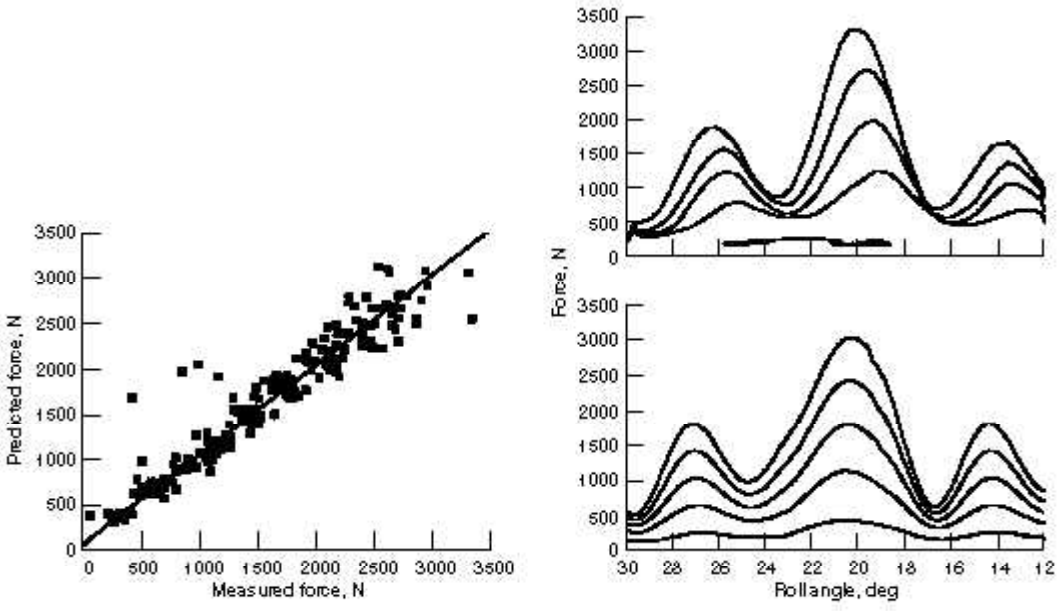
# Study of Gear Dynamic Forces Completed

Gearbox-generated noise and vibration is objectionable in many vehicles, particularly helicopters. This noise excitation is caused by the load fluctuation as gear teeth enter and leave mesh. In high-quality gears, a common technique to reduce gear noise and vibration is to modify the tooth profile. Gear noise reduction is a NASA and U.S. Army goal, and a NASA/U.S. Army research project sponsored development of gear dynamics computer codes to help design quiet gears. As part of this project, a series of experiments was performed in the NASA Lewis Research Center's Gear Noise Rig to develop a data base of dynamic test data and to validate the predictions of the codes for several gear designs under a variety of test conditions.

A method was developed to use dynamic strain gage measurements performed on Lewis' Gear Noise Rig to determine the forces acting between the gear teeth. Then, these dynamic force data were compared with predictions of DANST-PC, a NASA gear dynamics code. Tests were performed on six sets of low-contact-ratio spur gears that were identical except for different tooth profile modifications. The figures compare measured and predicted dynamic tooth force under several load conditions. They demonstrate that the analysis code successfully simulates the dynamic behavior of the gears under most conditions.

This analysis code can be used by gear designers to develop improved tooth profiles for quieter gears. Experiments continue to extend the data base to include high-contact-ratio gears and nonstandard tooth profiles. These promise further improvements in gear performance.




*Left: Comparison of measured and predicted maximum dynamic tooth force for 6 gear*

*designs and at 36 test conditions. Right: Measured (top) and predicted (bottom) dynamic tooth force for unmodified gear (4000 rpm and 5 different torque levels).*

# Bibliography

Oswald, F.B.; and Townsend, D.P.: Influence of Tooth Profile Modification on Spur Gear Dynamic Tooth Strain. AIAA Paper 95-3050 (NASA TM-106952), 1995.

Oswald, F.B., et al.: Measuring Dynamic Forces in Spur Gears to Validate a Gear Dynamics Code. To be published as a NASA TM, 1996