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Dodge® mounted bearings: lubricant viscosity selection

The selection of the proper oil or grease is essential in achieving the maximum life of a mounted bearing. Viscosity plays one of the most important roles in the selection of lubricants, and if chosen correctly, will provide the bearing with the proper fluid film thickness between the rollers, inner, and outer ring. This will inherently increase bearing life by decreasing friction and wear. If chosen incorrectly, metal to metal contact will take place, decreasing bearing life.

Viscosity is defined as the property of a fluid that resists internal flow by releasing counteracting forces. The viscosity of a lubricant is generally measured at 40° Celsius in Centistokes (cSt), or equivalent mm2/s units. In most applications a middle of the road viscosity of 100cSt at 40° Celsius will suffice. Think of the viscosity in terms of common liquids such as honey and water. A high viscosity liquid, like honey, would contain a high number of counteracting forces and would spread very little when poured onto a flat surface. Water, a low viscosity liquid, would contain a low number of counteracting forces and therefore spread quickly over a flat surface.

Multi-purpose lubricants generally have a viscosity in the neighborhood of 100cSt at 40° Celsius. These types of lubricants are acceptable for most applications, but when mounted bearings are subjected to extreme speed or temperature, either high or low, it's critical to select the lubricant with the proper viscosity. However, to make the correct selection you'll need to follow the steps below to calculate the required viscosity.

1. Identify the type of bearing i.e.: ball or roller
2. Calculate the mean bearing diameter: $d_m = \frac{D+d}{2}$

Where: D = O.D. of the bearing in mm

d = I.D. of the bearing in mm

(General dimensional information can be found in the bearing manufactures catalog)

1. Determine the operating RPM(n)
2. Determine the operating temperature in Celsius
3. Determine the viscosity ratio: $K = \frac{Operating\ Viscosity\ (v)}{Rated\ Viscosity\ (v_1)}$
   a. K = 1 for ball bearings
   b. K = 2 for roller bearings
   c. K = 2.5 for slow turning applications or when ndm < 10,000

Once you have gathered this information, you can determine the required viscosity by using the two diagrams contained in this article. The following fan application example will help explain the use of the

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diagrams. In our example we are using a 22220 spherical roller bearing, with an RPM of 2000, and an operating temperature of 90° Celsius. With this information, follow steps one through five.

1. **Identify the Type of Bearing**

   22220 Spherical Roller Bearing

2. **Calculate the Mean Bearing Diameter**

   $dm = \frac{D+d}{2}$ Where D = O.D. of bearing in mm

   $dm = \frac{180+100}{2}$ d = I.D. of bearing in mm

   $dm = 140mm$

3. **Determine Operating RPM**

   Given: Operating RPM(n) = 2000

4. **Determine Operating Temperature**

   Given: 90° Celsius

NOTE: Operating temperature is defined as the temperature of the bearing while being subjected to its normal operating conditions. This temperature can be taken by thermocouple, heat gun, or estimation. Generally, bearings will operate at 10° to 27°C above ambient temperatures.

5. **Determine the Viscosity Ratio (K)**

   Given: Spherical roller bearing

   Therefore K = 2

You now have all the information you need to use the following diagrams and determine the required viscosity of a lubricant.

First, using the Rated Viscosity diagram, draw a vertical line from the 140mm mean diameter axis until you intersect the 2000 diagonal RPM (n) line. From this intersection draw a horizontal line until you intersect with the rated viscosity (v1) axis. Record this value, Rated Viscosity (v1) = 8mm^2/s, because you will need to use it on the next diagram.

