Improve Reliability of Bearing with Special Lubricants

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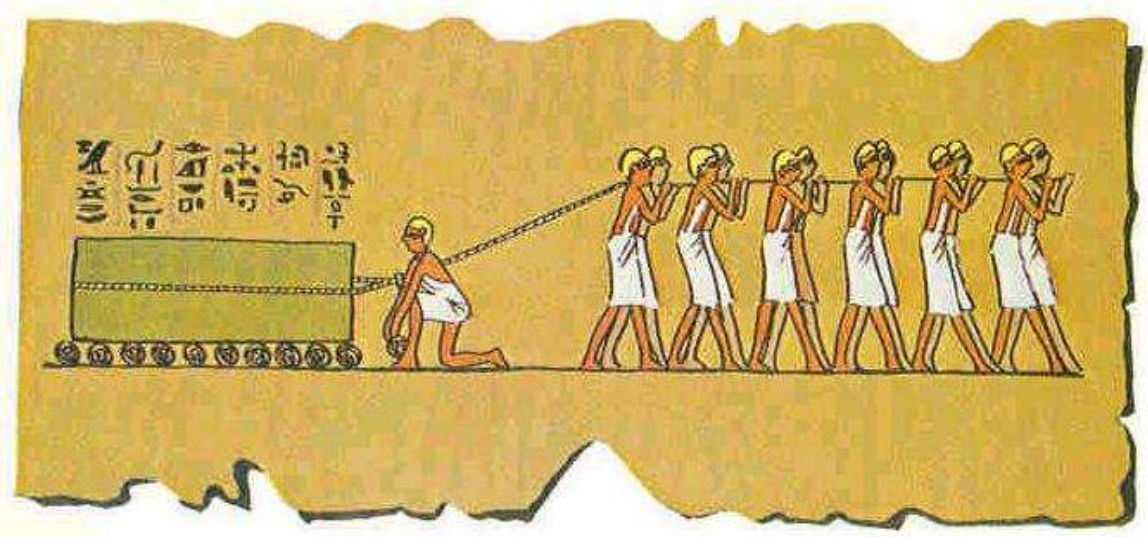
KLÜBER LUBRICATION a brand of FREUDENBERG

Agenda

01	What is bearing?
02	Lubrication method
03	Special Lubricants for Bearing Reliability
04	How to choose the right lubricant

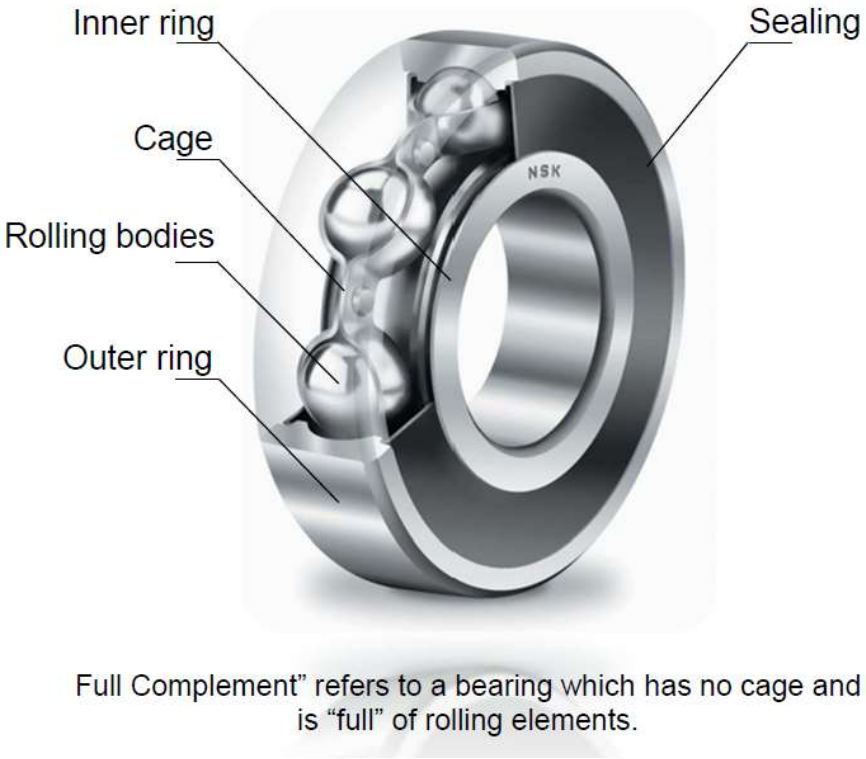
What is bearing?



