



AGMA Technical Paper

Analysis of Gear Root Forms: A Review of Designs, Standards and Manufacturing Methods for Root Forms in Cylindrical Gears

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Performance and Technological Potential of Gears Ground by Dressable cBN Tools

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[The statements and opinions contained herein are those of the author and should not be construed as an official action or opinion of the American Gear Manufacturers Association.]

Abstract

Gear root is an important but often neglected element of the gear. The stress concentration point typically lies in the tooth to root transition area and it is this point that determines the life or the fatigue life of a gear in many applications. Specific standards are in place on design of the involute part of a gear tooth, the root area however is less standardized. New manufacturing methods enable the designer of gears greater latitude in the design of strong alternative root forms. The standards on design and specification for the root geometry are lax so these root forms fit into current standards.

This paper reviews the designs of various root forms for the gears. It compares the various root forms on basis of their strength, fatigue resistance and other parameters. This analysis will be based on compilation of various research previously conducted on gear root forms.

The paper also discusses current manufacturing methods to produce the roots, and recently introduced alternatives. It will compare the traditional methods with new methods of gear manufacturing in terms of types of roots produced and overall control over the root profile.

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Example of root forms

There are various types of root forms that are used in gears. Most common are described below:

Stub tooth: A flat bottom (or very large radius approximating a flat) with radii blending the flat with each flank at points of tangency, see Figure 1.

Full root radius/Circular radius: This uses two radiuses at the end of each flank connected by a radius or a curve of constant radius terminating at points of tangency with each flank, see Figure 2.

Trochoidal root profile: This is a smooth curve generated by the hobbing process and is a complex curve of variable radius, which terminates at points of tangency with each flank. As it is a byproduct of the generation process its form is typically undefined. However the section of least radius can be expected in close proximity to the termination of the flank, see Figure 3.

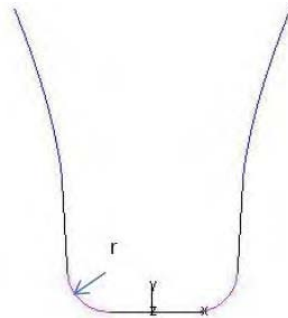


Figure 1. Stub root profile

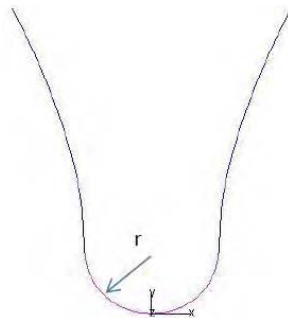


Figure 2. Full root radius



Figure 3. Trochoidal root profile