Effective Constant Level Lubrication

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Oil Sump Lubrication

Industrial equipment including pumps, blowers, gearboxes, drives and compressors frequently use an oil sump to lubricate, control temperature, and prevent corrosion of bearings and gears. Although it is a simple method of lubrication by design, a lack of understanding of the basic lubrication principles will often lead to poor application and neglect. This often leads to premature equipment failures, frequent oil changes, and increased maintenance costs.

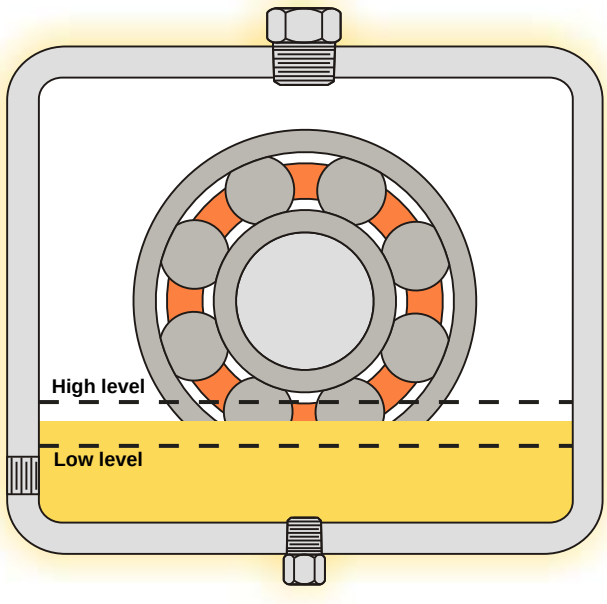

Figure 1. High-Low Level

This article outlines the critical elements of oil sump lubrication, and how to properly select and use constant level oilers to ensure effective oil sump lubrication.

Lubrication Principles

The oil sump is frequently selected by machine designers as a low-cost, low-maintenance, low-risk approach to maintaining component lubrication. Bearings and gears often run in sumps designed to supply a lubricant to loaded surfaces. The lubricant prevents wear, removes heat, removes contaminants, prevents corrosion, etc.

The oil level in a bearing or gear sump must be maintained within a narrow range to assure that the component receives the correct amount of lubricant coverage. For bearings, although there is some debate regarding the most effective depth of contact, the amount of contact between the rolling element and the oil is generally not considered a specific measurement, as long as the bearing receives a complete coating of oil to sustain the critical oil film. However, a good rule of thumb is that the bearing should have half of the element covered in oil when the bearing is not turning. The most important considerations are speed, oil viscosity and load.

Gear lubrication is generally

accomplished when one gear is submersed in lubricant, which then transfers oil to the other gears, shafts and seals. In some cases, an idler gear turns in the lubricant, transferring the oil between gears through direct contact. A good rule of thumb for oil level for sump-lubricated gears is that the level should completely cover the tooth of the gear sitting at the lowest position int the drive when the gear is idle.

If the level of lubricant in the sump is too high or too low excessive heat will be generated accelerating the degradation of the oil and shortening the life of the bearing (Figure 1). When the level of oil is too high, churning occurs, which is similar to the result of using an eggbeater when air is whipped into the oil. This, along with the induced heat, increases the oxidation rate shortening the effective life of the oil. When the oil level is too low, contact is insufficient to lubricate (provide oil film) the bearing or gear, and to act as a heat sink to carry away the normal levels of heat generated by the bearing.

Figure 1. Opto-Matic® Oiler

Maintaining the Correct Level of Oil

Perhaps the most widely used method of maintaining the proper lubricant level in a bearing housing is the constant level oiler. Simple by design, the constant level oiler replenishes oil lost by leakage through seals, vents (mist) and various connections and plugs in the bearing housing. Once the proper level is established, replacing the oil in the reservoir is accomplished by periodically refilling the bottle.

One such constant level oiler is the glass Opto-Matic® made by Trico Mfg. Corp. (Figure 2). This oiler consists of a glass reservoir mounted in a die cast collar which slides over a die cast base, or surge chamber. A beveled cap, attached to the bottom of the glass reservoir, ensures reliable oil delivery (Figure 3). It is at the surface of this cap that the level of oil is maintained, referred to as the control point, in both the oiler base and the equipment-housing sump. The cap/reservoir assembly sits on top of a level adjuster assembly that is inserted in the base, or surge chamber. Consistent oil sump level maintenance can be achieved by properly setting the adjuster assembly. Tightening the setscrew on the reservoir collar eliminates movement due to vibration and handling that can cause the oiler to feed more than needed.

