Lubrication plays key role in anti-friction bearing reliability

Proper lubrication is essential to reliable bearing operation. If lubrication is absent, contaminated or insufficient, metal-on-metal contact occurs between anti-friction bearing rollers and raceways. When this happens, the components will fatigue prematurely and will likely fail quickly. A lubricant by itself, either grease or oil, is not an enduring substance; it will have a service life requiring replacement in order to allow bearings to reach their allowable life span.

Additionally, grease and lubrication oils are not inexpensive supplies, particularly in view of embattled petroleum prices. The most efficient and cost-effective machinery maintenance program is one that understands and applies the ideal amount of lubrication at the proper operating intervals.

Choosing proper re-lubrication intervals

Choosing the correct re-lubrication interval is essential to achieving maximum life of a bearing. Following the proper re-lubrication interval will ensure that fresh grease is supplied to the bearing, and that old grease and contaminates are being displaced out of the bearing internals. An incorrect re-lubrication interval can decrease the life of the bearing through grease service-life limitations, contamination, and/or heat due to excessive grease in the sealed bearing cavity.

On the other hand, grease acts as a barrier or seal and helps in decreasing the incursion of contaminates into the sealed bearing cavity. When sufficient lubricant is not present, the sealing ability of the bearing is decreased and contaminates can more easily enter the cavity. Once contaminates reach the rolling elements or raceways, total bearing failure is imminent.

In contrast, too frequent lubrication intervals can damage some types of bearings. In high-speed applications, bearings could actually overheat due to the frequency and amount of grease being pumped into the bearing. When excess grease is pumped into the bearing, it causes the bearing to churn the grease. Churning, or continuous mixing of the grease, generates heat within the bearing housing. If this particular re-lubrication interval is continued, the bearing will keep filling with grease and eventually overheat and fail.

However, correct seal design is the prime factor in preventing contaminants from entering a bearing, and re-lubrication at proper prescheduled intervals offers the advantage of purging out any extraneous material from the seals before they have had an opportunity to gain access to the bearings or the housing cavity.

The frequency of re-lubrication to avoid corrosion and to aid in purging out any solid or liquid contaminants is difficult to establish since re-lubrication requirements vary with different types of applications.

Anticipating a not-quite-clean to moderately dirty environment as can be assumed to be present in refineries, petrochemical plants and pipeline operations, one authority suggests greasing intervals ranging from 1 to 8 weeks. Noting that the period during which a grease lubricated bearing will function satisfactorily without re-lubrication is dependent on the bearing type, size, speed, operating temperature and the grease used, a major bearing manufacturer suggests use of the graph shown in Figure 1. We must

note that this Figure was developed for an age-resistant, average quality grease and for bearing operating temperatures up to +70°C (+158°F) measured at the outer ring. Its authors suggest that the intervals should be halved for every 15°C (27°F) increase in temperature above +70°C (158°F), but the maximum permissible temperature for the grease must not be exceeded. On the other hand, SKF has published lube interval data for motor bearings in very clean locations which exceed those shown in Figure 1 by a factor of 3.

