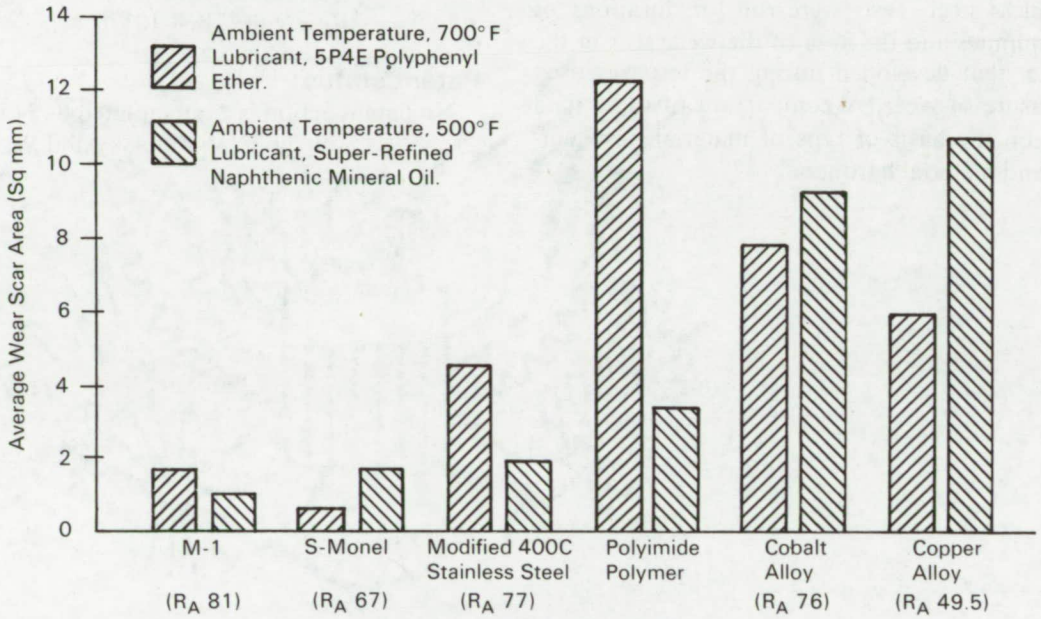
June 1968

Brief 68-10176

NASA TECH BRIEF

High-Temperature Bearing Cage Materials



Wear Of Materials In Inert Environment. Shaft Speed, 1200 rpm; System Load, 1000 Pounds; Duration, 30 Minutes. Figures In Parentheses Are Room Temperature Hardness.

The problem:

In the development of accessory drives and power-plant systems for advanced aerospace applications, the need for reliable, high-speed, high-temperature bearings has become of prime importance. The low starting torque, simplicity of design, and high reliability of rolling-element bearings make them ideally suited for use in rotating machinery.

At temperatures above 500°F, tests have indicated that bearing cage (retainer) wear can be a limiting factor in the operation of bearings under the severe lubrication conditions encountered at these high temperatures. Therefore, in addition to the race and the rolling-element material, careful consideration must be given to the choice of cage material.

Precision bearings, such as those used for aerospace applications, are usually equipped with cages machined from copper alloys or nonmetallic phenolic materials. Phenolic materials are limited to temperatures of approximately 250°F, while copper-base alloys can be used at temperatures to approximately 600°F. Other materials which have shown promise are high-temperature plastics which exhibit low friction and wear characteristics, high-alloy steels capable of maintaining their hot hardness at elevated temperatures, and stainless steels.

(continued overleaf)

The solution:

S-Monel and AISI M-1 were used as high temperature cage materials. These materials were tested in a cage compatibility tester at temperatures of 500° and 700° F.

How it's done:

Materials were selected and tested on the basis of their availability, their usage in current bearing application, and their desirable properties. The two most promising materials were tested in full-scale bearings at 600° F for up to 500 hours.

Test procedure:

Tests were conducted in a cage compatibility tester at temperatures of 500° and 700° F with six test cage materials: S-Monel, a copper alloy, a cobalt alloy, AISI M-1 steel, polyimide polymer, and a modified 440C stainless steel. Tests were run for durations of 30 to 120 minutes and the area of the wear scar in the cage pocket that developed during the test was used as the measure of wear. A comparison of these data was made on the basis of type of material, test temperature, and material hardness.

Two of the most promising materials (S-Monel and AISI M-1) were selected for use in 120-mm bore angular-contact ball bearings and were run at a speed of 12,000 rpm at 600° F for up to 500 hours. At temperatures of 500° and 700° F, they were found to be the most suitable as high temperature cage materials (see graph).

Notes:

1. Bearing cages designed with these materials should be of a one-piece thin-line construction for reliable long-term operation.
2. Complete details may be obtained from:

   Technology Utilization Officer
   Lewis Research Center
   21000 Brookpark Road
   Cleveland, Ohio 44135
   Reference: B68-10176

Patent status:

No patent action is contemplated by NASA.

Source: E. V. Zaretsky and W. J. Anderson (LEW-10403)