Other types of constant level oilers incorporate a tubular spout. This design differs from the glass reservoir/cap style by moving the level control point from the base of the reservoir to the spout opening (Figure 4). It is important to understand where the level is established in the constant level oiler in relation to the desired level in the housing oil sump. Depending on the oiler design, a simple mark on the base can effectively provide consistent level control.

Some constant level oilers are designed to be nonadjustable which eliminates the potential of incorrect level settings. The Watchdog® oiler combines both a viewport and oiler in one assembly (Figure 5). Because it is mounted on a port even with the desired oil sump level, there is no requirement for adjustment.

Identifying and Correcting Problems

The leading causes of incorrect oil sump levels include the following:

- Incorrect constant level oiler settings

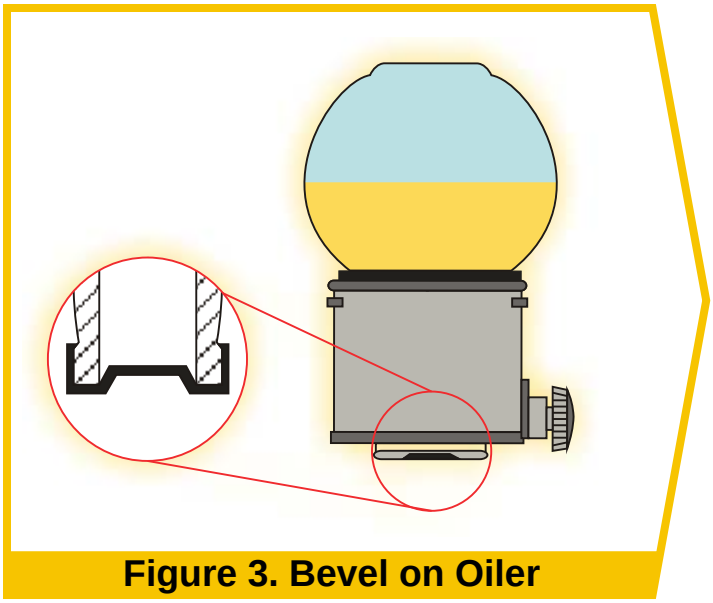

Figure 3. Bevel on Oiler

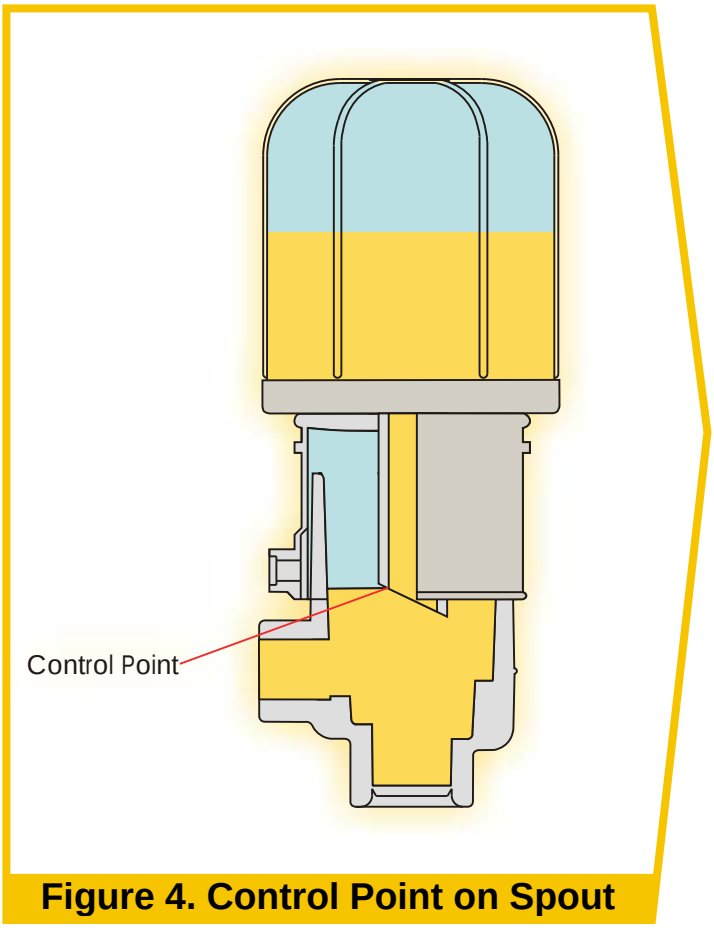

Figure 4. Control Point on Spout

- Pressure differentials
- Oiler location
- Shift-change syndrome
- Blocked or plugged fittings
- Improper filling methods

