Lubricant viscosity revisited

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Contributing Editor

In previous TLT articles we have discussed the concept of viscosity. These discussions were a little abstract with the goal of understanding the nature of fluid flow and the importance of viscosity in a lubrication system. Indeed, in STLE's Basic Lubrication courses, our instructors often state that viscosity is the single most important property of a lubricant.

As we have stated earlier, the measurement of viscosity is not a simplistic process. As it happens, building absolute viscometers to measure viscosity is a bit involved. A number of methods were developed to make the measurement, whether direct or indirect, less of a laboratory exercise and more of a shop floor skill. We have learned in the lubri-

Figure 1. Diagram of a capillary viscometer

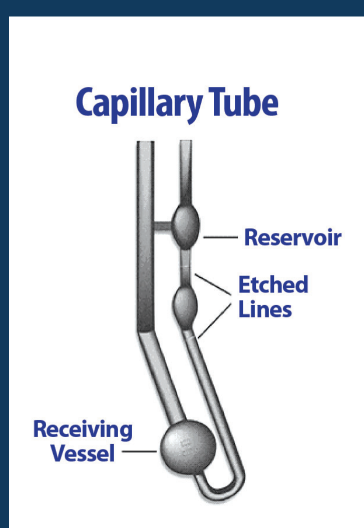
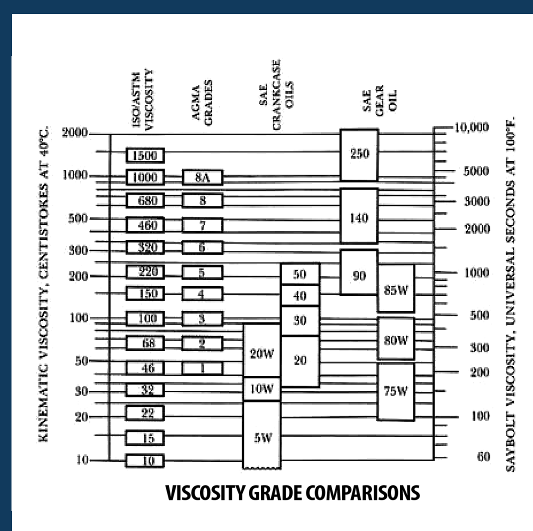


Figure 2. Viscosity Grade Comparisons



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cant industry that we can measure viscosity more easily by taking advantage of the properties of viscous fluids and their density.

Viscosity is normally determined by measuring the time required for a fixed volume of a fluid (at a given temperature) to flow through a calibrated orifice or capillary tube. The older method, Saybolt viscometer, ASTM D-88, measured the time required, in seconds, for 60 milliliters of the tested fluid at 100 F to pass through a standard orifice. This turned out to be a lot easier than using an absolute viscometer.

In a conceptually similar but more modern method, we measure the viscosity of lubricants by measuring the time required for a known amount of oil to flow through a small diameter (capillary) tube at a known temperature, providing the needed information with units in centistokes (*see Figure* 1, *page* 25). This test is called the kinematic viscosity, ASTM D-446, (moving-fluid-viscosity—get it?) and the units of measure are in centistokes. Now the industry has settled on kinematic viscosity as the preferred method for measuring viscosity. If absolute viscosity is needed, one need only multiply a lubricant's kinematic viscosity by its density to get absolute viscosity:

Kinematic viscosity X density = absolute viscosity

However, to further complicate things a variety of classification systems were developed to characterize viscosity. Unfortunately these evolved based more on the application and who was doing the classification. Thus, depending on who was doing the classifying, the same oil could be called many things.

Fortunately, as business became more global, the International Standards Organization (ISO) decided to help with the situation and developed the ISO classification system for characterizing lubricant viscosity. Thus, a given gear oil might have been an AGMA Grade 3 or a crankcase oil might have been a SAE 30, yet both are essentially the same viscosity as an ISO 100. However, we still see the older systems being used, especially in old specifications for equipment. To help with this, ASTM D-341 has published comparison charts like the one shown in Figure 2 on page 25.

For more information on ASTM standards, you can log on to **www.astm.org**. Next month we'll take a look at viscosity index and why that parameter is one of the most critical aspects of lubricant characterization. **<<**

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