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American Gear Manufacturers Association

ANSI/AGMA 2002-D19
(Revision of ANSI/AGMA 2002-C16)

American National Standard

Tooth Thickness and Backlash Measurement of Cylindrical Involute Gearing

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Approved December 9, 2019

ABSTRACT

This standard establishes the procedures for determining the specification limits for tooth thickness of external and internal cylindrical involute gearing. It includes equations and calculation procedures for the commonly used measuring methods. A specific tooth thickness specification limit can be established from the design thickness or from another tooth thickness measurement. The procedures can be used with an established design tooth thickness, or with actual tooth thickness dimensions. The effect of tooth geometric quality variations on tooth thickness dimensions is discussed. Calculations for backlash are included, and are based on the specified tooth thickness, center distance, and tolerances.

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Foreword

[The foreword, footnotes and annexes, if any, in this standard are provided for informational purposes only and are not to be construed as a part of AGMA Standard 2002-D20, *Tooth Thickness and Backlash Measurement of Cylindrical Involute Gearing*.]

This Standard presents calculation procedures for determining tooth thickness dimensions of external and internal cylindrical involute gearing. It supersedes AGMA 231.52, *Inspection – Pin Measurement Tables for Involute Spur Gears*.

This Standard has been prepared to consolidate previously published AGMA tooth thickness information, to add more information on internal and helical gears and to add details on more measurement methods.

Previous AGMA publications have presented this information in tabular form, calculated for 1 DP and standard tooth proportions, with adjustment factors for nonstandard conditions. This Standard is arranged for direct calculation of the desired results, to eliminate the intermediate calculation steps and interpolation previously required.

The study of tooth thickness and backlash has been a major interest of gear technicians throughout the history of the industry. In the last fifty years, many clarifications and contributions have been made by Buckingham, Candee, Leming, Vogel, Wildhaber and others. Their work is consolidated here, without further attribution, and the work of more recent contributors is added where it improves the presentation.

In this edition of ANSI/AGMA 2002-C16, the concept of functional tooth thickness has been broadened, and the treatment of the effects of tooth profile, pitch, lead, and runout deviations on tooth thickness dimensions has changed. This edition uses a direct calculation of measured tooth thickness from a nominal circular tooth thickness, and a clear distinction is made between measurement methods for nominal and functional tooth thickness. A section on the calculation of backlash was added, and the effects of tolerances are included in the calculation of backlash. As a result of these changes, the title of this standard has been revised to reflect the new content.

An annex was added to provide sample calculations.

ANSI/AGMA 2002-D19 is a revision of ANSI/AGMA 2002-C16. It was created to update:

– equation 87 – in the enominator minus was changed to plus;
– equation 104 - removed absolute value signs around the first and third z, and;
– corrected the calculated value of equation 113 in E.3.7.

The first draft of ANSI/AGMA 2002-D19 was created in September 2018. It was approved by the membership on May 17, 2019 and as an American National Standard on December 9, 2019.

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

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American National Standard–

Tooth Thickness and Backlash Measurement of Cylindrical Involute Gearing

1 Scope

This standard establishes the calculation procedures for determining specification limits for external and internal cylindrical involute gearing when the desired tooth thickness is known. This standard also shows the relationships between backlash and the tooth thickness, center distance, and tooth deviations in a pinion and gear mesh.

1.1 Measurement methods included in standard

Equations and procedures are included for the following tooth thickness measuring methods:

– measurement by pitch or index;
– measurement with a master gear on a double flank tester;
– measurement with a master gear on a single flank tester;
– span measurement;
– measurement over or between balls or pins;
– measurement with measuring blocks;
– chordal measurement.

1.2 Types of gears

This standard applies to the following types of gears:

– external and internal involute spur gears;
– external and internal parallel axis involute helical gears;
– involute worms and other crossed-axis helical gears;
– spur and helical racks;
– involute sector gears, spur, and helical.

1.3 Dimensional and material limitations

The equations in this standard apply to gears of all sizes and materials, and to all manufacturing methods. However, practical considerations and availability of test equipment can preclude the use of some methods on some sizes of gears.

Some methods may not be appropriate for compliant materials if the use of the tooth thickness measuring tools and techniques result in deformation of the gear teeth.

1.4 Exclusions

The determination of design tooth thickness for a given application is beyond the scope of this standard.

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