Dodge® Sleevoil hydrodynamic mounted bearings: frequently asked questions & troubleshooting

Contents

SLEEVOIL Terminology:

- R-Series Configuration Nomenclature
    - **Plain (PL):** The bearing does not have an internal cooling jacket.
    - **Water Cooled (WC):** The bearing has a cooling jacket which accepts only water as the cooling medium.

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- **Externally Cooled (XC):** The bearing has a cooling jacket which accepts air, water, or oil as the cooling medium.
- **Plain / Water Cooled (PLWC):** The bearing has a cooling jacket which accepts water as the cooling medium. The jacket can be plugged to act as a plain bearing.
- **Plain / Externally Cooled (PLXC):** The bearing has a cooling jacket which accepts air, water, or oil as the cooling medium. The jacket can be plugged to act as a plain bearing.

- Expansion Bearing: Also known as a free or float bearing, it is located on the end of the shaft which does not have thrust collars, allowing the shaft to expand freely through the bearing during operation. Expansion bearings are usually located on the non-drive end.
- Non-Expansion Bearing: Also known as a fixed bearing, it is located on the end of the shaft which has thrust collars, which hold the shaft in position axially and support thrust loads. Non-expansion bearings are usually located on the drive end.
- Short Series Housing: A Short Series housing is a version of the R-Series housing which has a shorter axial length. This housing is only available for expansion bearings, as there is not room inside for thrust collars.

- Center Hung Fan Arrangement: A center hung fan arrangement occurs when the two supporting bearings are on opposite sides of the fan. See the diagram below.

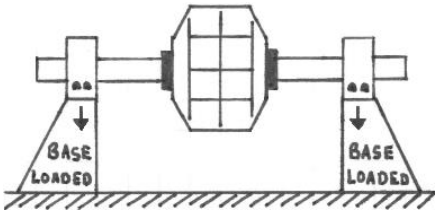

Figure 1. Center hung fan arrangement

- Over Hung Fan Arrangement: An over hung fan arrangement occurs when both supporting bearings are on the same side of the fan. See the diagram below.

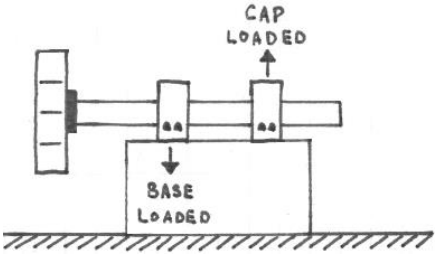

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Figure 2. Over hung fan arrangement

- Base Loaded Bearing: A bearing is base loaded when the radial load applied is downwards. This is the typical loading condition for SLEEVOIL bearings.
- Cap Loaded Bearing: A bearing is cap loaded when the radial load applied is upwards. This occurs in the outside bearing in over hung fan arrangements.
- Pillow Block: The complete SLEEVOIL bearing including the liner.
- Modular Housing: The complete SLEEVOIL bearing without the liner.

a. What is a Hydrodynamic Bearing?

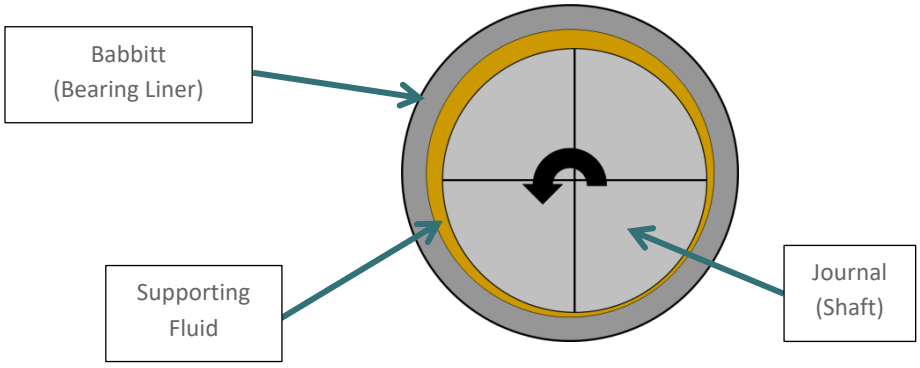

Figure 3. Bearing clearance example

A hydrodynamic bearing does not contain rolling elements but instead uses the high rotation speed of the journal, or shaft, to pressurize fluid in a wedge between the faces of the journal and bearing liner. This fluid completely supports the shaft loads. Hydrodynamic bearings are frequently used in high load, high precision, high speed, and continuous running applications.

b. Why Choose Dodge SLEEVOIL Bearings?