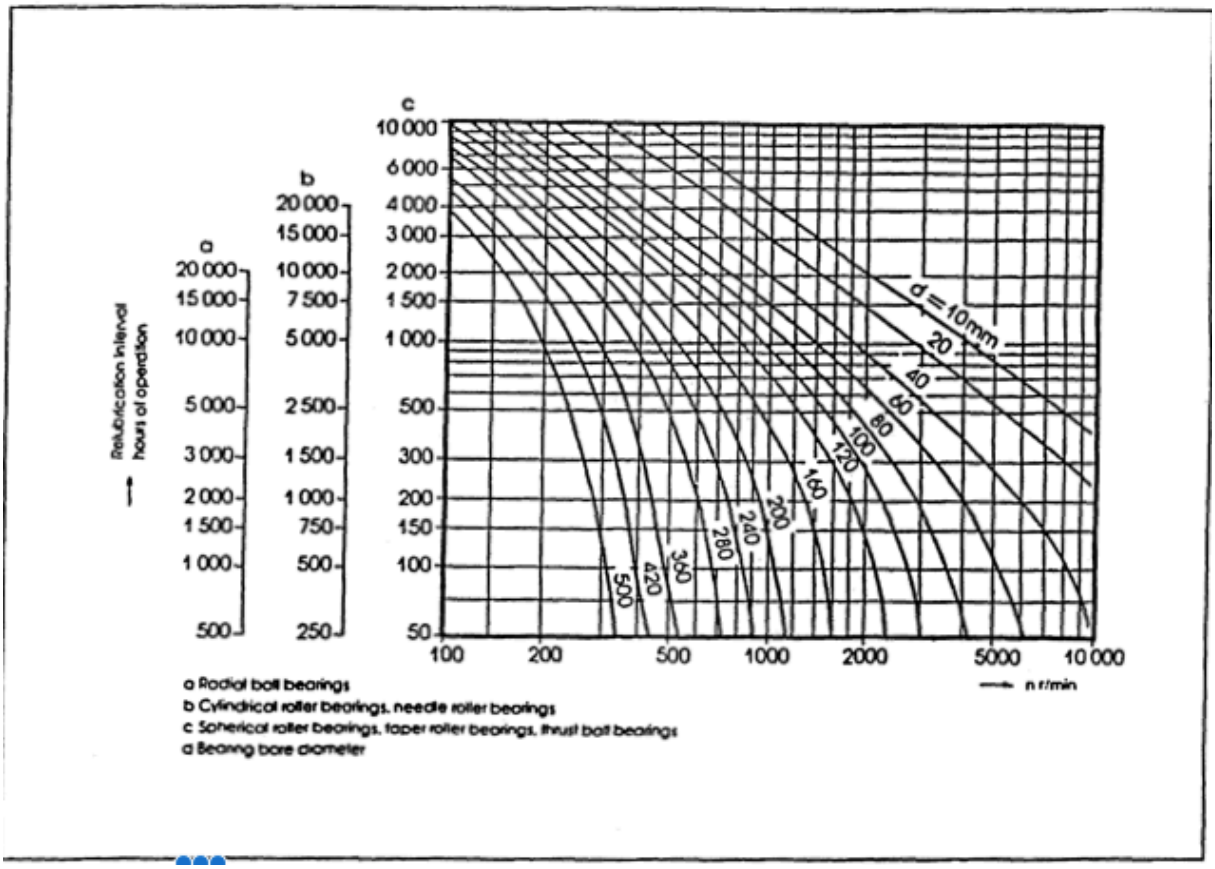

Figure 1. Recommended bearing re-lubrication intervals (in hours = c) as a function of shaft speed (n) and shaft size (d) - Source: SKF America

SKF[1] believes that if there is a definite risk of the grease becoming contaminated the above re-lubrication intervals should be reduced. This reduction also applies to applications where the grease is required to seal against moisture, e.g., bearings in paper making machines (where water runs over the bearing housing) should be re-lubricated once a week.

FAG[2] also opted for a graphical representation showing recommended re-lubrication intervals in Figure 2. Here, the horizontal scale depicts the ratio of running speed over the maximum allowable running speed for grease lubrication of a given type of bearing. This is similar to actual dn[3] over

[1] www.skf.com
[2] www.schaeffler.com

[3] The product of d = nominal bearing diameter in mm and n = bearing speed in rpm. A dn = 200,000

limiting dn of, say, 200,000. Most ball bearing-equipped motors are supplied with bearings operating at n/n_g approximately equal to 0.5.

