LEAD INDUSTRIES ASSOCIATION
292 MADISON AVENUE
NEW YORK 17, N. Y.

November 21, 1960

SUBJECT: REPRINTS CONCERNING NEW LEAD BEARINGS

To Members of the Lead Industries Association:

We are attaching reprints of two recent articles that appeared in the trade press, one in "Materials in Design Engineering" and the other in "Design News." Both deal with new developments in bearings, and both developments involve the use of lead, in one instance litharge and in the other lead powder. These articles appeared as the result of cooperation between the LIA staff and the editors of the respective publications.

Additional copies in quantities up to 25 are available free of charge as long as our limited supply lasts.

Very truly yours,

Secretary

RLZ:JRH

Att.

DESIGN NEWS
DESIGN IDEAS REPRINT
MATERIALS APPLICATIONS

Dry Bearings Reduce Helicopter's Rotor Hub Maintenance

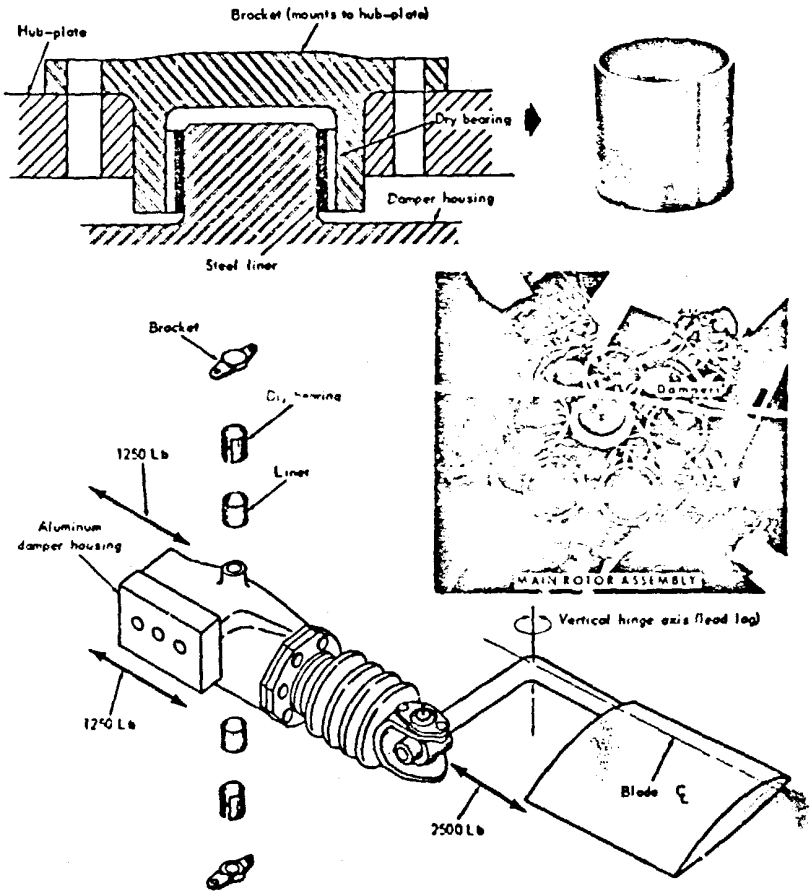
Victor W. Wigotsky, Eastern Editor

Oilless lead-"Teflon" bearings reduce maintenance in the rotor assembly of a turbine-powered helicopter. These bearings require no lubrication during the service life of the hub.

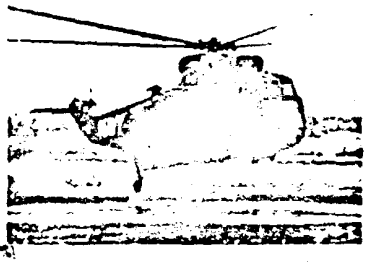
The design goal of a maintenance-free rotor hub is complicated by heavy loading of non-rotating components subjected to vibration, intermittent motion, weight limitations and corrosive environments. Normally, articulation of the rotor hub is accomplished by means of anti-friction and/or bronze bearings, both of which require frequent lubrication. The recently available oilless lead-"Teflon" bearings are now used to eliminate the lubrication need of helicopter's rotor damper assembly.

Material consists of a mixture of lead powder, 60 percent by weight, and T.F.E. fluorocarbon resin impregnated into a sintered bronze matrix. High structural rigidity is imparted to this composite by a tin-plated steel backing. A thin surface layer (0.0008 inch) of lead-T.F.E. covers the sintered bronze surface to provide material for the "bedding-in" process. Use of these bearings in the critical damper assembly permits elimination of 10 grease fittings which would have required daily lubrication.

