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Beyond having up-to-date information on gear design and application, today's gear engineer needs knowledge of all the components that are required in a gearbox.

In past columns, geared products have been discussed as to how they relate to the development and refinement of gearing standards to supply designers with reliable tools for today's requirements. However, the design of a complete gearbox for a power transmission system requires knowledge of all its components. The design of such items as bearings, shafts, and housing structures can be as critical—or more critical—than the design of the gears.

The type bearings that support the gears and shafts, as an example, need to be selected and sized to reliability provide an operating life that will equal the design life of the gears and other components within the gearbox. But there is a problem in trying to equate gear life and bearing life, as the methods for determining rating, life, and reliability are not equivalent. The underlying methods, based on similar principals, have been developed with different definitions of "life." Therefore, gearbox standards have traditionally contained methods of applying bearing ratings.

Standards for Gearbox Design

AGMA gearbox and component standards that have included topics such as bearing selection, drive components, assembly requirements, thermal rating, lubrication, and application information are:

- ANSI/AGMA 6001-D97 *Design and Selection of Components for Enclosed Gear Drives*
- ANSI/AGMA 6009-A00 *Standard for Gearmotor, Shaft Mounted, and Screw Conveyor Drives*
- ANSI/AGMA 6010-F97 *Standard for Spur, Helical, Herringbone, and Bevel Enclosed*
- ANSI/AGMA 6023-A88 *Design Manual for Enclosed Epicyclic Gear Drives*

"IT'S IMPORTANT TO UNDERSTAND THE SPECIFICS OF BEARING APPLICATION STANDARDS SO THAT YOU CAN BENEFIT FROM THEIR STRENGTHS AND KNOW THEIR WEAKNESSES."

The methods developed and applied in accordance with these standards are reliable as long as the gearbox design is within the scope and knowledge base covered by these documents. There are problems when these methods—that are typical of applications two decades past—are applied to the advanced high power density designs of some of today's applications.

For instance, ANSI/AGMA/AWEA 6006-A03 *Standard for Design and Specification of Gearboxes for Wind Turbines* has a comprehensive bearing section that covers the application of different types of bearings in various locations within the gearbox. It also recommends that the designer use three different methods to develop a bearing rating and life. By reconciling the differences in the results of these methods, the gearbox designer can gain confidence that bearing life may be equivalent and as reliable as the gearing life.

Other Sources for Bearing Design Knowledge

In addition to the AGMA standards there are other sources where a gear designer can obtain today's knowledge on the application of bearings within gearboxes:

- Studying and understanding some of the newer bearing rating practices used by manufacturers, such as ISO and DIN281-4 calculations;
- Participating in the committees that are revising all the AGMA standards that have been listed in this column; and
- Attending conferences where gearbox bearing application papers are presented, such as the AGMA 2005 Fall Technical Meeting this October in Detroit at GEAR EXPO.

It's important to understand the specifics of bearing application standards so that you can benefit from their strengths and know their weaknesses. Detailed information on all of the subjects discussed is provided on the AGMA Web site at [www.agma.org]. Send e-mail to tech@agma.org.

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