differences in rheological behavior of the lubricants under test. The shift of the lines (different \( \alpha \) value) is significant. Obviously, in these values the influence of the difference in chemical structure (composition) finds expression. Other fluids may have a first transition at 1 m/s, which is located between the lines drawn in Fig. 7. Also the viscosity dependence of the transition may, of course, have different slopes.

**Discussion**

The linear relation offers the possibility of predicting the load carrying capacity of the partial EHD film at 1 m/s over a large viscosity range (fluid temperature), thus reducing the amount of work to a minimum. Determination of the first transition at 1 m/s and two different temperatures of the bulk fluid, for example 30 and 100°C, already provides a good means of comparing the lubrication behavior with that of other fluids.

The viscosity influence on the transition at 1 m/s will be known with these measurements. To permit comparison of the whole region of partial EHD, information about exponent \( \alpha \) is required. The described test method still has the advantage of the transition diagrams, namely information of the range of speed and force in which unworn point contacts can run safely. It provides the possibility to compare transition diagrams of lubricants having different viscosity and composition in a more quantitative way.

Compared with other standard ASTM tests as carried out on the Fournier, Falex or Timken machines, the advantage of the described tests is the possibility to compare base fluids with different viscosity and/or structure. Also the effect of the use of additives applied to different base fluids can be studied. The disadvantage of the proposed method—i.e. more work than in the conventional ASTM tests—is fully compensated by the advantage that information is obtained over a large range of viscosities. In combination with some knowledge of the exponent value \( \alpha \), the method also provides information over a large range of speeds. In this way the information given in Figs. 6-7 is very useful to describe the lubrication behavior of unknown fluids in a given system.

**Conclusions**

1. In sliding concentrated steel contacts, transition diagrams \((F_x \cdot \nu)\) are useful for the characterization of lubricants.
2. TMP-esters have a significantly better lubrication performance than poly-\(\alpha\)-olefin or mineral oils based on paraffinic/naphthenic rings.
3. The collapse of the partial EHD film in the speed range 0.4 - 3 m/s can be described mathematically as a power function of speed \( \nu \) exponent \( x \) times Hertzian contact pressure \( P \).
4. The exponent \( x \) is only a function of the viscosity of the bulk fluid.
5. The contribution of viscosity \((\eta)\) and composition to the load carrying capacity of the first transition at 1 m/s \((P_c)\) can be described as a linear empirical function of the logarithm of viscosity and a parameter \((\alpha)\) in which the composition finds expression \(P_c = \beta \log \eta + \alpha \).
6. The empirical relation is a powerful tool in studying the influence of different molecular structures on the lubrication behavior of fluids in sliding concentrated steel contacts.

**References**

Authors’ Closure

The author wishes to thank Professor Czichos for his comments, with regard to the questions.
—Functional groups in the molecules as well as composition changes of the lubricant indeed provide a different failure protection.
—The surface damage has not been studied. The measurements of the wear scar, however, did not give any indication of different wear patterns on the balls.