ANSI/AGMA 2000–A88
March 1988
(Errata 1992)

(Partial Revision of AGMA 390.03)

AMERICAN NATIONAL STANDARD

GEAR CLASSIFICATION AND INSPECTION HANDBOOK

Tolerances And Measuring Methods For Unassembled Spur And Helical Gears (Including Metric Equivalents)

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ABSTRACT

This Standard, for spur and helical gearing, correlates gear quality levels with gear tooth tolerances. It provides information on manufacturing practices as well as gear measuring methods and practices. Appendix material provides guidance on specifying a quality level and information on additional methods of gear inspection.

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ERRATA A January, 1989
The following editorial corrections have been made to ANSI/AGMA 2000–A88, *Gear Classification and Inspection Handbook*, (originally printed March 1988 and September 1988). These changes, discovered after publication, have been made in this printing, as shown below:

PAGE	ITEM	CHANGE
29	Eq 5.10	The first term following the equal sign should read 5.0337, with the full equation reading, $Y = (5.0337 \log_{10} P_{nd}) - 0.5153$
32	Eq 5.2M	The last term should read $(1.42)^{(8-Q)}$. The full equation should read, $\pm V_{pA} = 7.289 (z_i)^{0.177} (m_n)^{0.401} (1.42)^{(8-Q)}$
33	Eq 5.10M	The second term following the equal sign should read 5.0337, with the full equation reading, $Y = 6.5562 - [5.0337 \log_{10} m_n]$
33	Eq 5.12M	The first term following the equal sign should read 36.83; the second term should read 0.03937, with the parentheses moved to include it. The full equation should read, $V_{cqT} = 36.83 \left[(0.03937\, z_i\, m_n)^{0.1477\, m_n^{(0.15)}} \right] \times \left[(1.16)^{(10-Y)} (1.4)^{(8-Q)} \right]$
58	Table 6–3	The missing values for line 5.0 Diametral Pitch, Quality 7 thru 15 are: A = 0.0075, B = 0.0037 and C= 0.0019.
60 through 81	symbols	The second symbol in the table heading, for module, should read m_n (lower case *m*) in all metric tables.
102	Fig 9–10	The *y–axis* of the figure,"INDEX READING", should read "INDICATOR READINGS" as in Fig 9–12.
103	Fig 9–14	The *y–axis* of the figure should be labeled "INDEX VARIATION, V_x"

ERRATA B June, 1990
These additional editorial corrections have been made to ANSI/AGMA 2000–A88, *Gear Classification and Inspection Handbook*. These changes, determined after publication and Errata A, have been made in this printing, as shown below:

Upon complete review and ballot, the active members of the AGMA Inspection and Handbook Committee have decided that the transverse plane is where the tooth thickness tolerance is applied. This changed the word "normal" to the word "transverse" on page 15 in the second line of the definition for Tooth Thickness Variation, and on page 35 in the third line of paragraph 6.2.4.

Additional corrections were also discovered after publication and Errata A:

PAGE	ITEM	CHANGE
32	Eq 5.5M	The first term following the equal sign should read 0.0974, with the full equation reading, $V_{\psi T} = 0.0974 [-0.0062 Q^3 + 0.34641 Q^2 - 6.8371\ Q + 48.148]\, b^{0.72}$
47 & 71	Table 6–2 & Table 6–2M	The values for Diametral Pitch 0.5 thru 8.0 (Module 3.0 thru 50), Quality 5 are removed to agree with the formula limits established in Sections 5 and 5M.
91	Table 8–1M	The values listed in inches were changed to the appropriate millimeter and micrometer values.

ERRATA C May, 1992
Additional editorial corrections to figures 9–18, 9–19, and 9–20 have been made to ANSI/AGMA 2000–A88, *Gear Classification and Inspection Handbook*. These changes, determined after publication of Errata B, have been made in this printing.

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FOREWORD

[The foreword, footnotes, and appendices are provided for informational purposes only, and should not be construed as a part of American Gear Manufacturers Association Standard 2000–A88, *Gear Classification and Inspection Handbook.*]

This Handbook provides tolerances for different gear quality levels from Q3 to Q15 for unassembled spur and helical gears. It further describes methods and practices for measuring the various gear elements for which tolerances are provided. Applicable definitions are provided.

The purpose is to provide a common basis for specifying quality, and for the procurement of unassembled gears. It is not a design manual for determining the specific quality levels for a given application. It is not intended for use as a reference in procurement of enclosed drives.

