# Lubrication of Roll Neck Bearings

## 1. Purpose and effect

The purpose of lubrication is to reduce friction and wear inside the bearing and thus to prevent seizure. Effects of the lubrication are described below:

### 1.1 Reduction in the wear and friction

To prevent contact between metals and to reduce friction and wear by forming a protective oil film over the mutual contact portion of the bearing ring, rolling element, and cage.

### 1.2 Removal of the frictional heat and cooling

To remove the heat generated through friction or heat transmitted from the outside and to cool the bearing by oil, preventing overheating of the bearing and degradation of the lubricating oil, by means of the circulating oil method.

### 1.3 Extension of contact fatigue life

To extend the rolling contact fatigue life of a bearing, by forming a sufficiently thick oil film over the rotating rolling contact surface. Lubrication can also prevent entry of foreign materials into the bearing and prevent rusting or corrosion.

## 2. Lubrication method

The rolling bearing lubrication method is accomplished either with grease or oil. Merits and demerits are compared in Table 1.

Selection of the lubrication method most appropriate to the operation conditions and purpose of the bearing is most important for the bearing to demonstrate its highest performance.

Table.1 Merits and demerits of grease and oil lubrication

| Item | Grease lubrication | Oil lubrication |
|---|---|---|
| Housing sealing system | Simplification possible in general | Slightly complicated, Requires careful maintenance |
| Speed | Applicable when the speed is medium or below | Applicable even when the speed is high |
| Cooling effect | None | Effective heat removal (circulating lubrication) |
| Removal of dust and water | Difficult | Possible (circulating lubrication) |
| Nearby mechanical devices can share a common lubrication system | Difficult | Easy |
| Maintenance | Easy | Requires checks at short intervals because of oil leakage, etc. |

## 2.1 Grease lubrication

Generally speaking, grease lubrication is a convenient way of lubrication as the seal unit becomes simplified. Namely, once the grease is filled, no more supply is necessary for a considerably long time. Actually, a bearing filled with grease is used as it is (sealing method), an adequate amount of grease is filled in a housing and replenished or changed after a given interval (grease filling method), or grease supply is provided by a centralized manner (centralized greasing method). Recently, with the grease itself being improved, its application field has expanded. But it is still necessary to select the best grease and lubrication method while considering the speed, operating temperature, grease filling rate, and grease life.

For a roll neck bearing, the lubrication practice employed frequently nowadays is to use a grease filling method, not the centralized lubrication method, so as to shorten the time necessary for the roll exchange procedure. It is particularly necessary to establish a work standard with due consideration of the reliability of the seal unit, grease characteristics, and grease supply amount in the roll shop.

### (1) Grease filling amount in the housing (chock)

The amount of grease to be filled into the housing (chock) varies depending on the housing (chock) construction, space volume, and atmosphere. The general guideline is described below. First, fill a sufficient amount of grease into the bearing, then depending on the speed range fill the grease amount (shown in Table 2) into the space (excluding the shaft and bearing in the chock).

Table 2. Grease Filling Amount

| Rotating conditions | Ratio for the space volume | Remarks |
|---|---|---|
| From extremely low to low speeds | 2/3~1 | Including prevention of water entry at low speed |
| Low to medium speeds | 1/2~2/3 | Applications at general speeds |
| Medium to high speeds | 1/3~1/2 | Small filling amount for high speed applications |

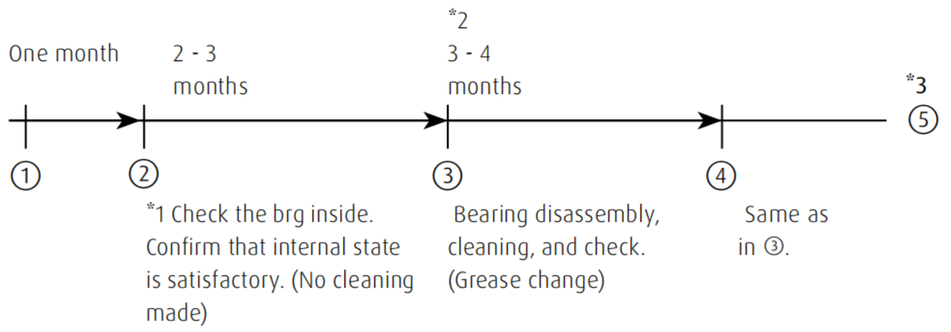
### (2) Grease supply

Generally speaking, once filled, grease need not be added for a long time. Depending on the operation conditions, however, frequent grease supply or change may become necessary. Due attention must be paid to this point when designing the housing.

