 was a revision of 421.06 approved by the AGMA membership in October, 1991. The most significant changes were the adaptation of ratings per ANSI/AGMA 2001–B88 and the addition of normal design limits for babbitted bearings. ANSI/AGMA 6011–G92 used "application factor" and not "service factor".

ANSI/AGMA 6011–H98 was a further refinement of ANSI/AGMA 6011–G92. One of the most significant changes was the conversion to an all metric standard. The rating methods were changed to be per ANSI/AGMA 2101–C95 which is the metric version of ANSI/AGMA 2001–C95. To provide uniform rating practices, clearly defined rating factors were included in the standard (ANSI/AGMA 6011–H98). While some equations may slightly change to conform to metric practices, no substantial changes were made to the rating practice for durability and strength rating. In addition, minimum pitch line velocity was raised from 25 m/s to 35 m/s and minimum rotational speed increased to 4000 rpm.

AGMA has reverted to the term "service factor" in their standards, which was reflected in ANSI/AGMA 6011–H98. The service factor approach is more descriptive of enclosed gear drive applications and can be defined as the combined effects of overload, reliability, desired life, and other application related factors. The service factor is applied only to the gear tooth rating, rather than to the ratings of all components. Components are designed based on the service power and the guidelines given in this standard.

In continued recognition of the effects of scuffing in the rating of the gear sets, additional information on scuffing resistance was added to annex B of ANSI/AGMA 6011–H98.

AGMA 427.01 has been withdrawn. The information found in AGMA 427.01 was included in annex D of ANSI/AGMA 6011–H98.

ANSI/AGMA 6011–I03 is a further refinement to ANSI/AGMA 6011–H98. Symbols have been changed where possible to conform with ANSI/AGMA 2101–C95 and ISO standards. The minimum rotational speed has been increased to 4500 rpm. Helix angle limits have changed, and a minimum axial contact ratio limit has been added. The L/D limits have changed, and use of modified leads is now encouraged with the use of predicted rotor deflection and distortion. Bearing load design limits have also changed. For gear tooth accuracy, reference is now made to ANSI/AGMA 2015–1–A01 rather than to ANSI/AGMA 2000–A88. The Z_n and Y_n life factors now have a maximum rather than a minimum limit when the number of load cycles exceeds 10^{10}. A table of dynamic factor as a function of accuracy grade has been added. References to AGMA oil grades have been removed; now only ISO viscosity grades are listed. To facilitate communications between purchaser and vendor, an annex with data sheets has been added.

Realistic evaluation of the various rating factors of ANSI/AGMA 6011–I03 requires specific knowledge and judgment which come from years of accumulated experience in designing, manufacturing and operating high speed gear units. This input has been provided by the AGMA High Speed Gear Committee.

The first draft of AGMA 6011–I03 was made in May, 2001. It was approved by the AGMA membership in October, 2003. It was approved as an American National Standard on February 12, 2004.

Suggestions for improvement of this standard will be welcome. They should be sent to the American Gear Manufacturers Association, 500 Montgomery Street, Suite 350, Alexandria, Virginia 22314.

PERSONNEL of the AGMA Helical Enclosed Drives High Speed Unit Committee

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American National Standard –

Specification for High Speed Helical Gear Units

1 Scope

This high speed helical gear unit standard is provided as a basis for improved communication regarding:

- establishment of uniform criteria for rating;
- guidance for design considerations; and,
- identification of the unique features of high speed gear units.

1.1 Application

Operational characteristics such as lubrication, maintenance, vibration limits and testing are discussed. This standard is applicable to enclosed high speed, external toothed, single and double helical gear units of the parallel axis type. Units in this classification are:

- single stage units with pitch line velocities equal to or greater than 35 meters per second or rotational speeds greater than 4500 rpm;
- multi–stage units with at least one stage having a pitch line velocity equal to or greater than 35 meters per second and other stages having pitch line velocities equal to or greater than 8 meters per second.

Limits specified are generally accepted design limits. When specific experience exists for gear units of similar requirements above or below these limits, this experience may be applied.

Marine propulsion, aircraft, automotive, and epicyclic gearing are not covered by this standard.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this American National Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this American National Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below.

ANSI/AGMA 1010–E95, *Appearance of Gear Teeth – Terminology of Wear and Failure*

ANSI/AGMA 2015–1–A01, *Accuracy Classification System – Tangential Measurements for Cylindrical Gears*

ANSI/AGMA 2101–C95, *Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gear Teeth*

ANSI/AGMA 6000–B96, *Specification for Measurement of Linear Vibration on Gear Units*

ANSI/AGMA 6001–D97, *Design and Selection of Components for Enclosed Gear Drives*

ANSI/AGMA 6025–D98, *Sound for Enclosed Helical, Herringbone, and Spiral Bevel Gear Drives*

ISO 14635–1, *Gears – FZG test procedures – Part 1: FZG test method A/8,3/90 for relative scuffing load carrying capacity of oils*

3 Symbols, terminology and definitions

3.1 Symbols

The symbols used in this standard are shown in table 1.

NOTE: The symbols and terms contained in this document may vary from those used in other AGMA standards. Users of this standard should assure themselves that they are using these symbols and terms in the manner indicated herein.