Tech topic

Viscosity

The internal resistance to flow (friction) within a fluid

Key insight

Synthetic gas turbine oils are classified by their viscosity at

100°C

Introduction

Viscosity is often thought of as the "thickness" or sometimes the "body" of an oil. For gas turbine lubricants (jet oils), viscosity is measured as Kinematic Viscosity (KV). The unit of KV in the SI system (Le System International d'Unites), is millimeter squared per second (mm^2/sec). The more general unit adopted is the centiStoke (cS or cs). 1 cs = $1mm^2/sec$. Viscosity changes with temperature and with pressure exponentially. It becomes much higher at low temperatures and at high pressures.

Rate of change

The Viscosity Index (VI) of an oil is the measure used to assess the rate of change of viscosity with temperature. A high VI indicates an oil where the rate of change of viscosity with temperature is low. A pressure viscosity coefficient is used to indicate the rate of increase of viscosity with pressure. Coefficient is used during engine design to calculate the oil film thickness in lubricated contact zones.

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Viscosity

Classifying oils

Synthetic gas turbine oils are classified by their viscosity at 100°C. The grades are: 3cs, 4cs, 5cs and 7.5cs. The 5cs grade is used in the majority of engines used in commercial aviation. 5cs oils are limited by specification to a maximum value of 13,000cs at -40°C. 5cs oils are often referred to as "Type 2" oils. This is a reference to viscosity grade.

Changes in viscosity

Viscosity can increase as the result of oxidative degradation in engine operation. However, due to the exceptional bulk oil stability of modern oils, this effect is very low and it does not limit the life of the oil in the engines. Viscosity decreases are usually the result of contamination with a less viscous fluid.

In exceptional circumstances, for instance, in certain engine configurations where oil volatilization is a significant factor in the total oil consumption, the viscosity can increase without oxidation taking place. This happens when the "lighter ends" volatilize off, leaving the more viscous component of the oil behind. The viscosity of the oil "charge" in the engine can continue to increase as more top off oil is added and volatilization continues.

For more information

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