In blooming or shape steel rolling mills with centralized lubrication of the roll neck bearing, the specified amount of grease is supplied at a set interval. When the grease filling method is employed as in the case of the roll neck bearing of a cold rolling mill, new grease is added until the old grease is pushed out slightly from the seal.

The cycle of disassembly and cleaning of the sealed bearing, namely grease change, varies depending on operation and actual rolling conditions and thus cannot be set to a standard interval. In practice, determine the typical disassembly and cleaning interval schedule by checking its state periodically for about one year after initial start-up.

**Typical disassembly / cleaning interval**




* 1. Add a new grease amount equal to the lost amount during inspection.
* 2. This interval is determined from the inspection results of ③. If damage or wear of seals or O-rings is observed during an inspection of a sealed bearing, replace it with a new one. Though the replacement interval varies depending on operating conditions, it is decided based on the conditions when checked. It is usually around 6 months.
* 3. Final disassembly/cleaning interval ⑤ is determined on the basis of the inspection result of ④. Generally, the recommended interval of disassembly for the sealed bearing of the roll neck is about 3 to 6 months though this may vary depending on the operation conditions.

## 2.2 Oil lubrication

### (1) Forced oil circulation lubrication

For high-speed or high ambient-temperature applications, cooling of the bearing with oil is necessary. Forced oil circulation lubrication is the method used most frequently. In this method, the oil returns to the tank via drain pipe after lubrication and cooling of the bearing's inside, then the oil is cooled, filtered, and forced to circulate for lubrication again by a pump. The drain pipe size is normally two times or more larger than that of the supply pipe to prevent overfilling of the lubricant. The guideline for the required supply amount for forced lubrication is determined as follows:

$$Q \fallingdotseq \frac{1.89 \times 10^{-6}}{T_2 - T_1} d \cdot \mu \cdot n \ \ F(\text{N}) \qquad \textbf{(5.1)}$$

$$Q \fallingdotseq \frac{1.85 \times 10^{-5}}{T_2 - T_1} d \cdot \mu \cdot n \cdot F\{\text{kgf}\} \qquad \textbf{(5.1)}$$

where,

$Q$ : Oil supply rate (liters/min)
$T_1$ : Oil temperature at oil inlet (°C)
$T_2$ : Oil temperature at oil outlet (°C)
$d$ : Bearing bore (mm)
$n$ : Bearing speed ($\text{min}^{-1}$)
$F$ : Load on the bearing (N) {kgf}
$\mu$ : Dynamic friction coefficient of bearing

| Bearing type | Approximate value of μ |
|---|---|
| Cylindrical roller bearing | 0.001 |
| Tapered roller bearing | 0.002 |

Using the value thus calculated and considering the limit due to the size of the oil supply and drain ports, an adequate supply amount is determined. For a large bearing (bore to exceed 200 mm) subject to heavy load, the oil amount determined with equation (5.1) may be too large. The recommended value would be 2/3 to 1/2 of the amount.

**(2) Oil mist lubrication method**

The mist oil from the oil mist generator is fed to the lubrication point via piping and sprayed in a form of readily adhering particles from a fitting (nozzle) in the housing or bearing. Oil mist lubrication method has the following advantages:

※ More suitable for applications with higher speed than oil bath lubrication.

※ High viscosity oil can be used, with thick oil film formed. This is advantageous against seizure and promotes a longer bearing fatigue life.

※ Only the minimum required amount of new oil is constantly supplied, effectively lubricating the bearing with a minimum of oil consumption.

※ Oil stains on machinery and product are less than in the case of grease lubrication. After disassembly, cleaning of parts is easier.

A ) Determining the mist amount

The air-oil mist amount can be calculated as follows:

B ) Mist flow rate in piping

The size of the distribution pipe to feed the required mist amount to each fitting must be one at which the mist flow rate in the piping becomes 5 m/sec or less. Higher flow rates may cause excessive condensation of mist in the distribution pipe, causing uneven mist supply and a partial deficiency.

C ) Fitting installation position

The fitting is installed near the bore of the housing (chock) or to the outer ring of the bearing. The latter is used particularly for backup roll bearings of high speeds. In the case of the work roll neck bearing of a rolling mill with a high rolling load, the nozzle may be installed directly to the outer ring spacer.

D ) Vent

The vent is an important element to keep the oil volume in the housing constant and to keep a satisfactory flow of mist in the bearing. Normally, the vent is provided in a position to enable the oil level to be maintained at a height which is equal to about the middle of the bottom rolling element.

