Measurement and Correlation of the Thermal Conductivity of a Pentaerythritol Polyol Ester (POE) Based Lubricant (MIL-PRF-23699) and Three Representative Components

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Pentaerythritol Polyol Ester (POE) based lubricants are used for many applications such as combustion turbines and refrigeration compressors. Measurements of the thermal conductivity of a MIL-PRF-23699 lubricant and three representative pure components of this lubricant are reported in the liquid phase at temperatures from 300 K to 500 K with pressures up to 69 MPa. The three pure components are pentaerythritol-based with varying numbers of carbon atoms in the side-chain esters: pentanoate (POE5), heptanoate (POE7), and nonanoate (POE9). The POE components in the MIL-PRF-23699 lubricant range from POE5 through POE10. The thermal conductivity measurements were made with a hot-wire apparatus with a single platinum wire of 12.7 mm diameter. Initial measurements were attempted with a hot-wire cell that used alumina ceramic for the electrically-insulating wire supports. It was found that the alumina was catalytic for decomposition of these POE based lubricants at elevated temperatures. A new hot-wire cell was developed with glass and Macor wire supports that enabled the reliable thermal conductivity measurements to 500 K reported here. Preliminary correlations are developed for the thermal conductivity of the MIL-PRF-23699 lubricant and the three representative pure components (POE5, POE7 and POE9) based on this data.