November 1964

Brief 63-10453

NASA TECH BRIEF

Molybdenum Disulfide Mixtures Make Effective High-Vacuum Lubricants

The problem: Development of a bearing lubricant that is effective in high-vacuum environments. Most ordinary lubricants, liquid or solid, vaporize too rapidly to be used in high-vacuum environments, even at very low temperatures. Inorganic solids normally exhibit much lower vapor pressures than organic solids or liquids and would therefore be preferable materials for lubricants not only at low temperatures but also at elevated temperatures in high vacuums.

The solution: Five different mixtures of molybdenum disulfide with other ingredients have been found to be effective bearing lubricants for high-vacuum environments.

How it's done: The different lubricants which were found to be effective in tests at pressures down to 10^{-6} Torr in the temperature range from 77° F to 400° F are listed below in relative order of lubricity, compared to the lubricity of a 0.001-inch-thick gold film used as a standard. (The figures in parentheses represent parts by weight of the indicated ingredient):

1. Molybdenum disulfide (10), graphite (1), bismuth (5), sodium silicate binder (7).
2. Molybdenum disulfide (10), graphite (1), gold (5), sodium silicate binder (7).
3. Molybdenum disulfide (10), graphite (1), molybdenum (2.5), sodium silicate binder (7).
4. Molybdenum disulfide (10), graphite (1), sodium phosphate binder (7).
5. Molybdenum disulfide (10), graphite (1), sodium silicate binder (7).

Notes:

1. No significant difference was noted in the results of tests at atmospheric and vacuum pressures, indicating that evaporation or sublimation of the lubricants was negligible. The test results were difficult to reproduce, apparently because of the formation of oxide and moisture films at the interfaces of the test specimens. Tests were not performed at cryogenic temperatures.
2. Further information concerning this innovation is given in "Research on Bearing Lubricants for Use in a High Vacuum"-Annual Summary Report, February 22, 1961 to March 22, 1962, MRI Project No. 2492-E.
3. Related innovations are described in NASA Tech Briefs B63-10337, May 1964; B64-10116, August 1964; and B63-10562, July 1964. Inquiries may also be directed to:

   Technology Utilization Officer
   Marshall Space Flight Center
   Huntsville, Alabama, 35812
   Reference: B63-10453

Patent status: NASA encourages commercial use of this innovation. No patent action is contemplated.

Source: Midwest Research Institute
under contract to Marshall Space Flight Center
(M-FS-54)

Category No. 03