



American
Gear Manufacturers
Association®

ANSI/AGMA 2116-B24
(Revision of ANSI/AGMA 2116-A05)

American National Standard

Evaluation of Double Flank Testers for Radial Composite Measurement of Gears

ANSI/AGMA 2116-B24

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Standard*****Evaluation of Double Flank Testers for Radial Composite Measurement
of Gears***

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[Revision of ANSI/AGMA 2116-A05]

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ABSTRACT

This standard provides the evaluation criteria for double flank testers. Recommended artifact sizes and geometry are provided along with measurement system conditions. Annex A provides a method for estimating calibration uncertainty.

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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 2116-B24, *Evaluation of Double Flank Testers for Radial Composite Measurement of Gears*.]

Between 1994 and 1998, AGMA published three standards on calibration of gear measuring instruments: ANSI/AGMA 2010-A94, *Measuring Instrument Calibration – Part I, Involute Measurement*, ANSI/AGMA 2113-A97, *Measuring Instrument Calibration, Gear Tooth Alignment Measurement*, and ANSI/AGMA 2114-A98, *Measuring Instrument Calibration, Gear Pitch and Runout Measurements*. These standards covered elemental measurements specified in the accuracy requirements of ANSI/AGMA 2015-1-A01, *Accuracy Classification System – Tangential Measurements for Cylindrical Gears*. The Calibration Committee decided that supplemental information, on measurement system conditions for calibration, accuracy requirements and uncertainty determination, was desirable to have in an Information Sheet, AGMA 931-A02, *Calibration of Gear Measuring Instruments and Their Application to the Inspection of Product Gears*, that was published in 2002.

The material in these AGMA documents was combined and submitted to ISO for the development of ISO 18653:2003, *Gears – Evaluation of instruments for the measurement of gears*, and ISO/TR 10064-5:2005, *Cylindrical gears – Code of inspection practice – Part 5: Recommendations relative to evaluation of gear measuring instruments*.

The Calibration Committee decided that similar standardization and information was needed for the evaluation methods of double flank testers used for radial composite measurement of gears. After a study of existing practices, standards, and literature the information contained herein is a consolidation of the most common methods currently in existence.

The first draft of ANSI/AGMA 2116-A05 was made in August 2003. It was approved by the AGMA membership in October 2005. It was approved as an American National Standard on December 29, 2005.

In August 2022, the AGMA Technical Division Executive Committee (TDEC) approved the start of the ANSI/AGMA 2116-B24 project, which was written by the AGMA Gear Accuracy Committee. It was approved by the AGMA Board of Directors in March 2024. It was approved as an American National Standard on April 1, 2024.

The changes in this edition include:

- incorporated AGMA 935 as the new Annex A, Recommendations relative to the evaluation of radial composite gear double flank testers;
- deleted the former Annex B, Calibration certificate requirements, and moved the content into the body of the document;
- added definition of Primary Laboratory;
- updated format.

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

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American National Standard –

Evaluation of Double Flank Testers for Radial Composite Measurement of Gears

1 Scope

This standard provides evaluation methods for double flank testers used for radial composite measurement of gears. Recommendations are given for the use of artifacts. Guidance is also given on calibration certificate requirements. Annex A is informative and discusses methods for calibration and measurement uncertainty.

2 Normative references

The following documents contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions were valid. All publications are subject to revision, and the users of this standard are encouraged to investigate the possibility of applying the most recent editions of the publications listed.

AGMA 915-2, *Inspection Practices – Part 2: Double Flank Radial Composite Measurements*

AGMA 915-3, *Inspection Practices – Part 3: Gear Blanks, Shaft Center Distance and Parallelism*

ANSI/AGMA 1012, *Gear Nomenclature, Definitions of Terms with Symbols*

ANSI/AGMA ISO 1328-2, *Cylindrical Gears – ISO System of Flank Tolerance Classification – Part 2: Definitions and Allowable Values of Double Flank Radial Composite Deviations*

ISO 14253-1, *Geometrical product specifications (GPS) – Inspection by measurement of workpieces and measuring equipment – Part 1: Decision rules for verifying conformity or nonconformity with specifications*

ISO 18653, *Gears – Evaluation of instruments for the measurement of individual gears*

ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*

ISO/TS 14253-2, *Geometrical product specifications (GPS) – Inspection by measurement of workpieces and measuring equipment – Part 2: Guidance for the estimation of uncertainty in GPS measurement, in calibration of measuring equipment and in product verification*

3 Definition of terms

3.1 General

The definitions, where applicable, conform to ANSI/AGMA 1012, ANSI/AGMA ISO 1328-1 [1], and ISO 18653.

3.2 Primary laboratory

The measurement laboratory with the lowest value of measurement uncertainty and that is in compliance with ISO/IEC 17025.

