"Lubricant Viscosity Ratio"

Lubrication in a bearing often comes down to the sufficiency of the fluid film layer that separates the bearing rolling elements and the raceways. For this film layer to be adequate, the lubricant must have a minimum viscosity when the bearing is at its operating temperature. The metric used to define film separation adequacy is the viscosity ratio kappa, κ.

Calculating the Viscosity Ratio

The viscosity ratio takes the actual kinematic viscosity *v* of the oil at operating temperature and compares it against a reference kinematic viscosity v_1. The reference viscosity v_1 takes into consideration the minimum film thickness, h_{min}, needed in relation to the contacting surface irregularities to give adequate lubrication. For example, when a lubricant is selected that provides a higher actual viscosity at the bearing operating temperature than the minimum required reference viscosity, v_1, then a thicker oil film is formed. Due to increased separation of the contacting surfaces, improved lubrication conditions and life occurs until viscous frictional moment increases to the point that a thermal imbalance takes place.

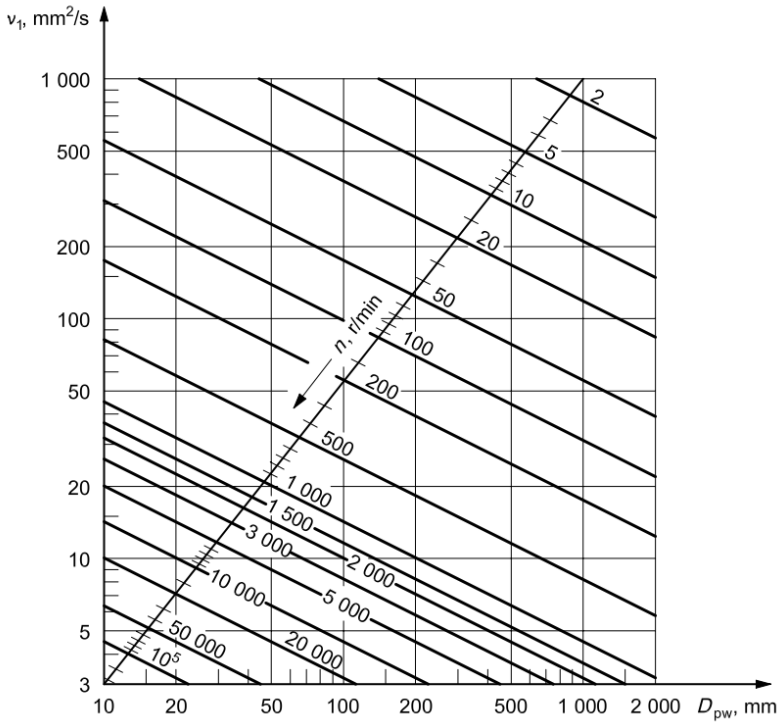
$$\kappa = \frac{\nu}{\nu_1}$$

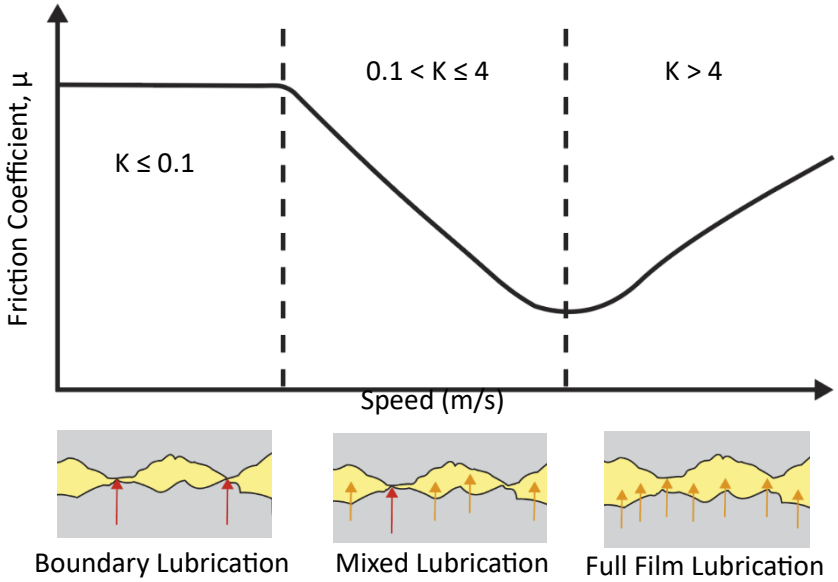
Reference Viscosity v_1

The reference viscosity (or required viscosity) is a function of bearing speed n, and pitch diameter D_{pw}. The value that is given will be one that provides a sufficient film separation for the bearing components where calculated L_{10} life is unchanged. So, when the actual viscosity exceeds the reference value the life will be improved, and vice versa. ISO standard 281 provides the two methods displayed for calculating reference viscosity. Additionally, the table to the right can be used to determine v_1.

$\nu_1 = 45{,}000 n^{-0.83} D_{pw}^{-0.5}$ for n < 1,000 rpm

$\nu_1 = 45{,}00 n^{-0.5} D_{pw}^{-0.5}$ for n ≥ 1,000 rpm





Effect on Life and Friction

When the κ is below 0.1 then full asperity contact is considered, and life is greatly reduced. And when κ is greater than 4 no asperity contact is considered, with no gain in life, and viscous friction moment will increase. If κ = 1 then it can be said that calculated L_{10} Life according to ISO standards is unaltered.

Contact NES

For more information on viscosity ratio please contact Andrew Hvizdzak (ahvizdzak@nesbearings.com) or Tim Asquith (tasquith@nesbearings.com)