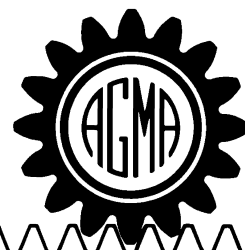


Manufacturing Net Shaped Cold Formed Gears

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American Gear Manufacturers Association



TECHNICAL PAPER

Manufacturing Net Shaped Cold Formed Gears

Dr. Dennis M. Engelmann, Milwaukee Wire Products

[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

An innovative metal forming process has been developed for manufacturing quality, durable and cost efficient gears for high volume production. In this paper, the development of Cold Formed Gears (CFG) will be presented along with their suitable applications. The manufacturing technique and equipment will be introduced as well as the advantages and limitations. Applicable materials and heat treatment practices will also be discussed. Gear tooth inspection charts will be presented and compared to conventional manufacturing methodologies.

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Introduction

A net shaped metal forming process has been developed for manufacturing quality, durable, high yield and cost efficient gears for high volume production. In this paper, the development of Net Shaped Cold Formed Gears (CFG) by using the Divided Flow Method will be presented along with their suitable applications. The manufacturing technique and equipment will be introduced as well as the advantages and limitations. Applicable materials and heat treatment practices will also be discussed. Gear tooth inspection charts will be presented and compared to conventional manufacturing methodologies.

Background Information

Cold forming/cold forging is a bulk metal forming process where a metallic workpiece (blank) is plastically deformed (pressed) into a tool (die cavity) by a press. The workpiece and tooling are at room temperature, i.e., they are not pre-heated as in the case of hot forging.

The advantages of using a cold forming process to manufacture parts are: 1) there is less material waste since material is being displaced and not removed, 2) the parts can be made at very high production rates, 3) the parts are strong due to the work hardening of the material, 4) the parts have tight tolerances, and 5) the parts have excellent surface quality.

Cold forming by the Divided Flow Method is a process where a workpiece is simultaneously pressed from an upper punch and a lower punch allowing the material to flow radially outward into the die cavity (Figure 1). This process is typically used for forming rotational symmetric components.

A Net Shaped or Near Net Shaped forming process is a process where no or minimal secondary and/or finishing operations are necessary. A Net Shaped gear is a gear where the teeth do not need to be machined or finished.

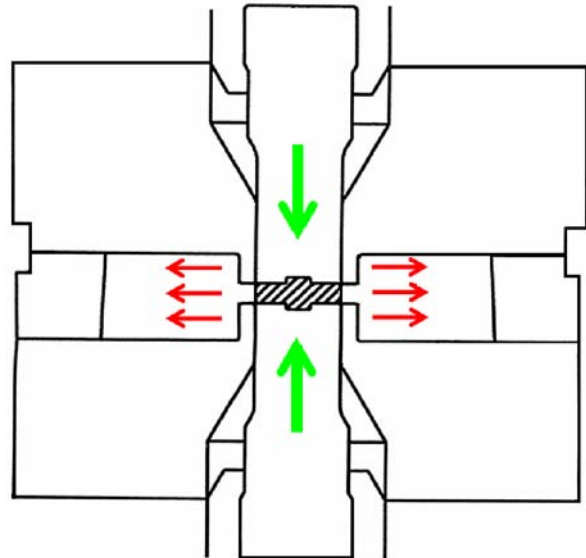


Figure 1. Cold forming by the divided flow method.

Development

To begin the development of cold forming gears, Finite Element Analysis (FEA) was used to determine how much forming load is required, how the material will flow, and how much the tools will deflect (Figure 2).

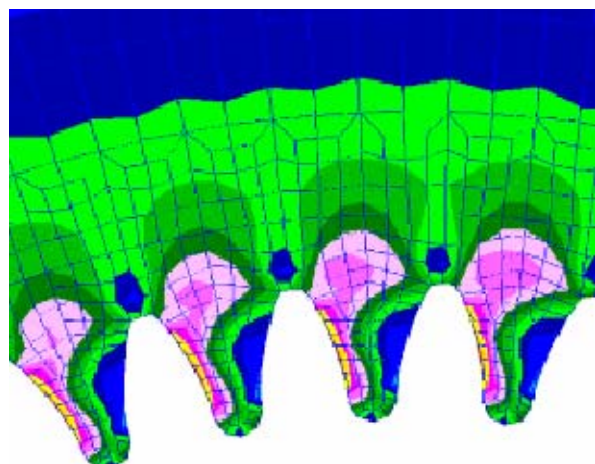


Figure 2. Gear die stress distribution.