3.3 Accredited calibration laboratory

A testing or calibration laboratory that is accredited to ISO/IEC 17025 by an International Laboratory Accreditation Cooperation (ILAC) accredited body.

4 Application

4.1 General

The purpose of the tests prescribed in this standard is to estimate measurement uncertainty. It is assumed that the double flank tester has been installed on site and a series of acceptance tests have been completed successfully. Prescribed tests may serve as interim checks to verify the measurement process.

The measurement and evaluation procedures may be used as part of acceptance tests for a double flank tester, with prior agreement between customer and supplier. In this situation, it is recommended that a series of traceably calibrated artifacts be used to verify the measurement uncertainty at specific points throughout the working volume of the double flank tester; at a minimum to include axis alignment and linear measuring system accuracy. These measurements should include provision for testing the machine with table loads that represent the weight of product gears being tested.

4.2 Traceability

The term traceability implies an unbroken calibration chain from measurements taken on a shop floor double flank tester to the primary artifacts at a primary laboratory, see Figure 1. Traceability is transferred by calibrated artifacts. The primary laboratory has the lowest uncertainty, and uncertainty increases at each level as the traceability chain is transferred to shop floor measuring instruments. Minimizing the steps from the primary laboratory to a shop floor double flank tester will reduce the measurement uncertainty.

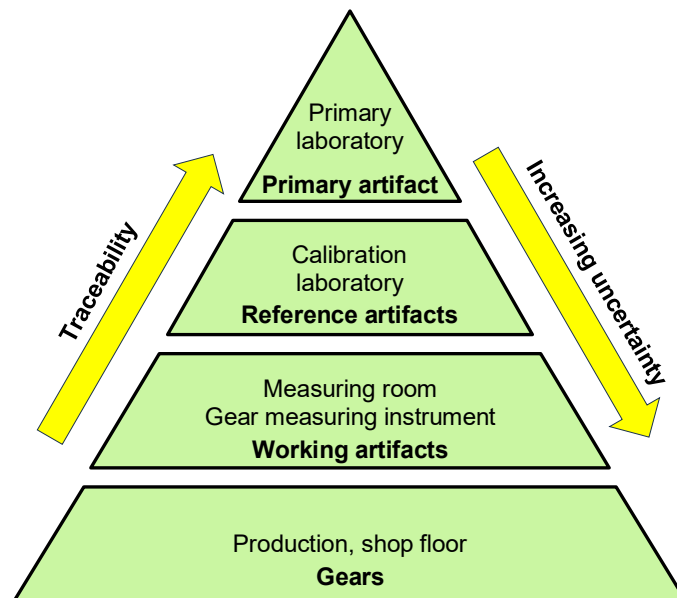


Figure 1 – Hierarchy of calibration

4.3 Artifacts

The artifacts used for these tests shall be of similar size to product gears inspected on the double flank composite tester. Artifacts shall be used to evaluate the accuracy of each parameter inspected. Specific artifact requirements are given in Clause 7.

4.4 Measurement uncertainty

Conventional practice recommends the uncertainty of a measurement process be less than 10% of the parameter tolerance measured, to ensure that the reliable interpretation of the measurement results is possible. However, this is not technically achievable when inspecting high accuracy gears.

For example, when gears have tolerances better than 10 micrometers, the best achievable uncertainty may be only 20 to 30%. Measurement uncertainty is discussed in Clause 8 of this document and Clause 7 of AGMA 915-2-B20.

4.5 Sources of uncertainty

The verification of measurement uncertainty shall include, but not be limited to, the assessment of the principal contributors to uncertainty, such as:

- artifact data;
- calibration data;
- repeatability of the instrument;
- reproducibility of the instrument;
- probe system filtering, damping and dynamic response, and accuracy;
- environmental influence, including temperature and vibration;
- mechanical alignment;
- runout and mounting error measurement;
- servo control system;
- evaluation software;
- operator.

Refer to ISO/TS 14253-2 for further information on this subject.

4.6 Evaluation interval

The user shall establish the interval for evaluation of the measurement process. It is also recommended that interim tests be performed on a designated artifact. Data produced by the interim tests on calibrated artifacts can be used for measurement uncertainty.

5 Condition of the measurement system

5.1 System characteristics

The characteristics of the measuring instrument and readout system should be checked or verified before proceeding with artifact measurement.

5.2 Suitability for calibration

The instrument should be suitable for calibration and representative of the normal operating conditions.

5.2.1 Double flank tester alignment

Double flank composite testers shall be checked for axis alignments. The results should be compared with design specifications and measurements at acceptance. Axis alignment includes the cross- and inline-axis parallelism of the work holding and master gear mount. These mounts include but are not