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NASA TECH BRIEF

High-Temperature Bearing Lubricants

The problem:

Proper lubrication of a bearing is as vital to its successful operation and endurance as is proper design and material selection. As aerospace technology advanced, higher bearing temperatures (in the range from 500° to 700°F) dictated the need for new lubricants with better thermal and oxidative stability.

Thermal breakdown is a common cause of lubricant failure in bearings that operate at high temperatures. This breakdown produces resins, sludges, and acids that can cause deposits on critical bearing surfaces, corrosion of bearing and lubrication system metal parts, clogging of screens, small clearances and passages in the lubrication system, and an increase in lubricant viscosity. Because of these problems, no reliable long term bearing operation had been possible at temperatures beyond 450°F.

The solution:

A synthetic paraffinic oil containing an antiwear additive and an antifoam additive was demonstrated in ball bearing tests to lubricate effectively at temperatures in the 600°F range. This lubricant is thermally stable in this temperature range, but requires protection from oxygen.

How it's done:

Seven test lubricants which were considered to have the greatest potential for high-temperature bearing applications were investigated and tested in a high-temperature bearing torque tester and a rolling-contact fatigue tester. The lubricants investigated were a polyester, a super-refined naphthenic mineral oil, a synthetic paraffinic oil, a polyphenyl ether, and a fluorocarbon. The synthetic paraffinic oil and the polyphenyl ether were evaluated with and without additives.

The tests were run with 204-size angular-contact ball bearings of AISI M-10 steel, at a thrust load of 100 pounds, an inner-race speed of 10,600 rpm, and outer-race temperatures from 400° to 900°F. Lubricants were applied continuously as a mist. The lubricants were compared with respect to bearing torque and the ability to provide an elastohydrodynamic film. Three of the lubricants were tested with AISI M-50 bar specimens in a rolling-contact fatigue tester at a 600°F test bar temperature.

Test Results

The test results showed that a synthetic paraffinic oil containing an antiwear additive and an antifoam agent provided adequate bearing lubrication to temperatures in the 600°F range and produced the longest bearing lives with no measurable wear. The bearing life potential with this lubricant equalled or exceeded the manufacturer's catalog life. The lubricant is thermally stable at the elevated temperature, but must be used in a reduced oxygen environment to prevent excessive oxidation.

Note:

Complete details may be obtained from:

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Patent status:

No patent action is contemplated by NASA.

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