AEC-NASA TECH BRIEF

Friction Characteristics of Graphite and Graphite-Metal Combinations at Various Temperatures

Certain useful characteristics of the coefficient of friction of graphite and of graphitic combinations between 70° and about 4000°F are reported. The combinations studied included graphite with graphite, carbide, and metals (aluminum alloys, stainless steels, and Inconel X-750), and carbide with carbide. The major factors investigated were (1) surface finish and "wear in"; (2) surface conditioning: influence of atmospheres and outgassing; (3) temperature; and (4) interfacial pressure.

Graphite's good frictional quality is attributed to a gas film on surface platelets; thus the surface finish greatly influences the wear-in characteristics. When one of the surfaces is graphite the static coefficient of friction at room temperature in air, hydrogen, or vacuum wears-in to a value of about 0.18 for surface pressures within the "elastic" range.

With increase in temperature the coefficient for graphitic combinations in hydrogen decreases, the static value being about 0.1 at 4000°F. This effect of temperature is reversible: the coefficient increases with cooling, returning to almost the same room-temperature value. The coefficient of friction for graphite-metal combinations decreases with temperature until a surface reaction occurs, after which it increases.

Removal of the surface film, by outgassing at 2540°F in vacuum, raises the static coefficient (in vacuum at 70°F) from about 0.18 to more than 0.4; this value returns to about 0.18 when hydrogen is admitted to the surfaces so that the gas film is restored.

Niobium carbide on niobium carbide has a room-temperature static coefficient of friction in air, hydrogen, or vacuum of 0.19; this value increases with temperature, reaching unity at about 3500°F.

Notes:

1. The report resolves significant conflicts in the literature regarding graphite's friction characteristics.
2. Requests for further information may be directed to:

   Technology Utilization Officer
   AEC-NASA Space Nuclear Propulsion Office
   U.S. Atomic Energy Commission
   Washington, D.C. 20545
   Reference: B70-10467

Patent status:

No patent action is contemplated by NASA.

Source: M. J. Manjoine of
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