



LEARN ABOUT THE NEW AGMA GEAR
INSPECTION STANDARD **2015-1-A01**,
WITH ADDITIONS ADDRESSING
PROFILE AND LEAD INSPECTIONS
INCLUDING **TOTAL, FORM,**
AND SLOPE DEVIATIONS.

GUARDING AGAINST GEARING DEVIATIONS

By Dennis Gimpert

In the June 2005 issue of *Gear Solutions* magazine we presented an article entitled “An Elementary Guide to Gear Inspection,” which was followed by “A New Standard in Gear Inspection” in October. In this article we will focus on additions to the new AGMA Gear Inspection Standard, 2015-1-A01. These additions in this current standard for profile and lead inspections include total, form, and slope deviations.

Materials contained in this paper are extracted from AGMA ISO 10064-2 “Cylindrical Gears-Code of Inspection Related to Radial Composite Deviations, Runout, Tooth Thickness and Backlash” and ANSI/AGMA Standards 2015-1-A01

“Accuracy Classification System-Tangential Measurements for Cylindrical Gears” with permission of the publisher, the American Gear Manufacturers Association.

Accuracy Grades and Inspection Requirements

The new AGMA 2015 standard places gears into three accuracy groups. The highest quality gears are placed in the “high accuracy” group and have designations of A2-A5. “Medium accuracy” are designated A6-A9, and “low accuracy” are A10-A11. Notice in this new AGMA standard that the letter “A” preceding the quality grade is used to distinguish it from the previous AGMA standards.

For the low accuracy gear grouping, A10-A11, no analytical inspection of profile or helix is required. For the medium accuracy gear grouping, A6-A9, analytical inspection of profile and helix is required, but only the total profile, F_{α} , and total helix deviation, F_{β} , measurements are mandatory. Other inspections are optional. For the high accuracy gear grouping, A2-A5, complete analytical inspection of profile and helix is required, including total profile (F_{α}), profile form (f_{α}), and profile slope ($f_{H\alpha}$), as well as total helix (F_{β}), helix form (f_{β}), and helix slope ($f_{H\beta}$).

Hint: To help remember the new designations note that “ β ” indicates helix, that “ α ” indicates profile, and that large “F” indicates total error. Also remember that “f” indicates form, and “H” indicates slope.

Definitions of Profile Inspection Requirements

Total Profile Deviation—designated F_{α} , total profile deviation is defined by the AGMA as the “distance between two design profile lines which enclose the actual profile trace over the functional profile length.” In figures 1, 2, and 3, $L_{\alpha c}$ is the functional profile length, CD is the profile control diameter such as SAP (Start of

Active Profile) or TIF (True Involute Form), etc., and TB is start of tip break. The first profile chart shows an unmodified profile without any designed tip break. The second chart shows a profile with designed tip relief, and the third a full crown shaped profile (see figure 1).

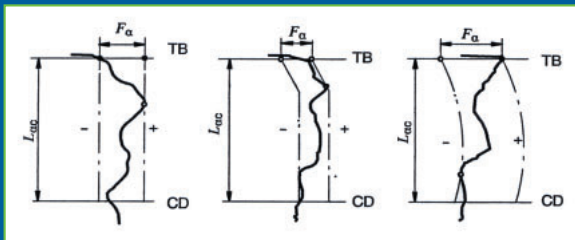


FIGURE 1 Total profile error F_{α}

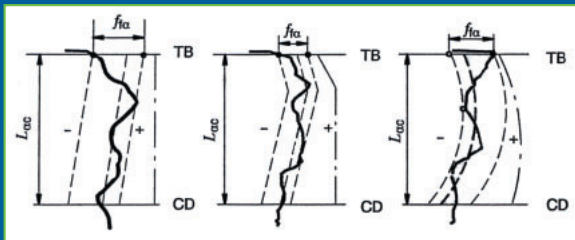


FIGURE 2 Profile form deviation, f_{α}

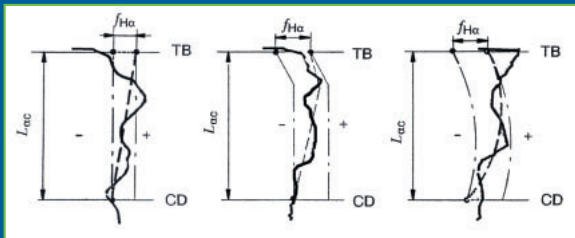


FIGURE 3 Profile slope deviation, $f_{H\alpha}$

Profile Form Deviation—designated f_{α} , profile form deviation is defined as the “distance between two facsimiles of the mean

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profile line, which are each placed with constant separation from the mean profile line, so as to enclose the actual profile trace over the functional profile length." Again, three typical profile designs are shown: unmodified, tip relief, and crown shaped (see figure 2).

Profile Slope Deviation—designated $fH\alpha$, profile slope deviation is defined as "the distance between two design profile lines which intersect the mean profile line at the endpoints of the functional profile length." Three typical profile designs are shown: unmodified, tip relief, and crown shaped (see figure 3).