The AGMA Standard 390.03 was published in 1973 as a consolidation and updating of several withdrawn AGMA publications, including:

AGMA 235.02 (Feb., 1966), *Information Sheet for Master Gears*

AGMA 239.01 (Oct., 1965), *Measuring Methods and Practices Manual for Control of Spur, Helical and Herringbone Gears*

AGMA 239.01A (Sept., 1966), *Measuring Methods and Practices Manual for Control of Bevel and Hypoid Gears*, and parts of

AGMA 236.04(05), *Inspection of Fine–Pitch Gears*

AGMA 390.02 (Sept., 1964), *Gear Classification Manual* originally published as AGMA 390.01 (1961)

Data was added for Gear Rack and Fine–Pitch Worms and Wormgears. The former separate sections of AGMA 390.02 for Coarse–Pitch and Fine–Pitch spur, Helical and Herringbone Gearing was blended to offer a single, compatible classification system The tolerance source identifier "Q" was added to indicate that the tolerances in 390.03 apply. If Q is not used as a prefix in the quality number, tolerances in AGMA 390.01 and 390.02 apply.

This Handbook is an update of those sections from AGMA 390.03 for parallel axis gears only. Additionally, the formulas have also been developed to derive the tolerances in metric terms. The format of the tolerance tables has been revised for improved presentation but basic tolerance levels are unchanged from AGMA 390.03. The other material in AGMA 390.03 on Bevels, Racks and Worms is not covered here, and is left unchanged in AGMA 390.03.

A revision of 390.03 was initiated by a joint panel of representatives of AGMA and General Motors Corporation, meeting from 1975 to 1977. Subsequently, it was revised by personnel of the AGMA Gear Classification Handbook Committee as AGMA 2000. This version was approved by AGMA membership in January 1988 and as a American National Standard Institute (ANSI) standard on March 31, 1988*.

Suggestions for 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.

* For the convenience of the reader, this Standard has been published on colored paper. Appropriate Sections in conventional units of measure are in yellow; SI (metric) in rose; and common material in white. The Appendices are in blue.

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1. Scope

This Standard establishes a classification system which may be used to communicate geometrical quality specifications of unassembled external and internal involute gearing. It provides a designation system for quality, materials, and heat treatment of spur, helical (single or double), and herringbone gears. It also provides information on measuring methods and practices. This Standard provides the gear manufacturer and the gear buyer with a mutually advantageous reference for uniform tolerances and inspection procedures. Thirteen classes of quality levels are defined in this Standard, numbered Q3 through Q15, in order of increasing precision.

1.1 Equations for Tolerances. Equations for tolerances are provided for those who wish to compute the tolerances that define the quality of gearing in Section 5. The equations yield the same values as the tables. The accuracy tolerance formulas are valid for gears of a minimum size of 6 teeth through a maximum size of the lesser of 1200 teeth or 400 inches (10 000 mm) pitch diameter.

1.2 Tolerance Tables. Tolerance tables derived from the equations are provided which show the maximum values that are allowed by the specific Quality Number for a gear in Section 6. The tolerance tables in this Standard list the formula values for diametral pitches 0.5 through 120 (modules 50 through 0.2), and for gears ranging in numbers of teeth from 6 through 200.

1.3 Tolerance for Master Gears. Tolerances which define levels of quality for master gears are provided in Section 8.

1.4 Measuring Methods and Practices. Measuring methods and practices are included in order to promote uniform inspection procedures (see Section 9). These methods permit the user to conduct measuring procedures which are accurate and repeatable to a degree compatible with the specified quality. Experienced personnel, with calibrated instruments in suitable surroundings, are required.

1.5 Materials and Heat Treatment. A designation of the required material and heat treatment can be included as a part of the AGMA Classification Number. Designation numbers are provided which identify gear materials, heat treatments, and hardness ranges (see Section 7).

1.6 Exceptions. This Standard does not apply to enclosed gear unit assemblies, including speed reducers or increasers, gear motors, shaft mounted reducers, high speed units, or other enclosed gear units which are sold on a rated horsepower basis for a given speed, ratio, or application. Gear design and backlash is beyond the scope of this Standard. Refer to the latest AGMA Publications Index for applicable standards. This Standard does not apply to gears larger than 400 inches (10 000 mm) in pitch diameter, or larger than 10 inches (250 mm) in face width, (per helix, if double helical or herringbone); or helix angles exceeding 45 degrees.

NOTE: Tolerance values for gears outside the limits stated in this Standard should be established by determining the specific application requirements. This may require setting a tolerance smaller than calculated by the formulas in this Standard, particularly for tooth alignment of gears with face widths over 10 inches (250 mm).

2. Symbols, Terminology and Definitions

The symbols, terminology and definitions pertaining to the tolerances and inspection of spur and helical gear teeth are listed here for use in this standard. For other definitions of geometric terms related to gearing, see AGMA 112 (ANSI B6.14), *Gear Nomenclature*.

NOTE: Some of the symbols and terminology contained in this document may differ from those used in other documents and AGMA Standards. Users of this standard should assure themselves that they are using the symbols, terminology and definitions in the manner indicated herein.