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Noise Reduction Through Generated Engagement Relief Modification

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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

For years, the international gear manufacturing industry has been pushing machine manufacturers to develop an economical realizable tooth flank modification that is made in contact direction, with a soft transfer from the modified to unmodified sections of the tooth.

To meet these demands, Höfler has developed, and is already implementing, Generated Engagement Relief Modifications. The tooth flank is modified at the areas of engagement only as opposed to the entire tooth flank as is the case with conventional modifications. The paper will discuss the advantages of this new technology over conventional modifications and discuss how to produce generated engagement relief modifications.

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American Gear Manufacturers Association
1500 King Street, Suite 201
Alexandria, Virginia, 22314

October, 1996

ISBN: 1-55589-670-7

NOISE REDUCTION THROUGH GENERATED ENGAGEMENT RELIEF MODIFICATIONS

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Introduction

It would be impossible to imagine today's world and our society without gears. Gear drive systems are still the most common mechanical element used to transfer power, adjust rotational speeds or change its direction. Gears can be designed to fulfill every possible axial position, power requirement, rpm, speed or transfer ratio. They are reliable, very efficient and, considering what they deliver, very compact.

Despite all of this, the gear manufacturing industry is constantly under pressure to reduce the size, increase the service life, reduce the noise emissions and improve the transmission accuracy of power drive trains. The development of new wear and thermal resistant cutting materials and tool coatings have strengthened the trend towards the fine machining of hardened gears and the development of new fine machin-

ing processes. Deep feed gear grinding, developed for CNC controlled index generating gear grinders, for instance, has improved the productivity of these machines many fold. Computer numerical controls (CNC) have replaced almost all mechanical generation couplings in gear manufacturing machines. Intelligent, multi-axial controls take over the machine setup, including infeed and modification movements. This has resulted in increased accuracy, flexibility and productivity. These benefits are also realized for small workpiece lot sizes and even single gears.

Gear design and quality assurance are also affected by new developments. Powerful calculating and simulation programs are now in use. These programs are made possible by recent advances in data processing. This is especially true in the areas of programming tools and computer speed. The demand for reliable, accurate and objective measuring and assessment processes for quality

control helped push the development of CNC controlled gear inspection equipment and control software.

In connection with these development trends in gear manufacturing machine technology, in the design departments and in the quality assurance departments, the design and use of tooth flank modifications in power transmission drive systems is a topic of increasing importance. Fine contact topography geometrical modifications can now be better calculated, manufactured and verified. Today, tooth flank modifications are an indispensable design element for modern gear trains.

All these developments will keep pressure on gear design engineers and the gear manufacturing industry at large to design and produce geared systems that can transfer more power in less space and make as little noise as possible. This pressure is more likely to increase than decrease. The following will introduce a tooth flank modification, "Generated Engagement Relief Modification", that will help the industry meet these goals.

Tooth Flank Modifications And Noise

The result of numerous experiments and research projects tell us that 60 - 80 % of total gear noise is produced by gear tooth rigidity behavior and gear tooth engagement impulses. This is true for different rotational speeds and different levels of power transmission.