E ) Selection of the mist oil to be used

The mist oil to be used must be a high-grade lubricating oil with extreme pressure performance and oxidation stability. This oil must also be readily misted. It is also desirable that the oil can be re coagulated readily after passing through the fitting. A lubricating oil dedicated for oil mist use (satisfies all these requirements) can be found in the market. The oil viscosity varies depending on the operation conditions, but is generally 330 - 430 mm2/s {cSt} at 40°C for roll neck bearings of rolling mills.

F ) Operation conditions of a mist generator

General conditions are described below:

Pressure distribution in pipe :500 mm in water column

Heating air temperature :65~80°C

Oil temperature :50°C

When a large bearing is used at high speed and is to be lubricated with mist, the effectiveness of such lubrication varies depending on the construction around the bearing. Please consult FV.

**(3) Oil-air lubrication**

Features of an oil-air lubrication system

※ Correct and stable oil supply at the set amount to the bearing, without being affected by the temperature change of lubricating oil and compressed air and pressure change in the piping.

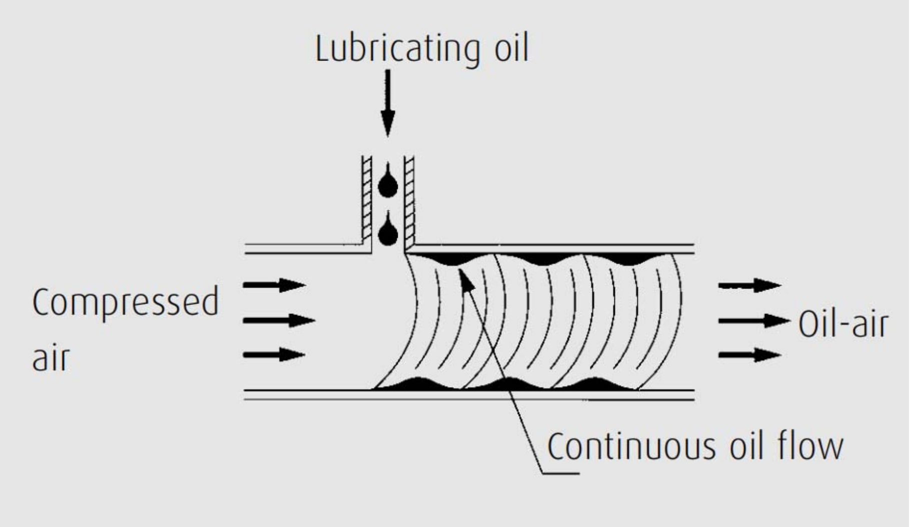



Fig. 5.1 Typical oil-air lubrication

※ Substantial savings in oil consumption.

A high-performance distributor in the oil-air system ensures correct supply of the lubrication oil to the bearing, which in turn makes it easy to determine the supply amount to each point beforehand. As a result, only the minimum required amount of oil is necessary, contributing to a reduction of the oil consumption, to about 1/10 that of oil-mist lubrication. The lubrication oil consumption can be saved greatly by this method. Required oil quantity Q can be calculated as follows:

$$Q = A \cdot D \cdot B \text{ (ml/h)} \qquad (6.1)$$

where,

**A** : Coefficient (Generally A =0.00003, but it may change depending on the operating conditions.)

**D** : Bearing outside diameter (mm)

**B** : Bearing width (mm)

※ Prevention of foreign materials from entering the bearing by means of pneumatic pressure in the housing. Since the compressed air is normally supplied along with the oil into the housing, the sealing function is enhanced, thereby preventing entry of water and scale from the outside. The result is an ideal bearing operation state, with the bearing life extended substantially.

※ Easy piping

Oil-air lubrication is made by using compressed air to supply the oil. There is no influence caused by the direction of piping.

※ Multi-branching distribution of oil-air

Most systems now enable correct distribution of the oil-air to multiple lubrication points (patent pending). The piping system is therefore simplified, ensuring easy maintenance.

※ Clean environment around machinery

Since the oil-air lubrication supplies the minimum required set amount of oil, the oil collected in the housing can be recovered periodically through the drain port. The equipment's environment can therefore be maintained in a cleaner condition.

( END )

FV® BEARING INDUSTRIES

# Grease Interchange Guide

High quality lubricant can effectively improve the work-life of roll neck bearings. FV is very happy to recommend good lubricants to you.