- All Dodge SLEEVOIL bearings and components are fully split for ease of replacement.
- All Dodge SLEEVOIL bearings come with heavy duty cast iron housings and the option to be customized from the factory.
- Dodge R-Series and RTL SLEEVOIL bearings can be cooled with water, air, or oil through the built in cooling jacket. This removes the need for a circulating oil system with separate heat exchangers.
- Dodge SLEEVOIL bearings are available with long length through bores for high load capacity.
- Dodge R-Series and RTL SLEEVOIL bearings come standard with elliptical bores which allow the bearing to run at cooler temperatures.
- Dodge offers a variety of high performance options including:

- IP56 Isolator seals
- Trapezoidal oil rings (now standard)
- Bi-Directional tapered land thrust plates (standard for RTL bearings)
- Oil Level and Filtration System (OLF-2)
- Cool Lube-2 circulating oil system with cooler
- Heater/Thermostat Combo
- RTD Kit
- End Cap Kit
- Coolant Hose Kit

- Dodge has exceptional engineering technical support with the ability to assist with your SLEEVOIL needs.

c. What are the differences between R, RTL, and RXT bearings?

Figure 4. R-Series, RTL, and RXT SLEEVOIL Pillow Blocks

R-Series

R Series bearings are the original Dodge SLEEVOIL bearings. They come in many different configurations and are available in the most sizes. R Series bearings offer the largest length through bore and have a length to diameter ratio of about 2.

- Configurations
  - 1-7/16” is stocked as a PL pillow block.
  - 1-11/16” through 3-7/16” are stocked as PLWC pillow blocks.
  - 3-15/16” through 8” are stocked as PLXC pillow blocks.
  - 9” through 12” are stocked as PL or XC pillow blocks.
  - 14” is stocked as a PL pillow block.

- R-Series features and options
  - Short Series housings are available in sizes 2-15/16” through 14”.
  - Available with optional IP56 rated SLEEVOIL Bearing Isolator Seals.

- Bearings with a bore size greater than 3-7/16" have housings that are pre-machined for thermocouples, heater/thermostats, vibration detector adapter kits, auxiliary seal kits, end cap kits and circulating oil kits. These accessories can be purchased separately.
- Machining for proximity probes is optional.

RTL

RTL bearings were developed to satisfy the demand for more compact bearings with higher thrust load capacity. RTL bearings have three times the thrust load capacity as the R Series bearings, and the length through bore is decreased by thirty percent (a length to diameter ratio of about 1.5). Note that the RTL bearings only have one configuration across all sizes.

- RTL features and options
    - Available in 2-15/16" to 12"
    - In 2014, RTL bearings include spherical seats on both halves of the liner and housing. This addition helps stabilize the bearing when vibration is less-than ideal, and the bearing liner is now gripped on all sides.
    - The fixed bearing has a single centrally located thrust collar (R-Series and RXT bearings contain a thrust collar on each end of the bearing).
    - High-capacity babbitted thrust plates are split and replaceable.
    - Available with optional IP56 rated SLEEVOIL Bearing Isolators.
    - Internal cooling jackets, which cool both the thrust plates and radial load sections, are of sufficient size to allow the use of water, air, or oil as the internal coolant.
    - All sizes are pre-machined for thermocouples, circulating oil kits, vibration detector adapter kits, auxiliary seal kits, end cap kits, heater/thermostats and proximity probes (2014). These accessories can be purchased separately.

RXT

RXT bearings were developed to meet the demand for even shorter length through bores. RXT bearings have a length to diameter ratio of about 1. This allows them to operate at higher speeds and generate less heat. Unlike other SLEEVOIL liners, RXT liners do not have an internal cooling jacket, but they still can be used with circulating oil. Note that the RXT bearings only have one housing configuration across all sizes.

