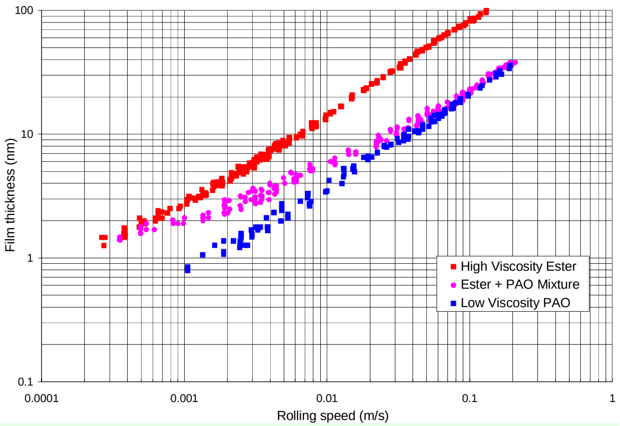
EHL Ultra Thin Film Measurement System

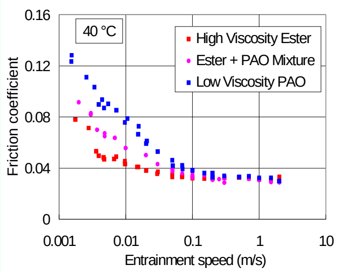
Examples of Research Work recently carried out by the Tribology Group at Imperial College

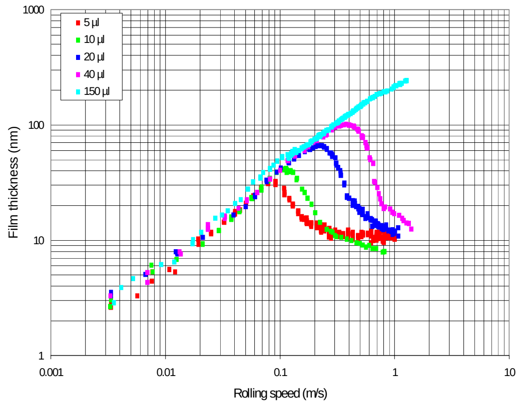
Molecular Fractionation of Base Fluid Mixtures at Metal Surfaces (STLE Preprint N0. 97-AM-4E-1)
For blends of 10% weight ester in hydrocarbon base fluid, the EHL film thickness in the thick film region is determined by the overall viscosity of the blend. In the very thin film region the thickness is enhanced and approaches that of the pure ester component.



The thick film friction is determined by the EHL friction properties of the major component of the blend. However the thin film friction is strongly influenced by the effect of base fluid fractionation on EHL film thickness.

This makes it possible to manipulate the speed at which the transition from boundary to EHL lubrication occurs by changing the blend of polar base fluids and so design more energy efficient lubricants.





The Role of Surface Tension and Disjoining Pressure in Starved and Parched Lubrication (Proc Inst Mech Engrs Vol 210)
EHL film thickness measurements on a polyalphaolefin revealed three stages of starvation behaviour. At slow speeds the film thickness is similar to that found for fully flooded contacts. At some critical speed, which depends on the quantity of lubricant available, the film thickness starts to decline and then falls rapidly as the speed is raised. However at still higher speeds, this film thickness levels out at about 10 - 20 nm.

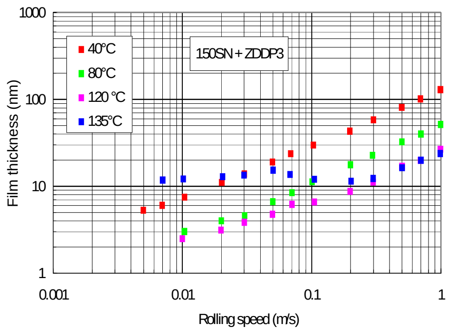
The initial film collapse occurs when the air/oil surface tension force is no longer able to replenish the out of contact track in the time available between successive over-rollings. The levelling-out of film thickness at around 10 - 20 nm occurs because solid/liquid van der Waals attractive forces produce a powerful replenishment mechanism at low film thicknesses.

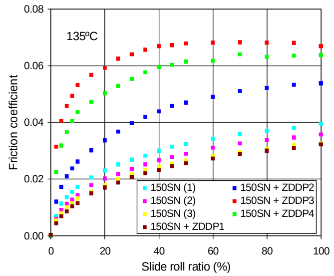
Friction Behaviour of ZDDP Films in the Mixed, Boundary/EHL Regime (SAE Technical Paper Series 962036)
Recent work has indicated that poor performance in the ASTM Sequence VI fuel efficiency test may result from an inappropriate balance of ZDDP antiwear additives.

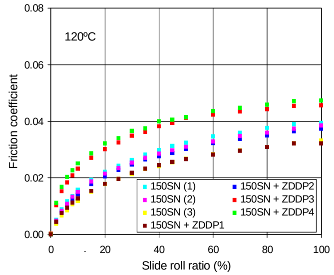
The thin film system was used to measure both the film thickness and friction behavior of ZDDP containing oils from the EHL through to the boundary lubrication regimes

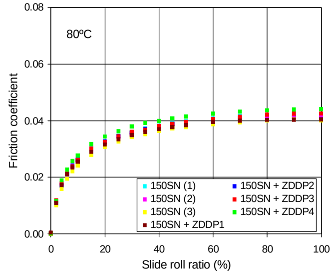
Some secondary ZDDP additives were found to give significantly higher friction coefficients in the mixed EHD/boundary regime at temperatures above 80ºC. Film thickness measurements showed that the onset of high friction correlated with the formation of a solid-like reaction film in the lubricated contact.

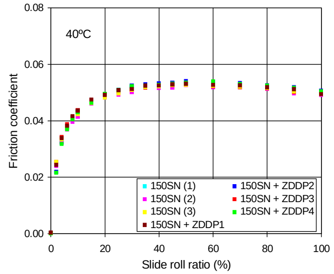
This behaviour is very similar to that seen using formulated ASTM sequence VI reference oils.











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