

Representative Form Accuracy of Gear Tooth Flanks on the Prediction of Vibration and Noise of Power Transmission

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American Gear Manufacturers Association



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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 noise and vibration are troublesome problems in power transmission systems. Recent research has shown that accuracy in three dimensional tooth flank form, which is usually represented by tooth form and tooth lead form, is an important factors in noise and vibration.

In this paper the authors discuss investigation into what form accuracy of gear tooth flank has a good correlation with gear vibration and noise, when the scattering of accuracy in tooth flank form cannot be avoided.

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1. Introduction

Gear noise and vibration while running are one of the most troublesome problem in power transmission gears. It has become clear by recent research that gear manufacturing accuracy, especially the accuracy in three dimensional tooth flank form which is usually represented by tooth form and tooth lead form, is important factor for this problem. But actually, even though we investigate how we could expect the reduction of gear noise and vibration according to the improvement of form accuracy of the gear tooth flank comparing previous forms, and gear dimensions and accuracy are specified by this results of investigation and the gear manufacturing is ordered, there are many times that the prediction does not come true.

In most of these investigation to find the optimum tooth flank form and the optimum gear dimensions, the tooth flank form is assumed to be same on each tooth flank of a gear. But when we measure the form accuracy of gear tooth flanks of actual gears from the production line, we find that the form accuracy is considerably different between each tooth of a gear. We can anticipate therefore one thing as the reason for the discrepancy between predictions and the actual state, that we do not consider the scattering of tooth flank accuracy on each tooth. When the target form accuracy of tooth flank and gear dimensions are predicted to obtain quiet gears without considering the deviation of actual tooth flank form from the target form and without considering the scattering of tooth flank form on each tooth of a gear, that target tooth flank form is in actual not the optimum form. This proposes also a big question what kind of accuracy in tooth flank form should be specified at gear designing and manufacturing to obtain a good result for noise reduction.

In this paper, we investigate what form accuracy of gear tooth flank has a good correlation with gear vibration and noise, when the scattering of accuracy in tooth flank form cannot be avoided. This gives also an information about how much tolerance can be allowed during gear manufacturing to realize silent gear drive unit.

2. Noise Measurement of Automotive Power Transmission

To investigate gear noise of drive unit for automotive power transmission, 6 helical gear pairs (a.....f) whose tooth flank forms were different to each other were prepared. These gears were manufactured by a process of hobbing, shaving and case hardening. Changing only this gear pair

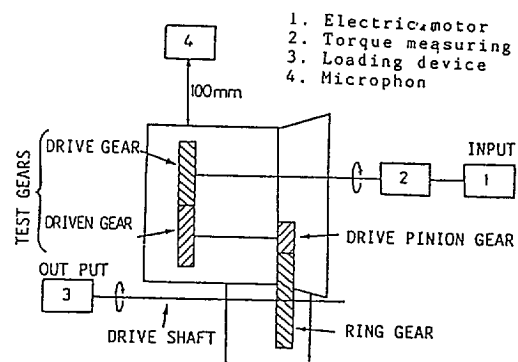


Fig.1 Schema of the set up for noise measurement from the automotive gear box