B. Venkatesham[1], Mayank Tiwari[2] and V. Aishwarya[3]

[1]Department of Mechanical & Aerospace Engineering, IIT Hyderabad

[2]Department of Mechanical Engineering IIT Patna

[3]Mechanical Engineering Student, Birla Institute of Technology and Science, Pilani, Rajasthan 333 031, India

venkatesham@iith.ac.in; mayankt@iitp.ac.in

Abstract

This paper quantitatively investigates the effect of micro-pitting on Transmission Error (TE) of a pair of spur gears and its correlation with vibrations. Micro-pitting is a gear surface failure phenomenon. It changes the gear profile form. The measured profile form variation can be used to calculate Transmission Error. This paper describes the micro-pitting test rig and profile form variation measurement. Calculation method of Transmission Error from profile form error data has also been presented.

Keywords: Micro-pitting, Transmission error, Gear micro geometry, Gear vibration

1 Introduction

1.1 Micro-pitting

Tribological components undergo interactions at the asperity levels when the lubricant film is not formed well. Gears are subjected to transient conditions of load and speed. The film thickness formation in gears can be difficult for low speed and high load conditions.

This results frequently in the wear of gear tooth, as the film is not thick enough to separate the surfaces from touching each other. The contact of surfaces is through asperity contacts which results in high stresses on the contact surfaces resulting in wear.

Micro-pitting can result in loss of tooth accuracy, increase in dynamic load, and increase in operating noise and can lead to gear failure modes such as pitting or tooth fracture. Gear micro-pitting is a complex gear surface damage mechanism in which the effect of contact stress, sliding speed, operating temperature, lubricant, surface finish and surface treatment process are critical parameters impacting the risk of micro-pitting.

The micro-pitting risk of a gear set is estimated from the minimum operating specific oil film thickness in the contact zone and wear of the tooth profile due to micro-pitting. The prevalent view on the mechanics of micro-pitting is high surface roughness causes rupture of the film thickness and solid-to-solid contact. The above parameters work together to maintain or break the film. So condition leading to high temperature of the oil reduces the viscosity and breaks the film.

Such conditions happen in gears running in slow speed which causes the asperity at the micro level to be broken from the surface causing microsize pits to be generated in the surface which causes the

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