Definitions of Helix Inspection Requirements

Total Helix Deviation—designated $F\beta$, total helix deviation is defined by the AGMA as the "distance between two design helix lines which enclose the actual helix trace over the evaluation range." In figures 4, 5, and 6, b is the face width of the gear and $L\beta$ is the helix evaluation range. The first helix chart shows an unmodified lead, the second chart shows a typical designed crown shaped lead, and the third chart shows both crown and helix design modifications (see figure 4).

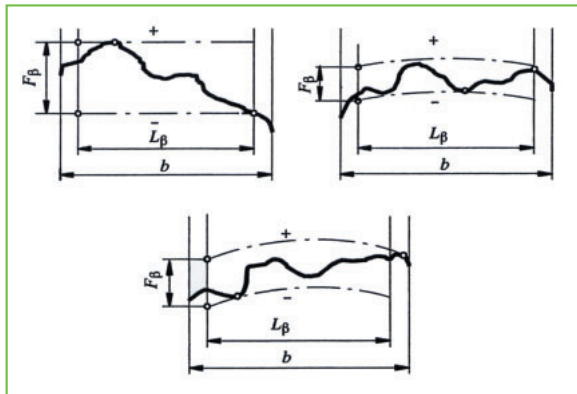


FIGURE 4 Total helix deviation, $F\beta$

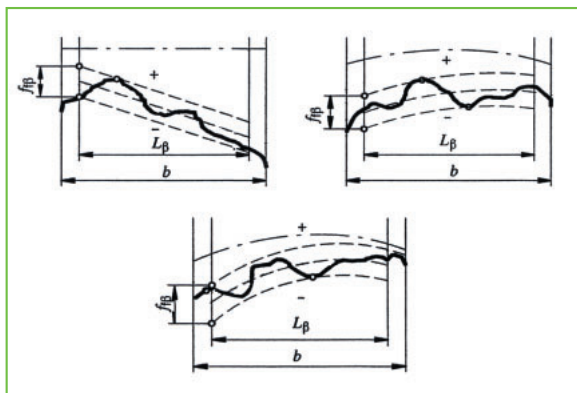


FIGURE 5 Helix form deviation, $ff\beta$

Helix Form Deviation—designated $ff\beta$, helix form deviation is defined as the "distance between two facsimiles of the mean helix

line, which are each placed with constant separation from the mean helix line, so as to enclose the actual helix trace over the evaluation range.” Again, three typical helix designs are shown: unmodified, crown, and crown with helix (see figure 5).

Helix Slope Deviation—designated $fH\beta$, helix slope deviation is defined as “the distance between two design helix lines which intersect the mean helix line at the endpoints of the evaluation range.” Three typical helix designs are shown: unmodified, crown, and crown with helix (see figure 6).

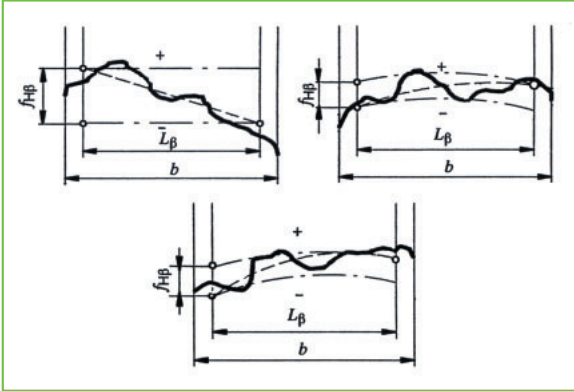


FIGURE 6 Helix slope deviation, $fH\beta$

Summary

On a very positive note, the new standards—AGMA ISO 10064-2 “Cylindrical Gears-Code of Inspection Related to Radial Composite Deviations, Runout, Tooth Thickness and Backlash” and ANSI/AGMA Standard 2015-1-A01 “Accuracy Classification System-Tangential Measurements for Cylindrical Gears”—provide the most advanced gear specification available in the world. It has corrected many weaknesses of the previous standard, AGMA 2000-A88. This new standard provides a clear technical definition for gear accuracy that can be used to compete on a global basis.

The challenge for some manufacturers will be the difficulty of providing the required inspection data if they do not have current computer controlled gear inspection capability. A modern gear inspection machine with the necessary mathematical software will provide this required data. The machine software should also be operator friendly to expedite the increased level of data required. All Wenzel GearTec equipment utilize a Windows-based operator interface for ease and flexibility.

ABOUT THE AUTHOR:

Dennis Gimpert is president of North American operations for Jos. Koeper & Sohne GmbH of Furtwangen, Germany. He holds a bachelor's degree from Michigan Technological University and has worked as an application engineer for the machine tool division of Barber Colman and as vice president of marketing for American Pfauter. Gimpert is active with the American Gear Manufacturers Association, a member of the AGMA Board of Directors, and chairman of the Business Management Executive Committee. To learn more go to [www.koepferamerica.com].





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