Issue 22: Bearing Temperatures Influence on Grease

Bearing Temperatures Influence on Grease Life

In Bud's Take Issue 11, found on Midpointbearing.com, I discussed an article found in *Machinery Lubrication* September-October 2016 issue. This article, *How to Manage Hot Bearings in Your Plant*, discussed the difference of housing skin temperature and bearing temperature. I parlayed that into a discussion of temperature difference between bearing components.

The rule of thumb out of Issue 11 was that:

- If the outer ring temperature is less than (<) 212 ^{0}F, balls are 18 ^{0}F hotter and inner ring is 9 ^{0}F hotter than the outer ring.
- If the outer ring temperature is greater than or equal to (>=) 212 ^{0}F, balls are 36 ^{0}F hotter and inner ring 18 ^{0}F hotter than the outer ring.

Now we have established that the bearing does get hot, so how does that affect grease life?

Basic Bearing Life

In Bud's Take Issue 20 I discussed that the results of the basic bearing life or L10 equation are extremely accurate. In its basic form the equation does not account for multiple key items that influence bearing life: fitting practice, lubrication, temperature, etc. The equation assumes all other factors that can affect bearing life have been accounted for.

$$L_{10} = \frac{10^6}{60 * n}\left[\frac{C}{P}\right]^p$$

Equation 1: Basic L10 Life Equation

So How Does Temperature Influence Grease Life?

This is an extremely hard topic to generalize because there are so many types of greases/oils and bearing applications. To best explain I will use the basic life equation and a common grease life estimation equation that is used to estimate grease life in a sealed or shielded bearing.

$$\text{Log } L=6.7-4.404^{-6}d_m n-250\,(Pr/Cr-0.05)-(0.021-1.801^{-8}d_m n)T$$

- L = grease life, in hour
- 6.7 estimated constant for Polyrex EM
- d_m = (D + d)/2, D=outside diameter, in mm
- Pr= dynamic equivalent radial load, in N
- Cr= basic dynamic radial load rating, in N
- T = operating temperature, in C

Equation 2: Grease Life in Closed Ball Bearing Estimator

For this example, I will use a 6220 deep groove ball bearing running at 1200 rpm. I will apply 8 kN (1798 lbs) and 1kN (225 lbs) which the L_{10} = 49,258 hours.

As I increase temperature the grease life shortens dramatically, although L_{10} in theory is the same.

L_{10}	^{0}F	^{0}C	Grease Life	% of L_{10}
49,258	160	71.1	44,032	89
49,258	180	82.2	27,812	56
49,258	200	93.3	17,567	36
49,258	220	104.4	11,096	23

Chart 1: Reduction of grease life based on temperature.

Most bearing manufacturers will agree that normal operating temperature in electric motor and pump applications is between 140 – 160 ^{0}F. Grease/oil is always very important in achieving your desired bearing life, but it appears that once you exceed 160 ^{0}F the maintenance of the grease/oil becomes critical.

A Little Proof

The percent of bearing life vs. grease life shown in chart 1 changes with each bearing and application criteria. Again, it is very hard to validate my assumption because of the vast differences in grease, oil and applications. To justify my comments, I went to bearing catalogs and an article from October 2010 *Tribology & Lubrication Technology* magazine called *Grease Life in Ball Bearings: The Effect of Temperatures.*

In the bearing catalogs I reviewed I didn't find a study on the exact concept but I was able to justify my finding by reviewing the temperature correction chart for re-grease interval. On chart 2, the correction factor, a, are not exact but tend to follow the reduction of grease life shown on chart 1. For example, chart 2 shows that if your temperature is 200 ^{0}F your correction factor is 0.4, and the result of reduction in chart 1 at 200 ^{0}F is 0.36.

Chart 2: Temperature correction coefficient.

From the article in *Lubrication & Tribology* chart 3 confirms two ideas previously discussed. The chart is showing common industrial temperature range at 40-70 ^{0}C (104-158 ^{0}F.) The 104 ^{0}F is lower than I discussed because the article is trying to generalize tens of thousands of industrial applications. My focus is on electric motor and pump applications.

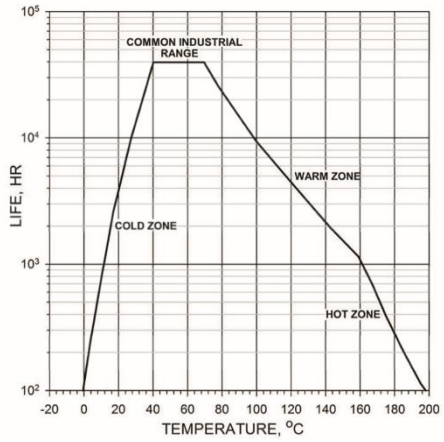

Chart 3: Bearing Temperature vs. Grease Oil Life Plot

The second item of interest on chart 3 is the data confirms the temperature coefficient used on chart 2. It is not easy to read because it was necessary to view using a logarithmic scale. Quick check, the chart is showing grease life of 40,000 hours at 40-70 ^{0}C (104-158 ^{0}F.) At 100 ^{0}C (212 ^{0}F) we see life drop to 10,000 hours, a reduction of 75% which correlates to the temperature correction coefficient of 0.25.

Conclusion

It's my opinion that I reasonably proved that bearing temperature clearly has an effect on grease or oil life. Although it wasn't my original intention, I feel my research and the calculations I performed for this report confirmed the accuracy of the temperature coefficient charts found in most bearing manufacturer's catalogs.

If your application is running hot, it is a guarantee that your grease life is being reduced. This has the capability to significantly reduce your bearing and equipment life. If you are unsure on how to apply the temperature coefficient to your re-grease interval, please don't hesitate to contact Midpoint Bearing.

If you have any questions, comment, ideas for future topics please feel free to contact me directly at bud@midpointbearing.com

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