

Improving Pump Gear Geometry Through Secondary Gear Tooth Finishing

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American Gear Manufacturers Association



TECHNICAL PAPER

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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

The direction of the hydraulic gear pump industry is higher-pressure pumps that run quieter and more efficiently. In light of this, there is great importance in developing improved pump gears that will satisfy the demands of tomorrow's hydraulic industry. The objective of improved geometry for reduced noise and contact stresses falls in step with the entire gear industry.

Following is a discussion of three gears that have been developed for their strength and quality. One of the gears is a fuel pump gear with stringent controls placed on tooth alignment variation. Another gear was developed for high fatigue strength and improved gear geometry for high-pressure oil pumping applications. The third gear is not a pump gear but was developed for better gear geometry to reduce noise in a copier application.

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ABSTRACT

The direction of the hydraulic gear pump industry is higher-pressure pumps that run quieter and more efficiently. In light of this, there is great importance in developing improved pump gears that will satisfy the demands of tomorrow's hydraulic industry. The objective of improved geometry for reduced noise and contact stresses falls in step with the entire gear industry.

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INTRODUCTION

In the past, P/M pump gears offered a cost effective, near net shape alternative to high cost wrought steel gears. The P/M industry was able to offer cost savings because of the limited secondary machining required to produce P/M gears. Typical secondary operations are to finish the internal bore concentric to the pitch diameter and to a specified size, the outside diameter concentric to the bore and to a specified size, and the two ends parallel to each other, perpendicular to the bore, and to a specified size. Typically, once the gear was pressed, the gear teeth were left untouched.

Because tooth geometry is a critical feature of the gear, there have been substantial efforts to improve gear quality without forfeiting the cost advantage of P/M. Continuous improvement activities have been applied to improve gear

tolerances. Until recently, improvement efforts have been focused on the P/M tool geometry and better control of the P/M process. Recent gear improvements have come from secondary gear tooth finishing processes, which are now in full production. Typical results are presented in this paper.

PUMP GEAR NOMENCLATURE

Gear pump manufacturers have been improving their pumps to obtain higher pressures and efficiencies to meet the demands of the marketplace. Because of this, there is a tangible need for better gear geometry. The five main features of the pump gear tooth are: arc tooth thickness, involute, tooth alignment variation (also known as lead error), pitch error, and roll (a functional characteristic of the previous features).

Arc Tooth Thickness:

Arc tooth thickness (also known as chordal or circular tooth thickness) is a measure of size (thickness) of the gear tooth at the pitch diameter (see figure 1). Control of arc tooth thickness will result in better control of backlash. Backlash is the amount of play between two mating gears. Reduced backlash will reduce the noise in the gear system, particularly in gear sets that operate in both directions.

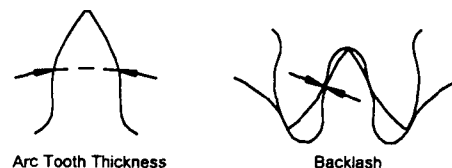


Figure 1