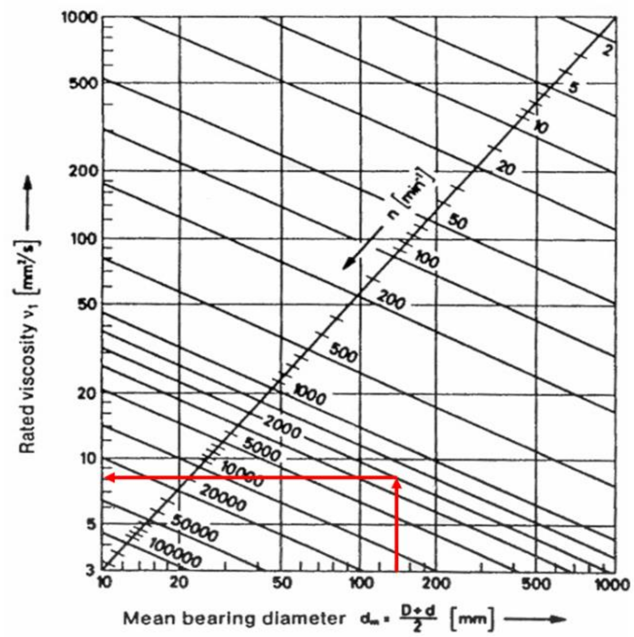

Figure 1. Rated viscosity diagram

Next, find the value of the Operating Viscosity (v) by taking the Rated Viscosity (v_1), determined from the previous diagram, and plugging it into the viscosity ratio equation.

$$Viscosity\ Ratio\ (K) = \frac{Operating\ Viscosity\ (v)}{Rated\ Viscosity\ (v_1)}$$

$$2 = \frac{Operating\ Viscosity\ (v)}{8\,{}^{mm^2}/_{s}}$$

$$Operating\ Viscosity\ (v) = 16\,{}^{mm^2}/_{s}$$

Now, using the Operating Viscosity diagram, find 16mm^2/s on the Operating Viscosity (v) axis, and draw a vertical line until it intersects the operating Temperature of 90° Celsius. Compare this intersection point to the diagonal Required Viscosity lines. The intersection point falls between the 100 and 150 diagonal Required Viscosity lines. Scaling the diagram shows that the minimum required viscosity is 125mm^2/s. Therefore, when selecting a lubricant for this application you would choose one with a minimum viscosity of 125 mm^2/s. If for some reason the chosen viscosity is not available, you would need to move up to the next available viscosity lubricant. In our example it would be 150mm^2/s.

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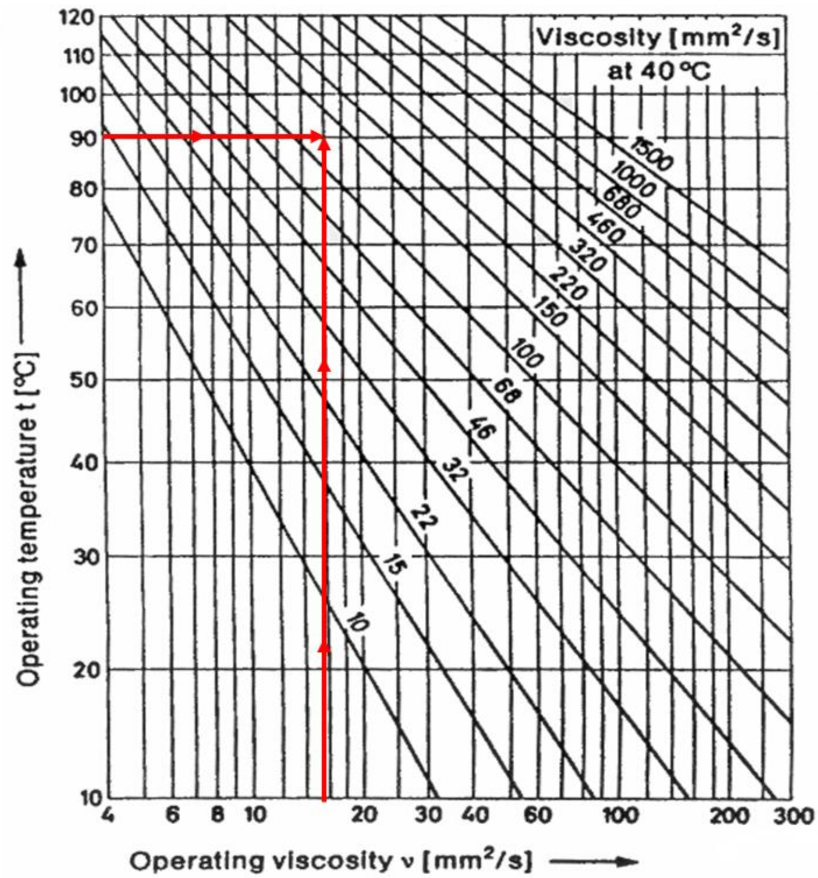

Figure 2. Operating Viscosity Diagram

In summary, the selection of the proper oil or grease is essential in achieving the maximum life of a mounted bearing. The selection of the proper lubrication ensures that you will obtain the correct fluid film thickness between the rollers, inner, and outer ring. This will inherently increase bearing life and decrease maintenance time associated with bearing failures.