- RXT Features and Options
    - Currently offered for shaft sizes 6" through 14".
    - Reversible multi-labyrinth seals.

- All sizes are pre-machined for thermocouples, circulating oil kits, vibration detector adapter kits, heaters and thermostats. These accessories can be purchased separately.
- Machining for proximity probes is optional.
- RXT-S liners have been upgraded to include bi-directional tapered lands on the thrust faces for improved thrust capacity (2015).

d. Where can SLEEVOIL bearings, replacement parts, and accessories be purchased?

To purchase any Dodge SLEEVOIL products, use the distributor locator tool found from the link below:

http://www.baldor.com/resources-and-support/customer-support/distributors

e. Where can the correct installation and operating manuals be obtained?

1. Visit http://www.baldor.com/resources-and-support/download-center
2. Choose *Manuals* from the download center tab.
3. Search for the proper manual based upon your product description.

f. Are 3-D models available?

Dodge's parts server website contains downloadable 3-D models of SLEEVOIL bearings.

1. Visit http://baldor.partcommunity.com/portal/portal/baldor?info=baldor/dodge
2. Select *Bearings > SLEEVOIL Bearings >,* and select the product needed.
3. Select the bearing and click on *Generate CAD model or Generate PDF datasheet* (registration is required).

    a. Note: Mounting dimensions are accurate, but other bearing specifics and dimensions may not be to scale. Information is for reference purposes only.

g. What type of oil is recommended?

The recommended oil for SLEEVOIL bearings is a premium grade, industrial mineral oil or turbine oil with rust and oxidation inhibitors and anti-foaming agents. Extreme pressure (EP) additives are not recommended. Oil viscosity is determined individually for each application and is based on bearing clearances, loads, temperatures, and speeds. The most common oil viscosity is ISO-VG 68. For units operating in hot or cold climates, synthetic oils can be considered. Certain synthetic oils will not thicken as much at low temperatures and/or have better oxidation resistance at high temperatures.

h. How often should I replace the oil?

Drain, flush, and refill with oil after two to three weeks of initial break-in operation. Since the satisfactory operation of the bearing depends entirely on an oil film being maintained between the shaft and the bearing liner surface, it is recommended that an oil analysis be performed at regular intervals:

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- Every 3 months for 24 hour/day service
- Every 6 months for 8 hour/day service

Visually inspect oil for contamination between complete oil analysis surveys. Oil service life depends on several factors such as (but not limited to) ambient conditions, operating temperature, and frequency of starts and stops. It is recommended that the oil be changed at least once a year in unfiltered static applications. The acceptability of the oil should ultimately be determined by the lubricant manufacturer. Removing contaminants through the use of an Oil Level and Filtration (OLF-2) System can extend oil and bearing service life.

i. How can we tell the level of acceptable contamination from an oil inspection report?

There are many types of oil analysis tests available today. The most informative tests for SLEEVOIL bearings include:

- Oil viscosity
- Water content
- Total Acid Number (oxidation indicator)
- Parts per million for each contaminate type

Some small (less than 10µm) particulate is to be expected under normal operation; therefore, keeping a trend of particle count can be more helpful than a single particle count for assessing bearing performance. A spike in particle count during steady operation (with few starts and stops) is indicative of external contamination or abnormal wear. Particles of 10µm or larger are on the same magnitude as the oil film thickness, and should be kept to a minimum in order to prevent abnormal wear. Water content also should be kept below 500 ppm (1000 ppm maximum). The acceptability of the oil should ultimately be determined by the lubricant manufacturer.

A very practical tool for analyzing oil samples in the field is an oil patch test kit. It can be used to obtain quick test results of the oil contamination level without having to wait on results from a laboratory. In most cases, an accurate analysis of the oil quality can be determined by simply keeping a trend of oil patch tests and monitoring the oil color.

j. What causes the bearing to leak oil?

There are several possible causes for the bearing to leak oil. The most common are listed below:

- Oil level is too high.
    - Oil level gauge is not being utilized correctly or has been relocated or replaced.

