AGMA & MPIF Develop Standards, Information Sheet for Powder Metal Gears

AGMA and members of the Metal Powder Industries Federation (MPIF) are three years into a joint project to develop specifications and an information sheet on rating powder metal gears. According to committee vice chairman Glen A. Moore of Burgess-Norton Mfg. Co., the first phase of the project, the publication of AGMA Standard "6008-AXX, Specifications for Powder Metallurgy Gears," should be completed in late 1996 or early 1997.

The object of the standard is to spell out through descriptions and examples the minimum data needed to adequately specify P/M gears. It covers external spur, external helical and straight bevel gears, the types most often made by the conventional P/M process. The subjects covered include gear tooth geometry data, gear drawing specifications and gear material specifications.

Moore points out that 6008-AXX is still a work in progress. The draft is almost complete, but has yet to go through the formal AGMA process of review and approval.

Courtesy of Burgess-Norton Mfg. Co.

P/M gears are available for a wide varity of applications.

The standard addresses the long-standing powder metal industry concern about the lack of information available to gear purchasers to properly convey their gear design intent to the gear producer. The lack of properly detailed gear data often leads to confusion and delays in quotations and deliveries and in manufacturing gears for particular applications.

"This standard addresses a long-term need," says Moore. "As powder metal gears appear in more and more applications, it's important that this information becomes available."

Powder metal part producers like Burgess-Norton welcome this joint effort, which has produced the first AGMA standard for powder metal gears. They feel it constitutes recognition of the fact that P/M is a viable alternative to wrought metal in some applications. Tables 1 and 2 are samples of this data.

The Bending Load Rating Information Sheet

The second part of this joint AGMA/MPIF project is an information sheet, "9XX-AXX, Calculated Load Capacity of P/M Gears," which will contain rating procedures and data on the failure of powder metal gears caused by bending loads, either as fatigue failures brought on by repeated loading or as breakage or yielding caused by a temporary overload condition.

The wear and pitting modes of failure have been omitted from the information sheet for a number of reasons. AGMA standards for wrought metal gears do not cover the wear mode of failure because it is successfully avoided in most cases by proper lubrication. Although the wear mode is common enough in P/M gears where adequate lubrication is not practical, the limited data available and the complexity of the issues involved forced the decision to follow the present practice, according to Moore.

Inadequate test data for pitting in P/M gears made eliminating it from the information sheet necessary as well. Furthermore, the committee felt that omitting pitting data would not be a significant handicap to the usefulness of the information sheet because this mode of failure is

Table 1 — Basic Data Required to Describe Gear in General Terms			
	TYPE OF GEAR		
SPECIFICATION	SPUR	HELICAL	STRAIGHT BEVEL
Number of Teeth	X	X	X
Diametral Pitch	X		X
Normal Diametral Pitch		X	
Pressure Angle	X		X
Normal Pressure Angle		X	
Helix Angle		X[1]	
Hand of Helix		X	
Pitch Angle			X
Face Angle[2]			X
Root Angle[2]			X
Back Angle[2,3]			X
Tooth Form	X[4]	X[4]	X

Notes:
1) Value of helix angle when calculated from other data specifications may be approximate due to rounding.
2) These data items may be shown instead on an outline drawing of the gear blank.
3) The outer form of P/M gears is generally cylindrical, in which case the back angle is zero degrees and this specification item may be omitted.
4) Tooth form may be omitted when the tooth outline is fully defined by other data.

Table 2 — Inspection Data (For Use With Composite Action Testing) Appropriate For Each Gear Type			
	FILLET FORM		
SPECIFICATION	SPUR (EXTERNAL)	HELICAL (EXTERNAL)	STRAIGHT BEVEL
Specification	X[2]	X[2]	X[2]
Outside Diameter	X[3]	X[3]	
Root Diameter	X	X	X
Master Gear (Spec or Data)			X
Pitch Apex to Back	X	X	X[4]
Total Composite Tolerance	X	X	X[4]
Tooth-to-Tooth Composite Tolerance	X[2]	X[2]	
Test Radius	X[2]	X[2]	X[2]
Tip Radius	X		

Notes:
1) Value of helix angle when calculated from other data specifications may be approximate due to rounding.
2) These data items may be shown instead on an outline drawing of the gear blank.
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4) Tooth form may be omitted when the tooth outline is fully defined by other data.

much less common than the tooth bending mode in P/M gears.

According to Moore, efforts are being made now to collect pitting data, and when it becomes available, to include the pitting mode in the information sheet will be reconsidered.

Developing the data for the information sheet will be a long process, says Moore. "It took three years to develop the specification, and the information sheet will probably take as long," he says.

The committee will take the existing AGMA formulas and plug in appropriate factors for P/M to make similar gears. Then test gears will have to be manufactured and tested to compare the actual results with the theoretical ones. Drafts of the procedures will have to be written and discussed and their calculations compared with available field experience with gears in real applications. Only at that point will the draft be approved and circulated as an information sheet.

Eventually, as field experience increases, the information sheet could go through other revisions and be upgraded as a rating standard.

The next meeting of the AGMA/MPIF committee will be Sept. 16–17 at AGMA headquarters in Alexandria, VA. Information about participation and other committee matters is available from Mr. Bill Bradley at AGMA. ○

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