AMERICAN GEAR MANUFACTURERS ASSOCIATION

Calibration of Gear Measuring Instruments and Their Application to the Inspection of Product Gears

AGMA 931-A02

AGMA INFORMATION SHEET

(This Information Sheet is NOT an AGMA Standard)

American Gear Manufacturers Association

Calibration of Gear Measuring Instruments and Their Application to the Inspection of Product Gears

AGMA 931–A02

Approved April 16, 2002

ABSTRACT

The condition and alignment of gear measuring instruments can greatly influence the measurement of product gears. This information sheet provides guidelines for the alignment of instrument elements such as centers, ways, probe systems, etc. The instrument accuracy requirements needed to meet the accuracy of product gears is also discussed. It also covers the application of gear artifacts to determine instrument accuracy. This involves the calculation of U_{95} uncertainty at all steps from the artifact to the final product gears.

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Foreword

[This document, AGMA Information Sheet 931–A02, *Calibration of Gear Measuring Instruments and Their Application to the Inspection of Product Gears,* is provided for informational purposes only and is not to be construed as an AGMA Standard.]

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.* The Calibration Committee decided that supplemental information, particularly on measurement system conditions for calibration, accuracy requirements and uncertainty determination, was desirable to have in an AGMA Information Sheet.

This information sheet was developed after intensive study of existing practices, standards and literature. In general, the information contained is a consolidation of the most common practices and standards currently in existence. The uncertainty determination methods were developed concurrently with those determined for ISO 18653, *Gears – Evaluation of instruments for the measurement of gears,* with additional information to assist in obtaining values for workpieces.

Work was started on this draft in 1997. This version was approved by the AGMA Calibration Committee membership in January 2002, and approved for publication by the Technical Division Executive Committee on April 16, 2002.

Suggestions for improvement of this document 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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American Gear Manufacturers Association –

Calibration of Gear Measuring Instruments and Their Application to the Inspection of Product Gears

1 Scope

This information sheet covers material useful for the calibration of gear measuring instruments and their application to the inspection of product gears. It provides information for determining the condition and alignment of instrument elements such as centers, ways, probe systems, etc. It provides guidance for the requirement of instrument accuracy relative to the accuracy of product gears to be inspected.

This information is to be used in conjunction with, or in the absence of the manufacturer's procedures and specifications.

It also covers the application of gear artifacts to the determination of instrument accuracy. This involves the calculation of U_{95} uncertainty at all steps from the primary artifact to the final product gears.

2 Normative references

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

AGMA 915-3-A99, *Inspection Practices - Gear Blanks, Shaft Center Distance and Parallelism*

ANSI/AGMA 2110-A94, *Measuring Instrument Calibration - Part I, Involute Measurement (Metric)*

ANSI/AGMA 2113-A97, *Measuring Instrument Calibration, Gear Tooth Alignment Measurement*

ANSI/AGMA 2114-A98, *Measuring Instrument Calibration, Pitch and Runout Measurement*

3 Definitions and symbols

3.1 Definitions

The terms used, wherever applicable, conform to ANSI/AGMA 1012-F90.

bias The difference between the observed average of measurements and the certified calibration value. See figure 1. Bias can be affected by systematic errors such as linearity or gain, and may be different throughout the operating range of the measurement system.

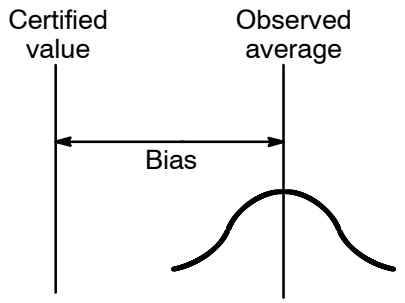

Figure 1 - Bias

calibration The set of operations which establish, under specified conditions, the relationship between values indicated by a measuring instrument or measuring system, and the corresponding standard or known values derived from the standard.

calibration uncertainty, $U_{95\ (cal)}$ The measuring uncertainty, U_{95}, associated with a calibration value due to variations in the calibration process. There is a 95% probability that the true value X lies in the range $X_{cal} \pm U_{95\ (cal)}$. The calibration uncertainty must be stated on all calibration certificates.