==

For more advanced **aircraft jet engines**, which really are just higher performing gas turbines, we have to kick it up a notch. These turbines use primarily ester-based lubricants for their wide temperature range capabilities, such as those described by military specifications Mil-L-7808 and Mil-L-23699.

For even higher-temperature resistance with operating temperatures as high as 300 °C (572 F), **polyphenyl ether** lubricants as described in Mil-L-87100 could be used. But these are not for the financially faint of heart, and the polyphenyl ethers have poor low-temperature performance, which is not so critical for an industrial gas turbine but can be a show stopper for an airplane.

==

How to detect electric discharge at Motor bearings?

Ken Brown

Owner at Eco Fluid Center Ltd.

Top Contributor

A good question and hopefully at the design stage this was considered and a solution was provided. Typically this an insulated bearing housing but this can have issues. There are also various shaft grounding brush solutions. See http://www.est-aegis.com/index.php.

If you have a used bearing look at the races. Arcing can cause pits and/or fluting. See http://www.technicallyspecializedsolutions.com/Electrical_Fluting.html

To detect it first try a high impedance device like an oscilloscope to look for voltage spikes and/or use a mechanics stethoscope to listen for arcing. If the bearings had an insulated housing make sure that the insulation was not compromised by painting (i.e. zinc based primer), sensor leads, modifications or being left out when reassembled.

Mark Lynskey   Condition monitoring and Reliability Services

Skf have a device specifically for this application
TKED1 Electrical discharge detector pen.
http://www.skf.com/group/products/condition-monitoring/basic-condition-monitoring-products/electrical-discharge-detector/index.html

Har Prashad   Technical Advisor

I suggest to read a book on "tribology in electrical environment" published by Elsevier UK. The book gives many approaches and detailed investigations.

Ken Brown

Damanik, that SKF spark discharge pen suggested by Mark looks very interesting. I have send them an inquiry to ask if it can also detect arcing in filters. Any way your question because of problems? In which case look at the bearing. If you suspect it then detecting the arcing using the SKF pen or an oscilloscope should work and if you have damage now in the motor bearings then it should show up on in increased high frequency vibrations. You need an accelerometer and not velocity or displacement.

Damanik Ramidi   ISO VA II,MLTI,MLAII Reliability & Condition Monitoring

Ken I have problems with the 1 MW motor with VFD,Currently I have bought the electric discharge SKF tool, as suggested by mark, ED SKF tool reading there is to much difference results among of the 8 electric motors, one Motor high reading value and another motors is very low value, While also actual reading with Acceleration or enveloping ,very bad value SKF tool but at low vibration, while high Acceleration but in medium level SKF tools reading. Still there is confusion about Electric discharge SKF Tools measurement and as well as interpretation.

Ken Brown   Owner at Eco Fluid Center Ltd.

Damanik, if the quality of the insulation is different and/or something about the electronics and/or motor windings are different or if the QA was not so good then you will see differences. Do the vibration readings show a lot of very high frequency noise for any of them and are these also the ones with high ED readings? If so you might want to pull a bearing when you get a chance. If oil or even grease lubricated check for wear metals and/or do a filter patch test.

For greased bearings you can sometimes use a grease thief to collect samples as the used grease is purged. See http://greasethief.com/.

For a grounding brush option see
http://www.bartlettbearing.com/wp-content/uploads/2011/04/AEGIS-iPRO-Datasheet-700-6.pdf

Har Prashad   Technical Advisor

Flutes on bearing surfaces or craters along with the lubricant deterioration is the clear indication of charges passing through bearing. Current passes through bearing if threshold voltage across bearing increases.

===

A rather large number of factors influences lubricating oil degradation and, consequently, pump bearing life. If your centrifugal pumps are equipped with rolling element bearings, there is little doubt that medium viscosity turbine oils (ISO Grade 68) will perform better than the lighter oils originally specified by many pump manufacturers. But, by far, the most frequent cause of lube-oil-related failure incidents is water and dirt contamination. With only 20 ppm water in pure mineral oil, bearing surface and rolling element fatigue life is reduced by an incredible 48 percent. Although the fatigue life reduction is less pronounced with inhibited lubricants, there are always compelling reasons to exclude dirt and water from pump bearing housings. Lip seals are a poor choice for centrifugal pump installations demanding high reliability. Face seals represent superior, "hermetic" sealing and should be given serious consideration.

"On a related subject, have you explained to your operators and maintenance personnel that a full-bottle oiler is no guarantee of adequate lubrication? The height of the beveled tube determines the level of oil in the bearing housing, and all too often there will be costly misunderstandings. However, there are at least two considerably more elusive problems involving bottle oilers.