- Circulating oil flow exceeds maximum for the bearing size.
- Circulating oil drain line is too small, or it is not sloped or vented properly.

- Seal installed incorrectly.
- Seal worn and needs replacement.

k. What is the minimum operating speed?

SLEEVOIL bearings have a minimum operating speed, which is defined as the speed required to develop a full oil film. This speed is based on the bearing size as well as its application (including many different factors). The minimum speed can vary for each application. Consult the equipment manufacturer for minimum speed.

l. What is the acceptable bearing operating temperature range?

The operating temperatures of SLEEVOIL bearings can vary as a result of the following system properties (but not limited to): fan temperature, shaft speed, oil viscosity, radial load, thrust load, shaft temperature, ambient temperature, axial clearance, and radial clearance. As a result, the expected normal operating temperature is specific to the application in which it is being used, but should be between 100 °F and 180 °F (as measured by RTDs or thermocouples). The recommended alarm setting is 15 °F above steady-state normal operating temperature range, and the recommended shutdown setting is 30 °F above the normal steady-state operating temperature range. In some applications, bearing temperatures may be highly susceptible to seasonal changes in ambient temperature. In such applications, alarm and shutdown points may need to be changed seasonally.

Note: There is only one way to properly measure bearing operating temperature. Use RTDs or thermocouples in the supplied bearing provisions. Exterior bearing or sump oil measurement is not indicative, nor responsive enough, to determine bearing health in SLEEVOIL applications.

m. Do I need to run a cooling medium through the bearing? If so, what is the acceptable coolant temperature and flow rate?

A cooling system may be necessary to keep the SLEEVOIL bearing running within its temperature operating range. The coolant temperature and flow rate are based on the bearing type as well as its application. Contact the equipment manufacturer for specific cooling requirements for your application.

n. Should dowel pins be used when mounting the bearing housing?

Yes, Dodge recommends that dowel pins be used to ensure that the bearing housing remains aligned to the pedestal.

o. What causes vibration?

There are many system issues that can cause vibration, but the main sources of SLEEVOIL bearing vibration are outlined below.

- **Rotor Unbalance:** Unbalance is the most common source of vibration in fan assemblies. It is a result of an uneven distribution of mass in the rotating machinery. This uneven distribution could possibly be from debris build up or a bent shaft.
- **Misalignment:** Parallel misalignment and angular misalignment will both cause vibration in the system, and these vibration amplitudes can be temperature dependent.
- **Mechanical Looseness:** This type of vibration is caused from an alternating motion of a machine element from its resting place. Looseness does not cause vibration, but it will increase its amplitude.
- **Oil Whirl:** Oil whirl occurs when the fluid in a lightly loaded journal bearing does not exert a constant force on the shaft that is being supported and a stable operating position is not maintained. This can be a result of bearing loads that are too light relative to the oil pressures built up by higher speeds, or too much clearance in the bearings.

Specific items to check for are:

- Loose plunger screw
- Excessive clearance
- Fretting on the housing or the spherical seats of the liner
- Incorrect bore profile
- Incorrect weight of oil
- Loose mounting bolts/damaged pedestals
- Incorrect shaft tolerances and surface finish

p. What is the acceptable vibration limit of a SLEEVOIL bearing?

In lieu of standards from the equipment manufacturer, Dodge recommends the use of API 673 Vibration Limits for Fans.

q. What options are available to measure shaft vibration?

The use of proximity probes and accelerometers are the two main ways to measure shaft vibration. All housings with 3-7/16 inch bore sizes or greater come with a tapped hole to mount an accelerometer. Additional holes in other locations can be provided upon request. Because the accelerometers are mounting on the housing, they only give measurements of the housing vibration. Proximity probes are better suited for SLEEVOIL bearings to measure shaft vibration, because they directly measure shaft displacement. Provisions in the bearing housing to mount proximity probes can be provided upon request (Proximity probe provisions became a standard offering on RTL-Spherical housings in 2014).

Both accelerometers and proximity probes are useful tools to monitor shaft vibration. Dodge does not provide vibration instrumentation at this time.

r. What is the Sleevoil bore profile?

