Materials Engineering Branch

TIP*

No. 047 Use of Grease Lubricants in Spacecraft

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Grease lubricants are composed of a base fluid (oil) combined with a thickening agent (filler). They are recommended over oils for the lubrication of gears because oils tend to be thrown out or migrate since gears are open and offer no resistance to surface migration. However, in ball bearings oils are preferred over greases because of the lower drag torque of the oils, especially when rotational speeds are high enough for the oil to establish a hydrodynamic film between the balls and the races.

In those cases where rotation of the bearing is so slow that a fluid film cannot be developed with a suitable oil, then a grease is advisable (because the grease thickener may help keep the metal surfaces separated). In applications of slow movement, the drag force of the lubricant is of minor influence. Greases are not easily filterable and, therefore, may have more particulate contaminants than oils. As a result, if very low bearing jitter is required, oils are the lubricant of choice. In addition, the greases are not as easy to apply as the oils. Consequently, it is most important that greased bearings be examined microscopically to ensure entrance of the grease into the ball groove, especially if the grease is of the stiff channeling type.

One method that is frequently employed to ensure adequate coverage of the balls and races by the grease is that of grease plating. In this method, the grease is thinned with a volatile solvent to a smooth syrupy consistency and the clean assembled bearing is dipped into the grease syrup to coat all surfaces. After a period of evaporation of the solvent, the bearing may be dipped again and this procedure continued until the desired amount of grease buildup is achieved. If porous ball cages are used, they should be thoroughly cleaned, vacuum dried and vacuum impregnated with an oil corresponding to the base oil of the grease used.

Greases that may be considered include those using the following base oils: perfluoro polyether (PFPE), such as Castrol Specialty Lubricants' Braycote or DuPont's Krytox or synthetic hydrocarbons such as Nye Lubricants' Rheolube or refined mineral oil such as Apiezon grease. Be aware that most lubricants,

including the majority of those mentioned here, do not meet the acceptable vacuum outgassing criteria. They are acceptable for space flight use only when the proper design precautions are taken. Each use of a lubricant is approved on the merits of the specific application that takes into account such factors as: usage temperature, loads, speeds, continuous or intermittent operation, labyrinth or hermetic seals, etc.

Regardless of what grease is used, the bearing should be weighed before and after the grease application in order to ascertain the exact quantity added. In addition, if the mechanism is not hermetically sealed it should have labyrinth seals designed into it to inhibit the loss of oil from the grease.