GUEST EDITORIAL

GEAR RESEARCH, THE STATE OF THE ART

Gear research seems to be thriving. Between September 10th and October 17th, 120 papers about gears were presented, at three conferences in Milwaukee, Boston, and Washington, to a total audience of about 400. The authors were from nine countries. Slightly more than half of the papers were prepared by authors who live outside the US and Canada.

Why is it then, that gear designers, manufacturers, and standards writers seem uncertain about the performance of their products? Why do prototypes undergo extensive testing before release for volume manufacture? Why did the total audience at the three conferences, with duplicate attendees and authors eliminated, probably not exceed 200?

Let's look at the papers which attracted this audience. They might be divided into four groups:

- Many papers could have been subtitled "What I Did With My Computer". More than one third of them would fit into this group.
- Other papers might have been named "Here is a Product or Process I'd Like You To Buy". About one fifth of them fit into this group.
- Some covered new ways to do old tricks: calculating the AGMA geometry factors, laying out tooth forms and constructing ratio tables.

MR. DON McVITTIE, *author of the Guest Editorial, joined The Gear Works—Seattle, Inc. as Executive Vice President in 1969. The Gear Works specializes in the unusual, particularly small lot production of coarse pitch, ground gears, planetary drives and custom designed reducers and increasers. He is also the President of Gear Engineers, Inc. He has been an active participant in the American Gear Manufacturers Association since 1972. His main interest has been the Technical Division, where he has served on many committees, including the Gear Rating Committee, the Manufacturing Committee and the Metric Resource and Advisory Committee. He is chairman of section 1 of the Technical Division, comprising nomenclature, metrication, lubrication, and metallurgy, and is a member of the Technical Division Executive Committee. He is the current President of AGMA. Mr. McVittie is a Licensed Professional Engineer in Washington, and a member of ASME, SNAME, and SAE.*

- *The rest of the papers, which were the most valuable to me, and I think most engineers, covered a variety of subjects, including interesting historical mechanisms, new methods of analysis with test results for verification, investigation of the fundamental mechanisms of failure and real test results on real gears.*

Few, if any, of the research projects reported on the subjects which are of the greatest concern in gear design:

- Transverse load distribution, particularly for gears with *large initial misalignments or large elastic deflection* under load.
- Internal dynamic factor, the effect of transmission error on tooth load. We sorely need an analysis method which gives good results for most gears using the normal quality measurements as input, without the use of a mainframe computer for the analysis.
- External dynamic factor or application factor. We used to call it service factor. It relates the performance of gears under steady state laboratory conditions to their performance under the fluctuating loads they usually see in the field. What is it about some loads that makes them so hard on drives?
- What material quality factors make the most difference in the allowable stress numbers for gears? What are reasonable limits on material and process for each level of allowable stress?

These little understood areas of gear design account for most of the failures in industrial gear drives. Our present

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design methods don't predict all failures, so we tend to be conservative in gear design or in instituting gear standards to cover all of the unknowns. Certainly we over design and over specify most of our products to cover those cases where our analyses or our materials fall down.

None of these problems will be easy to solve, but isn't it time that we redirected our research if we are going to solve them? A good research job requires real experimental data and data acquisition is expensive. No single company, nor single institution, private or public, has the funds today. It's tragic that the funds we do have are frittered away on peripheral projects, without attacking the areas of real need.

Kettering's famous quotation bears another repetition. "Secrecy in industrial research keeps out more good information than it keeps in."

Most gear manufacturers, and many large users, have data in their own fields of experience, which if analyzed and correlated with that of others, would provide a broader basis than we now have. The initiative must come from the industry, where the data, the judgement and the need all reside. We must find a way for those companies which have this data to share it to their own advantage.

It's time for the users of gears, gear manufacturers, and gear specifiers to show some leadership in gear research. The direction must come from those who will use the results, but there must be direct feedback of field experience which is pertinent to the research. When did you last talk to a mechanical engineering professor, a mechanical engineering graduate student, or an engineering class about gear research? How can they know the need if we don't tell them?

It's time to share our information with the universities and research institutions, and to make a united effort to fund the work required to improve our solutions to these problems.

Don McVittie
President, AGMA

NOTE: The opinions expressed herein are mine, not those of AGMA or any other organization.

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