Rolling bearing components

Bearing components

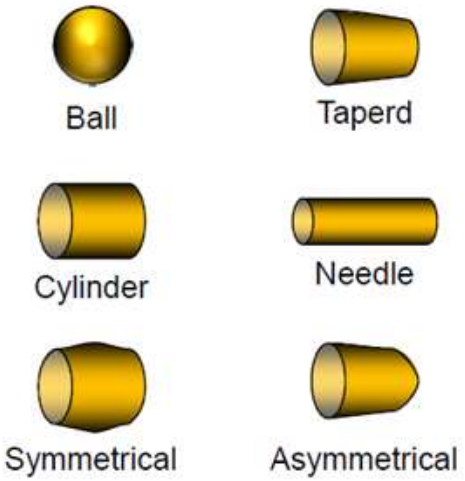
Bearings

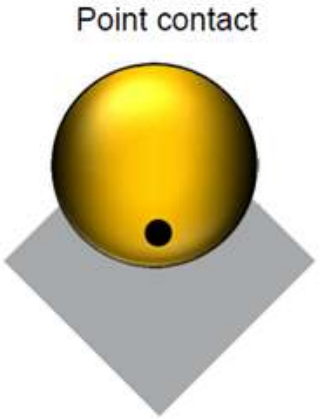


Full Complement" refers to a bearing which has no cage and is "full" of rolling elements.

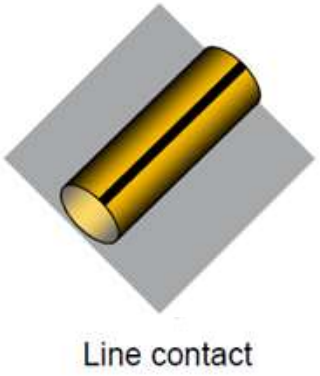
Rolling bearing components

Rolling element





- Higher speeds
- Lower Loads



- Lower Speeds
- Higher Loads

Rolling bearing components

Cage function

Cages, or retainers, are used to separate the rotating balls or rolling elements from contacting one another during rotation of the bearing. Cages also provide many other important functions, details as follows:

- ALLOW SEPARATION OF ROLLING ELEMENTS
- PROVIDE A REDUCTION OF FRICTION
- KEEP DISTANCE BETWEEN ROLLING ELEMENTS
- PROVIDE SUPPORT UNDER HIGH CENTRIFUGAL CONDITIONS
- ALLOW ONE PIECE BEARING ASSEMBLY AND DISASSEMBLY
- ACT AS A LUBRICANT RESERVOIR

