Evaluating wear tests

By R. David Whitby

While reading the Cutting Edge column in the December 2005 TLT, I was reminded of a related issue with measuring wear: the nature and variability of wear tests.

During many years of developing and assessing lubricants and lubrication, I have used or become aware of many different wear tests. Some are useful indicators of lubricants that might provide good antiwear performance in "real life," while others are simple screening tests. Examples of different wear tests include:

- Alpha LFW-1 (ASTM D2714).
- Cam and tappet rig (VW PV 5106).
- Falex (ASTM D2670 or D3233).
- Four-ball (ASTM D2266, D2783 or D4172).
- ZG (IP334, ASTM D4988 or D5182).
- MB planetary gear rig.
- Optimol SRV oscillating friction and wear test.
- Pin-on-disc.
- Reichert (DBL 6570).
- Timken (ASTM D2782).
- Vacuum four-ball tribometer.
- Valve train scuffing wear (CEC-L38-A-94).

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One of the issues about these tests is that they may measure different aspects of wear; abrasive, corrosive, adhesive or fatigue wear, or a combination of these. Another issue is the nature of the test. (1.) Some involve continuous sliding while others involve reciprocating sliding, (2.) Some are run at relatively low loads while others at higher loads, (3.) Some are high sliding speed tests while others involve low sliding speed tests and (4.) Some use point contacts while others use line contacts.

Dr. Allan Matthews, professor of surface engineering at the University of Sheffield, who contributed to the International Wear of Engineering Materials (IRG-OECD) wear group's Web page www.vtt.fi/virtual/proj3/irg, indicated, for example, that in many tests the sliding speed isn't constant and the sliding distance is often quoted inaccurately.

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Although none of these factors are problems, they do make meaningful comparisons of the antiwear properties of different base fluids or formulated lubricants either very difficult or virtually impossible. The only reliable way of comparing the antiwear or load carrying properties of different fluids is to run tests using the same test equipment and identical test conditions of metallurgy, load, speed, time, temperature and so on. Trying to compare fluids tested on the same equipment, but using different metallurgy, load(s), speed(s) and/or time(s) seems to me to be nonsensical.

I am often asked by client companies developing new or improved base fluids or formulated lubricants for assistance in evaluating and advising on the properties and performance of the new product compared with existing products. When the antiwear tests are run using the same equipment and the same test conditions, the comparison is relatively easy. But when fluids are tested using different equipment and very different test conditions, comparisons can be misleading.

Furthermore, there is the additional problem that a single type of wear test and set of test conditions is highly unlikely to indicate the antiwear performance of a candidate fluid in different types of mechanical equipment used over wide ranges of operating conditions. So a number of wear tests is usually required to establish the range of antiwear performance of a lubricant.

Unfortunately, it appears to me that some tribologists, when trying to evaluate the antiwear properties of a fluid, simply choose the test equipment that is either readily to hand or easiest to use. As a result, when they find a fluid with apparently interesting antiwear properties, other tribologists then need to re-evaluate the fluid in a more appropriate or application-specific test, using different representative test conditions. Perhaps we ought to test the antiwear performance of fluids in a number of tests before publishing the results. **<<**

David Whitby is chief executive of Pathmaster Marketing Ltd. in Surrey, England. You can contact him at **pathmaster@dial.pipex.com**.