## All Purpose Industrial LC-2 Grease

- Castrol 4020/220-2™
- Castrol 8060/220-2™
- Chevron Delo® EP 2
- Chevron RPM Automotive LC Grease EP-2™
- Citgo Lithoplex MP2™
- Citgo Premium Lithium EP 2™
- Conoco Phillips Super-STA® 2
- Exxon Mobil Ronex MP™
- Exxon Mobil Unirex EP 2™
- FAG LOAD220™
- Fuchs (Century) Uniwrl 2™
- Lubrication Engineers Almagard® 3752
- LUBRIPLATE® 1552
- Mobilgrease® XHP 222
- Pennzoil® Pennlith® EP 712
- Pennzoil® Premium Lithium Complex 2
- Petro-Canada Multipurpose EP 2™
- Royal Purple® Ultra-Performance® 2
- Shell Albida® LC 2
- Shell Retinax® LC 2
- SKF LGWA2™
- SKF LGEP2™
- Texaco Starplex® 2
- Unocal 76 Multiplex Red™

## Construction and Off-Highway Grease

- Castrol Moly 860-2ES™
- Castrol Contractor Grease 2™
- Conoco Phillips Super Lube M EP™
- D.A. Stuart Molyplex EP 2™
- Exxon Mobil Centaur Moly
- Exxon Mobil Ronex Extra Duty Moly™
- Fuchs Moreplex 2™
- LUBRIPLATE® 3000
- Mobilgrease® Moly 52
- Mystik® Tetrimoly® Extreme
- Pennzoil® Multipurpose EP 302
- Pennzoil® Premium Lithium Complex 2 with Moly
- Petro-Canada Precision Moly EP 2™
- Schaeffer Moly Ultra Supreme 238™
- Shell Retinax CMX 2™
- Texaco Starplex® Moly MPGM2
- Unocal 76 Megaplex™

## Ball Bearing Pillow Block Grease

- Conoco Phillips Polyurea 2™
- Chevron SRI™
- Citgo Polyurea 2™
- Citgo Polyurea MP2™
- Conoco Phillips Polyurea 2™
- Exxon Mobil Polyrex® EM
- Exxon Mobil Unirex N™
- LUBRIPLATE® EM
- Mobilgrease® AW2
- Petro-Canada EMB™
- Shell Alvania RL3™
- Shell Dolium® BRB
- SKF LGHP2™
- Unocal 76 Unolife Grease™

## Synthetic Industrial LC-1.5 Grease

- Mobilith SHC™ 460
- Chevron Ulti-Plex Synthetic Grease EP™
- Conoco Phillips SynCon Extra Long Life™
- Exxon Mobil SHC® PM
- Shell Albida® 460
- Texaco Starfak® PM

## Mill Grease

- Castrol Molub-Alloy 777-2ES™
- Chem & Lube Black Magic™
- Chevron Ulti-Plex EP 2™
- Conoco Phillips HD Calcium™
- Conoco Phillips Milube™
- Exxon Mobil Ronex Extra Duty 2™
- FAG Arcanol Load 400™
- Kyodo Yushi Palmax RBG™
- Loctite ViperLube™
- LUBRIPLATE® 1444
- Shell Retinax® Grease HD
- SKF LGHB2™

## Ultra-High Speed Spindle Grease

- Kluberspeed BF 72-22™
- FAG Arcanol L-75™
- FAG Arcanol Speed 2,6™
- LubCon Highspeed L252™
- SKF LGCT2™

## Food Safe Grease

- SKF LGFP2™
- FAG Arcanol FOOD2™
- Keystone Nevastane HT/AW2™
- LE 4025 H1 Quinplex™
- LPS ThermaPlex Foodlube ™
- LUBRIPLATE® FGL-2
- Mobilgrease® FM 102
- Petro-Canada Purity FG™
- Royal Purple® Ultra-Performance® Clear FDA Grease

## Multi-Use Lithium EP1 and EP2 Grease

- Castrol Longtime™ PD
- Castrol Spheerol EPL
- Conoco Phillips Conolith EP
- Dow Molykote® BR2
- Exxon Mobil Beacon EP
- 76® Unoba EP
- CITGO Premium Lithium EP-2
- Chevron Multifak® EP
- Fina Lithium EP
- Chevron Dura-Lith® EP
- FAG® Arcanol-MULTI2™
- LUBRIPLATE® 1200-2
- LUBRIPLATE® 1241, 1242
- LUBRIPLATE® 630-AA
- SKF® LGMT2
- SKF® LGEP2
- Shell® Alvania EP
- Mobilux® EP

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**⚠ WARNING** ***Failure to observe the following warnings could create a risk of serious injury.***

Proper maintenance and handling practices are critical. Failure to follow installation instructions and to maintain proper lubrication can result in equipment failure, creating a risk of serious bodily harm.