Overview

The issue of high-temperature, high-shear (HTHS) oil viscosity and its relationship to engine operation has achieved the distinction of one of the most controversial issues to enter the arena of automotive lubricant development. This symposium was organized not to espouse any particular view on this issue, but rather to summarize the results of a twelve-year effort on the part of ASTM D-2, Subcommittee 7 on Flow Properties of Petroleum Products and Lubricants. This effort has yielded ASTM Data Series 62, *The Relationship Between High-Temperature Oil Rheology and Engine Operation* in which the technical literature on the subject up to 1984 is reviewed and produced ASTM Test for the Measurement of Viscosity at High Temperature and High Shear Rate by Tapered Plug Viscometer (D 4741), ASTM Test for Measuring Viscosity at High Temperature and High Shear Rate by Tapered Bearing Simulator (D 4683), and ASTM Test to Measure Apparent Viscosity by Capillary Viscometer at High Temperature and High Shear Rate (D 4624) to measure HTHS viscosity at temperatures up to 150°C and shear rates of 1 000 000 s^{-1}. The effort also resulted in the creation of a task force within Section B of Subcommittee 7 dedicated to the study of bearing oil film thickness in fired engines on a continuing basis.

Within this Special Technical Publication, the reader will learn about assessments of the state of the art of HTHS oil viscosity and its relationship to engine performance as given by key contributors to our present knowledge.

The technical community within the automotive industry has long recognized that kinematic viscosity does not adequately define rheological parameters insofar as engine operation is concerned. Kinematic viscosity as a property in automotive specifications was put in place when only straight grade oils were available. Temporary viscosity losses as a result of high shear rates were not an issue. The rapid growth of non-Newtonian multigraded oils has rendered kinematic viscosity as a nearly useless parameter for characterizing "real" viscosity in critical zones in an engine. Lack of an adequate tool has led, in some cases, to indirect control of high-temperature viscosity through control of low-temperature rheology.

There are those who are disappointed that the twelve-year effort has not resulted in a redefinition of the SAE J300 Engine Oil Viscosity Classification document so as to express high-temperature viscosity parameters of the various grades

(1) in terms of HTHS oil viscosity only,
(2) in terms of both kinematic *and* HTHS oil viscosity, or
(3) in terms of *minimum* HTHS oil viscosity.

In the view of this writer, this redefinition did not occur because the automotive lubricant market knows of no field failures unambiguously attributable to insufficient HTHS oil viscosity. In addition, there are those in the industry who refuse to believe that such failures are likely to occur in future engine designs if HTHS oil viscosity of lubricants is not defined. Apparently fully satisfactory performance has been observed with lubricants whose HTHS oil viscosities are lower than the minimum acceptable values that have been proposed. It has been argued that inclusion of these higher limits would arbitrarily and

unfairly restrict marketing of otherwise fully acceptable products. Such restriction could be justified only by unequivocal field problems attributable to low HTHS engine oil viscosity or convincing technical justification supporting the position that field problems are imminent.

As in many scientific endeavors, it sometimes seems that many more new questions have been raised than old questions answered. So it seems with the twelve-year effort of ASTM Subcommittee 7 in defining methodology for the measurement of HTHS engine oil viscosity and applying these measurements to the SAE J300 oil classification. It seems that the forum of this issue has room for the believers who will pursue oil grade definition in terms of HTHS viscosity with a real commitment, for the skeptics who will play "devil's advocate" to make sure that unnecessary restrictions do not find their way into specifications, and for the "fence sitters" who will act as referees. Ultimately, the desirable end will be achieved, one that will serve the user and manufacturer alike. It is crucial that this be accomplished within the framework of a sound test development philosophy and in an atmosphere of scientific objectivity and healthy skepticism.

I wish to take this opportunity to express appreciation on behalf of ASTM Subcommittee 7 to Dr. James Spearot of General Motors Research for organizing this symposium and for arranging for authors and speakers.

Z. M. Holubec
Lubrizol Corp., Wickliffe, OH; chairman, ASTM Subcommittee DO2.07