"The first of these is that bottle oilers may malfunction unless suitably large bearing housing vents are provided. With a relatively viscous oil and close clearance at the bearing housing seal, an oil film may exist between seal bore and shaft surface. Good lube oils have a certain film strength and under certain operating conditions, this sealing film near the bearing end cap may break only if the pressure difference bearing housing interior-to-surrounding atmosphere exceeds 3/8 inch of water column.

"If now, the bearing housing is exposed to a temperature increase of a few degrees, the trapped vapors - usually an air-oil mix - floating above the liquid oil level will expand and the pressure may rise 1/4 inch of water column. While this would not be sufficient to rupture the oil film so as to establish equilibrium between atmosphere and bearing housing interior, the pressure buildup is nevertheless sufficient to depress the oil level from its former location near the center of a bearing ball at the 6 o'clock position to a new level now barely touching the extreme bottom of the lowermost bearing rolling element. At that time, the bearing will overheat and the lube oil in contact with it will carbonize. An oil analysis will usually determine that the resulting blackening of the oil is due to this high temperature degradation.

"The second of the elusive oil-related problems often causes the contents of bottle oilers to turn grayish color. This one is primarily observed on ring-oil lubricated rolling element bearings.

"Suppose you have very precisely aligned the shafts of pump and driver; nevertheless, shims placed under the equipment feet in order to achieve this precise alignment caused the shaft system to slant 0.005" or 0.010" per foot of shaft length. As a consequence, the brass or bronze oil slinger ring will now exhibit a strong tendency to run "downhill." Thus bumping into other pump components thousands of times per day, the slinger ring gradually degrades and sheds numerous tiny specks of the alloy material. The specks of metal cause progressive oil deterioration and, ultimately, bearing distress.

"Pump users may wish to pursue one of two time-tested preventive measures. First, use properly vented bearing housings or, better yet, hermetically sealed bearing housings without oiler bottles. The latter are offered by some pump manufacturers and incorporate bull's-eye-type sight glasses to ascertain proper oil levels.

"The second preventive measure would take into account the need for radically improved pump and driver leveling during shaft alignment or, even more desirable, apply flinger spools. Of course, oil mist lubrication or direct oil injection into the bearings would represent an altogether more dependable, long- term satisfactory lube application method for centrifugal pumps."

Viscosity Guide Table of Limits

Maximum Viscosities
Centistokes
(Normally At Start-Up)

22,000
Probably maximum pouring viscosity.

11,000
Probably maximum for splash or bath lubrication.

8,600
Barely pumpable by gear or piston pump too heavy to be serviceable.

2,200
Upper limit for an automatic oil lubricator.

2,200
Upper limit for circulation system (good practice).

2,200
Upper limit for an oil constituent of a grease for dispensing.

1,000
Ring or rolling element bearings.

860
Hydraulic Vane Pumps @ start-up temperature to prevent cavitation and wear.

860
Fuel oil for good pumpability and atomizing.

220
Oil mist generators without heat at minimum operating temperature.

220
Hydraulic-piston pump start-up temperature to prevent wear.

54
Hydraulic Systems at operating fluid temperature.

Minimum Viscosities
Centistokes
(At Operating Temperature)

33

For gear lubrication.
30
For a gear pump.
21
Spherical roller bearings.
13
Other rolling element bearings.
13
Hydraulic systems to prevent excessive pump wear and slippage.
13
Plain bearings.
4
Minimum viscosity to support a dynamic load.

Optimum Viscosities
The optimum viscosity is the ideal allowable at the operating temperature.-
Centistokes

25
Hydraulic systems
30
Plain Bearings
40
Spur & Helical Gears (e.g. ISO-VG 150 @ 60 °C)
75
Worm Gears (e.g. 460 @ 75 °C)
=====================================

A journal of diameter 150 mm runs in a bearing 300 mm long. The lubricant used has a density of 0.855 and a kinematic viscosity of 180 cSt.
If the radial clearance is assumed to be uniform and equal to 0,05 mm,
determine the power required to overcome the viscous resistance of the lubricant when the journal rotates at 5 r/s.

Answer:

$$\text{Tang. Force} = \frac{\overbrace{\text{density} \times \text{kin.viscosity}}^{\text{(abs.viscosity } \mu)} \times \pi \text{ squared} \times \text{dia squared} \times \text{speed} \times \text{lenght}}{\text{clearance}}$$

$$= \frac{855 \times 1.8 \times 10^{-4} \times \pi^2 \quad \times 0.15^2 \quad \times 5 \quad \times 0.3}{0.05 \times 10^{-3}}$$

$$= 1025 \text{ N}$$

Tangential Torque = Tangential Force x radius

$$= 77 \text{ Nm}$$

Power to overcome viscous resistance = 2 x π x torque x speed

$$= 2416 \text{ W}$$

=====================================

=====================================