Issue 11: Bud's Take on Bearing Temperature

Have you ever had the situation where you place your hand on a housing and it doesn't feel that hot, then your bearing fails due to a heat related issue.

In the September-October 2016 issue of *Machinery Lubrication* they had an article called *How to Manage Hot Bearings in your Plant*. The author, Mr. Randy Riddell, discussed what actions can be taken at particular temperatures. If you have not read this article I strongly suggest it. In this edition of Bud's Take I want to further explore the how temperature is translated through the bearing.

In the article Mr. Riddle discusses that the first step in his process is to determine the actual bearing temperature. He states, "Keep in mind that the temperatures measured are only the skin temperatures of the bearing housings. The actual bearing temperature will be 15-25 degrees hotter."

Key Definitions:

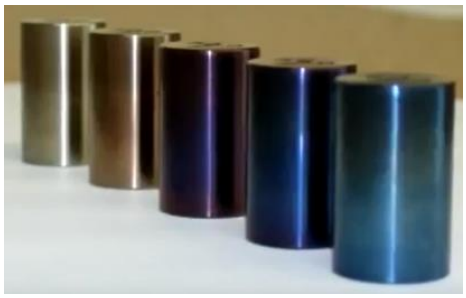
Quench Hardening: process that strengthens and hardens a steel and cooling at a specific rate resulting in surface hardness or through hardening.

Temper: improve the toughness and elasticity of steel by reheating and then cooling.

Annealing: process of heat treatment that increases ductility and reduces hardness.

Steel Color Change

It is commonly known that as you put steel through a heat treat process such as hardening or tempering, the color of the material will change depending on the temperature and the material. In general, as temperature increases, its color changes from a silver, pale yellow, brownish, purple, blue, dull grey, red, orange, then it will melt.



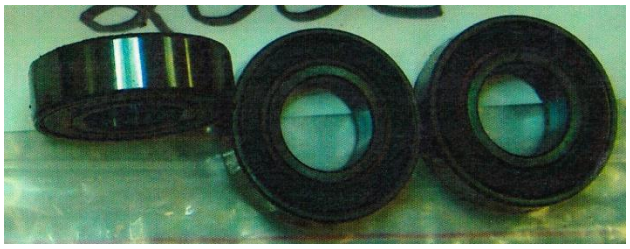
Picture 1: Steel colors

In oven testing we can verify this with bearings. In the pictures below, we see bearings displaying the colors pale yellow, brownish, purple and blue. The corresponding temperatures are noted below the pictures:

Picture 2: Pale Yellow (120^{0}C - 240^{0}F)

Picture 3: Brownish (150^{0}C - 302^{0}F)

Picture 4: Purple (180^{0}C - 356^{0}F)



Picture 5: Blue (200^{0}C - 392^{0}F)

How Does this Translate to Operation?

In operation bearings are not subjected to the same steady, consistent heating method as seen in oven testing. They are subjected to varying load zones, speeds, loads, lubrications, etc. The components of the bearing are subjected to a variance of temperatures. In most cases where the inner ring is rotating we see the temperature through the bearings as lowest to highest: outer ring, inner ring, rolling elements.

Picture 6: Discoloration of bearing

If we look at picture 6, we see the inner ring appears to be brownish and the outer ring appears very pale yellow. The rolling elements can't be seen due to the cage, but the cage is a hue of red. The inner ring had some lubrication staining enhancing the color. That provides a good example of heat passage through the bearing.

Rule of Thumb:

I am not a big fan of rules of thumb, but in this case the concept that the rings and rolling elements will have different temperature is the main idea:

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.

Examples:

- ⇨ If the outer ring is 150 ^{0}F, the inner ring is 159 ^{0}F and the balls are 168 ^{0}F
- ⇨ If your outer ring is 215 ^{0}F, the inner ring is 233 ^{0}F and the balls are 251 ^{0}F.

If the outer ring temperature is less than (<) 100 ^{0}C, balls are 10 ^{0}C hotter and inner ring is 5 ^{0}C hotter.

If the outer ring temperature is greater than or equal to (>=) 100 ^{0}C, balls are 20 ^{0}C hotter and inner ring 10 ^{0}C hotter

Examples:

- ⇨ If the outer ring is 80 ^{0}C, the inner ring is 85 ^{0}C and the balls are 90 ^{0}C.
- ⇨ If the outer ring is 110 ^{0}C, the inner ring is 120 ^{0}C and the balls are 130 ^{0}C.

Conclusion:

My goal in this article was not to prove or disprove Mr. Riddell's comments, just to go a little further in the discussion on how heat passes through the bearing. In doing so I believe I have added credence to his statements. Going back to the original comment, if the housing doesn't feel hot it doesn't guarantee the bearing is not hot. Understanding actual bearing temperature will help you determine bearing maintenance and improve bearing performance.