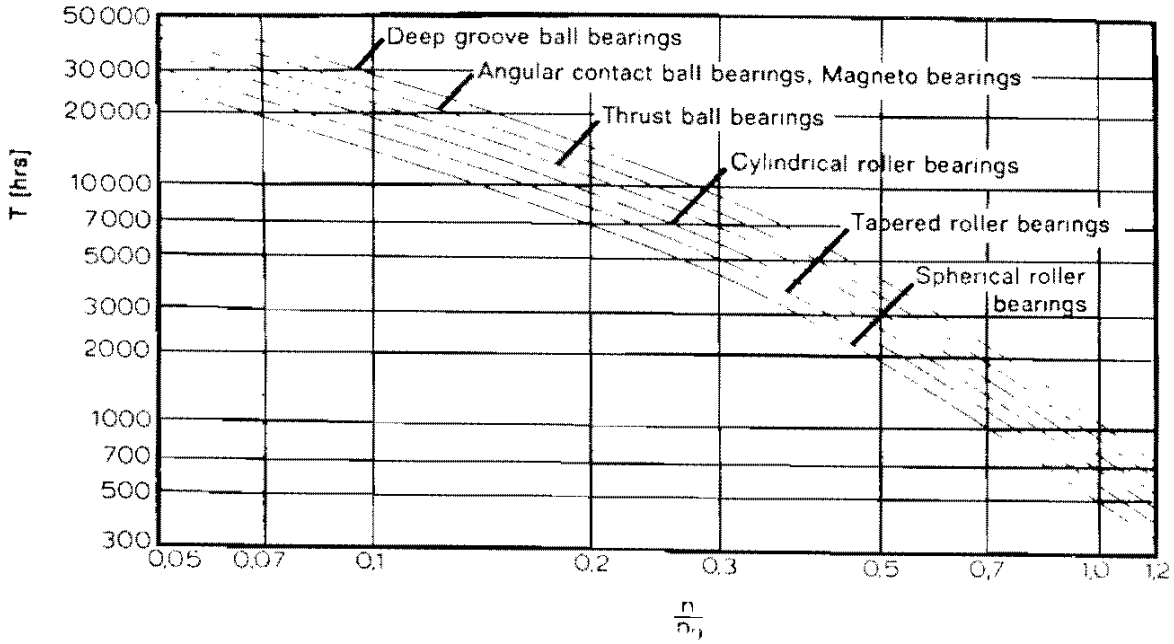

Figure 2. Re-lubrication intervals recommended by FAG Bearing Company.

FAG seems to adopt SKF's approach by giving it more emphasis and sophistication in their current publication.[4] Here basic grease operating life (t_f) is introduced as the ordinate and a bearing-specific speed parameter (k_f x n x d_M) as the abscissa where k_f , the bearing type factor, can be obtained from a look-up table and d_M , the mean bearing diameter, determined as (d+D)/2.[5]

Choosing the right amount of lubrication

If the right amount of lubricant is not added, the benefits of a correct lubrication interval are not fully realized. The bearing can still suffer if either too much or too little lubricant is available inside the bearing cavity.

There are four methods to determine the correct re-lubrication quantity. The first method is to contact the bearing manufacturer and request a recommendation based on the specific application. The second option is to calculate the correct re-lubrication quantity using the bearing manufacturer's recommended guidelines. They also have on-line software available for this purpose. The third method would be the use of a portable ultrasonic instrument.[6] The fourth method would be field trial and error.

Determining the correct re-lubrication quantity and re-lubrication

is considered the limit of grease lubrication for most 200,000 rolling element bearings.

[4] Publication TPI www.schaeffler.com

[5] Bearing dimensions: (ID = d) x (OD = D) x (W = W)

[6] www.uesystems.com

interval are both essential to achieve the maximum bearing life. It has been estimated that 90 percent of mounted bearing failures are lubricant related. The proper re-lubrication quantity and interval ensure that the bearing rollers and raceways are receiving fresh grease, while the old degraded grease and contaminants are expelled. Taking the time to follow these practices will increase bearing life, and decrease maintenance time as a consequence of bearing failures.

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References

Optimized Equipment Lubrication, Oil Mist Technology and Storage Preservation, Heinz P. Bloch, Don Ehlert and Fred K. Geitner, ISBN HF012020, © 2020, Reliabilityweb, Inc., www.reliabilityweb.com

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