Called DU, the bearings are marketed exclusively in the U.S. by Special Products Dept. of Garlock, Inc., Camden, N. J. The dry bearings are used in the Navy's HSS-2 twin gas-turbine helicopter developed by Sikorsky Aircraft Div. of United Aircraft Corp., Stratford, Conn.



VISCOUS ROTOR DAMPER restricts lead and lag motion of blade. Two split bushings with total area of 0.894 sq in must withstand reversing unidirectional load of 1250 lb each at 205 cycles per minute. Complete and sudden reversal of 1250-lb load subjects bearings to shock condition. On basis of very successful results obtained from rigorous whirlstand testings, which simulate in-flight rotor conditions, three dry bearings have been incorporated into production. Steel liner is shrunk on stub shaft of damper housing to provide hard surface for bearing. Bracket containing split lead-"Teflon" bushing then attaches damper to hub.



ALL-WEATHER HELICOPTER, powered by twin gas-turbine engines, can function as anti-submarine warfare weapons system. Flying boat hull enables it to operate from water, land or almost any other surface.

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Low Friction Coating Works Best at 600-1200 F

Lead monoxide provides high temperature bearing surface

A new bearing development makes use of the lubricating properties of lead monoxide (PbO) to provide a low friction coating which can function from room temperature up to 1250 F. Lead monoxide coatings were developed at the NASA Lewis Research Center, Cleveland.

Applied like porcelain enamel

Effective lead monoxide coatings of several compositions have been successfully applied, in the manner of porcelain enamels, to stainless steel (types 440C and 304) and to Inconel X. One of the better coatings, combining excellent adherence with low friction properties, contains about 5% silicon dioxide and 5% iron oxide absorbed from the steel during the firing operation.

The coatings are applied as a dry powder or sprayed on as a water slurry, then fired in the range 1650 F to 1800 F. Such fired-on films provide lower friction coefficients at temperatures exceeding 600 F than commercial resin-bonded molybdenum disulfide coatings (see Fig 1).

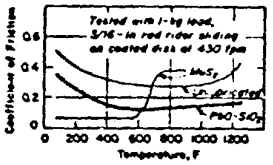
High temperatures help

Unlike conventional lubricating systems which function best when low surface temperatures are maintained at the bearing interface, the NASA coatings lubricate best under conditions that tend to promote high bearing surface temperatures, i.e., high ambient temperatures and high sliding velocities. At sliding velocities ranging from 2400 to 10,000 fpm (Fig 2) friction coefficients were within the range 0.05 to 0.08 at all temperatures studied.

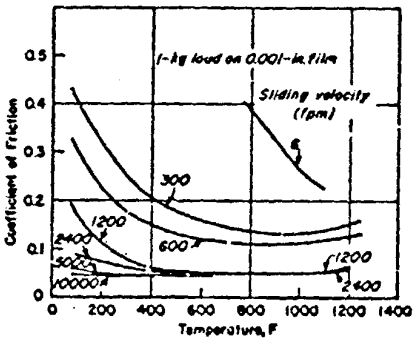
Reason for such performance is probably the formation of a glazed or vitreous surface promoted by the lead monoxide in the zone of sliding. Sliding then takes place by plastic or viscous shear rather than by shear along crystal planes.

Endurance life and temperature

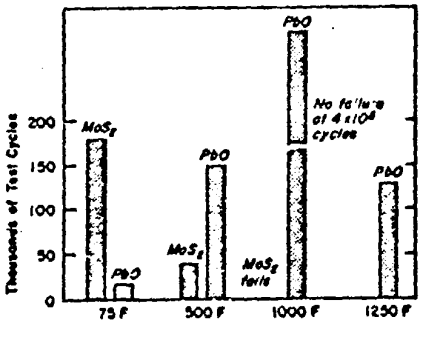
Endurance life of the lead monoxide coating seems to be sensitive to temperature, approaching a maximum at 1000 F, then decreasing slightly at 1250 F as shown in Fig 3. Although these coatings were designed to operate in the 600 to 1200 F range, the data show that both life expectancy and friction coefficient are good enough in cool operation to recommend them—even when the bearings must be started or cycled through room temperature



1—Effect of temperature on bearing lubricating properties.



2—Effect of sliding velocity on lubricity of PbO·SiO2 film.



3—How temperature affects life of lubricant coatings.

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