Elliptical bores allow for slightly cooler operating temperatures, and their profile offers more forgiveness during shaft growth. This occurs because there is a direct increase in radial clearance as the attitude angle rises. Cylindrically bored bearings usually generate more heat, but they are useful in applications where higher horizontal stiffness coefficients are required by the fan equipment manufacturer. In 2020, Dodge began manufacturing all RTL bearings with a cylindrical bore for standard sized shafts. R-series bearings remain unchanged, and have elliptical bores.

s. When should the liner be replaced?

As a rule of thumb, as long as a bearing does not indicate any signs of problems (increases in temperature or vibration), the liner should be replaced when the vertical clearance doubles compared to the original value measured at installation. If the installation clearance is unknown, then twice the maximum possible vertical clearance of a new liner should be used. Dodge always recommends keeping spare liners on hand, especially when the liners are modified.

t. When should the seals, oil rings, grommets, and housing be replaced?

It is recommended to have replacement seals, oil rings, and grommets on hand every time the bearing housing is opened for routine maintenance. All components should be inspected for wear, cracks, or other damage and replaced as necessary. Care should also be taken to inspect the spherical seats in the housing for damage or fretting. If the spherical seats are damaged, the housing will need to be replaced to ensure the proper seating of the liner.

u. What is an undercut?

Undercuts are used on lightly loaded bearings to prevent the shaft from lifting too high in the liner. An undercut modification removes a percentage of the bearing load zone in order to increase the unit loading in the remaining load zone. Please note that the percentage undercut represents the percentage of the bore area which *remains*.

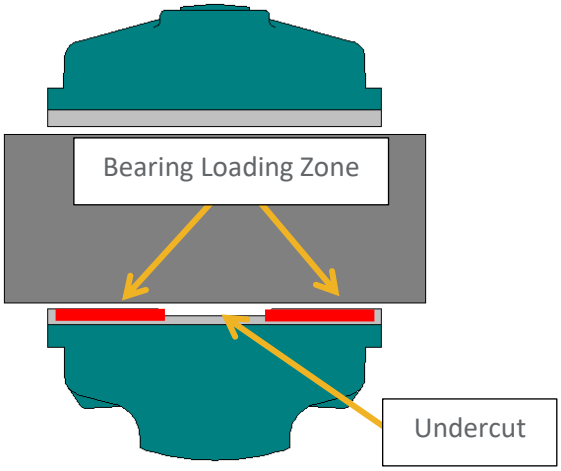

Figure 5. Undercut Example

v. What is the attitude angle?

The attitude angle is the angular position of the minimum oil film thickness. The attitude angle increases with shaft speed and light radial loads. If the attitude angle gets too high the bearing can become susceptible to instability. See section "*o) What causes vibration?"* for more details.

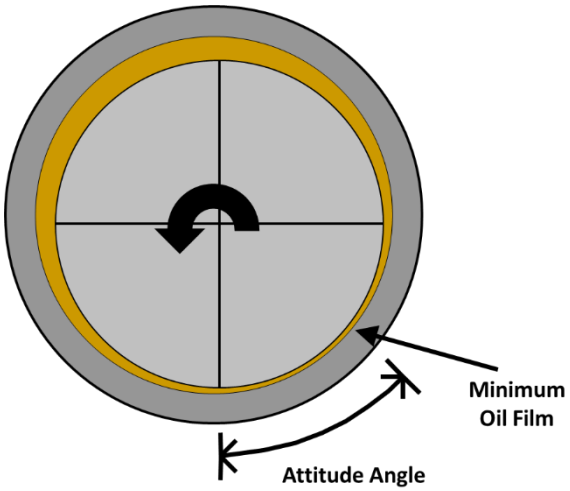

Figure 6. Attitude Angle Example

w. What are thrust buttons/tilting pads?

Thrust buttons, or tilting pad journal bearings, have bearing surfaces which can pivot to adaptively change with load and speed. This allows for increased dynamic dampening and misalignment capabilities. Thrust buttons are extremely expensive and are usually selected for applications with very high thrust loads.

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