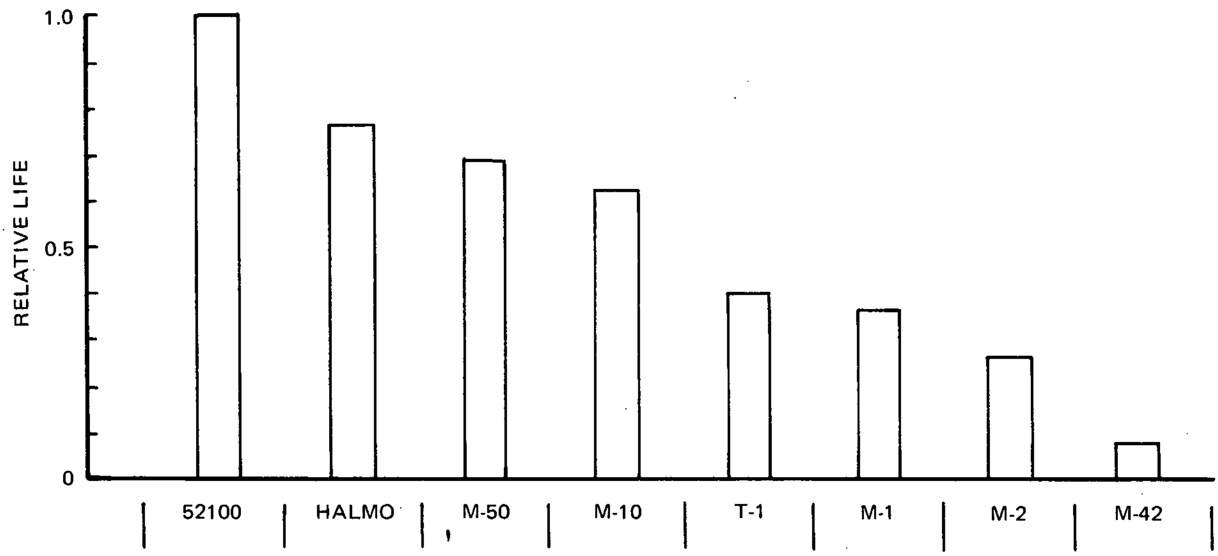
NASA TECH BRIEF
Lewis Research Center

Common Bearing Material Has Highest Fatigue Life at Moderate Temperature



Relative Rolling-Element Fatigue Lives of Eight Through-Hardened Bearing Materials at 340K

Eight bearing materials were tested to determine their relative rolling-element fatigue lives at moderate operating temperatures. Of these eight materials, AISI 52100, a high carbon chromium steel, had the longest fatigue life (see the figure). Fatigue lives of the other materials, AISI M-1, AISI M-2, AISI M-10, AISI M-42, AISI M-50, AISI T-1, and Halmo (see Note 2), ranged from 7 to 78 percent of the fatigue life of AISI 52100 at the moderate temperature of 340K (150°F). AISI 52100 is also the least expensive and most easily fabricated of these materials.

The tests were made with 12.7-mm (½-in.) diameter balls in a five-ball fatigue tester under very closely controlled conditions. All variables known to affect rolling-element fatigue life were kept constant. All test balls were of the same room-temperature hardness. Operating temperature was 340K (150°F). The lubricant was a super-refined naphtenic mineral oil.

For this operating temperature, AISI 52100 gives significantly better rolling-element fatigue life, provided that the hardness of AISI 52100 is approximately the same as the other materials at operating temperature. At temperatures below and above 340K up to 394K (250°F), relative hardness investigations indicate that AISI 52100 retains its superior fatigue life. At about 450K (350°F), the hardness of AISI 52100 drops below the minimum of Rockwell C58 acceptable for rolling-element bearings. The other materials tested were precipitation-hardened high-chromium steels alloyed with tungsten, vanadium, molybdenum, and cobalt to retain their hardness at higher temperatures. Above about 394K, the hardness of these materials at the operating temperature significantly exceeds that of AISI 52100 for balls of the same room temperature hardness. At moderate operating temperatures, however, AISI 52100 has the advantages

(continued overleaf)

of longer fatigue life, lower cost, and easier fabricability. Only as bearing temperatures exceed 394K is the choice of a precipitation hardened, higher alloy steel advantageous.

Notes:

1. This study should be of interest to bearing users who have been purchasing the more expensive higher alloy bearing materials because of assumed longer fatigue life.
2. Halmo is a trademark of Crucible Steel Company, Division of Colt Industries, Inc.
3. The following documentation may be obtained from:
   National Technical Information Service
   Springfield, Virginia 22151
   Single document price $3.00
   (or microfiche $0.95)

   Reference: NASA TN-D-6179 (N71-17329), Rolling-Element Fatigue Lives of AISI T-1, AISI M-42, AISI 52100, and Halmo at 150°F.

   Reference: NASA TN-D-7033 (N71-17409), Rolling-Element Fatigue Lives of Four M-Series Steels and AISI 52100 at 150°F.
4. Technical questions may be directed to:
   Technology Utilization Officer
   Lewis Research Center
   21000 Brookpark Road
   Cleveland, Ohio 44135
   Reference: B72-10382

Patent status:

No patent action is contemplated by NASA.

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