Incorrect Oiler Settings

Review the instruction sheet provided with the oiler for a better understanding of how to adjust and set the device for proper use. Understanding where the control point is can greatly reduce problems associated with low or high levels of oil in the sump. Oil temperature and viscosity can affect the feeding of oil. A meniscus forms under the bottle, or spout of a constant level oiler before it feeds. The degree to which this occurs depends on the oil's surface tension (which changes as the oil ages), and resistance to flow (viscosity) of the oil, and the oiler design. Check oil levels in comparison to oiler settings to confirm proper adjustment under varying viscosities and operating conditions.

Pressure Differential

Airflow across equipment housings generated by fans, blowers and even equipment motor can be sufficient to create a pressure differential between the bearing housing and the oiler reservoir, causing the oiler to overfill the sump - resulting in a level that is too high. Equipment operating temperature changes can also create pressure differentials, depending on the housing configuration including seals, vents, and oilers. In some instances, pressure can increase in the housing, which can lower the level by pushing the sump oil back into the oiler or level sight (when equipped). Pressure increases/decreases can be controlled by closing the housing through the use of nonvented oilers, replacement of vents with expansion chambers, and proper seal selections.

Oiler Location

Gears and bearings create currents and flows in an oil sump housing. Depending on viscosity and speed, the proximity of the oiler to these currents can cause unwanted oiler to feed. The most common fix for this condition is to mount the oiler either on the opposite side of the housing, or farther away from these currents and flows.

Shift-Change Syndrome

Shift-change syndrome describes how an oil sump can become overfilled by frequent removal and replacement of the constant level oiler reservoir. Maintenance personnel are often instructed to keep the reservoir of the oiler completely full. Tests have shown that frequent removal and replacement of the

constant level oiler reservoir result in an increased level of oil in the equipment sump. For example, when simulating a removal/replacement sequence once every eight hours for ten days, the level in an ANSI style process pump was raised 1/8-inch. It is recommended that the level of oil in the reservoir be kept half full at a minimum, which will reduce the number of refills. If the oiler needs to be filled frequently, locate the source of the oil loss. This should not be considered a normal operating condition.

Blocked or Plugged Fittings

It is important to check the connection fitting between the oiler and the housing to verify that there is no blockage. When oil becomes oxidized or contaminated, it can easily plug this fitting, which is commonly ¼-inch NPT or smaller. If this occurs, the oiler will not feed, and the oil level in the sump can become dangerously low. This is easy to check by removing the oiler during oil changes and looking at the fitting opening.

Figure 5. Watchdog® Oilers

Improper Filling Methods

The two most common mistakes when filling an oil sump housing are filling from the top of the housing until the oil level is visually correct, and filling through the constant level oiler base until it is full.

When filling from the top of the housing, it is important to know the required volume of oil for the sump. For example, if it is known that the sump capacity is two quarts, then it is safe to use this method for filling. If the capacity is unknown, filling from the top until the level is verified through a sight gauge will result in a high level - after the oil drains down from the shaft, gears, or other components.

Filling through the oiler base while using a sight gauge can be effective. However, if oil is added to the oiler base until it is full, without the use of a gauge, the level in the sump will be too high. A constant level oiler can only control the level by replacing lost oil volume, it can't reduce high levels.

The Watchdog-type oiler is designed for accurate filling by eliminating the adding of oil from the housing top and combining a sight gauge for instant, accurate filling of an oil sump.

Constant level lubricators have been used effectively to maintain the level of oil in equipment for decades. Proper selection, installation and maintenance of these oilers are all important aspects in achieving the desired result of reliable oil sump lubrication. These lubricating devices help to eliminate unnecessary oil changes, reducing equipment repairs and minimizing equipment maintenance requirements.