Rolling bearing components

Moulded Polyamide Cage

Rolling bearing components

Pressed Steel Cage

Rolling bearing components

Pressed Steel Cage

Rolling bearing technology

Types of rolling bearing


Ball bearing


Needle bearing


Toroidal bearing


Axial needle bearing


Angular contact ball bearing


Tapered roller bearing


Axial deep groove ball bearing


Axial spherical roller bearing


Cylindrical roller bearings


Spherical roller bearing


Axial cylindrical roller bearing

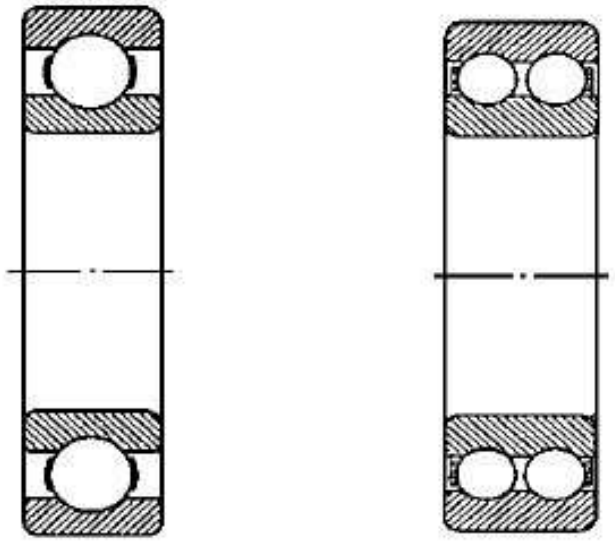
Rolling bearing technology

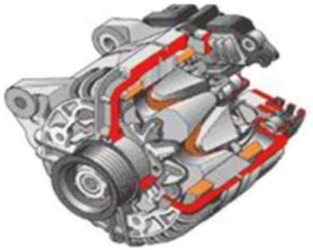
Deep groove ball bearings

ISO Identification code on outer ring:

Single row: 6 _ _ _ / _

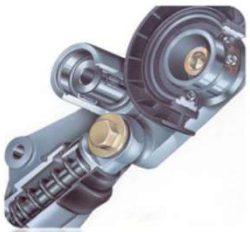
Double row: 4 _ _ _





Compact Generator

Smoke extraction motor

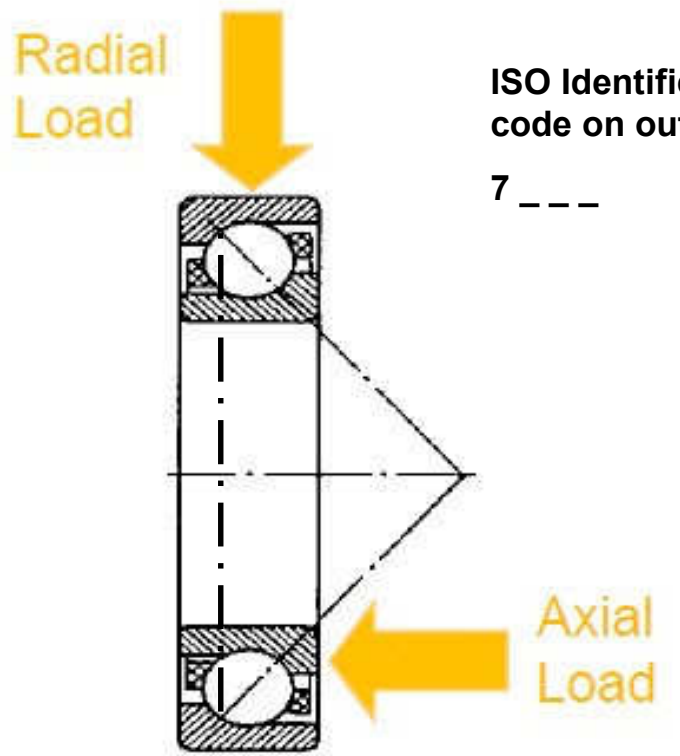


Engine Belt Tensioner

Automotive Water Pump assembly

Rolling bearing technology

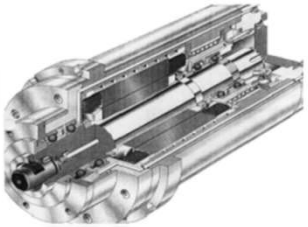
Angular contact ball bearings



ISO Identification code on outer ring:

7 _ _ _

Clutch Release bearing



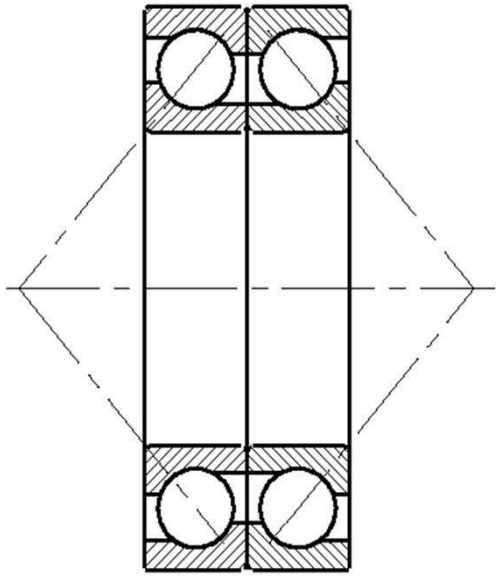
Machine Tool Spindle

Automotive Hub Unit bearings

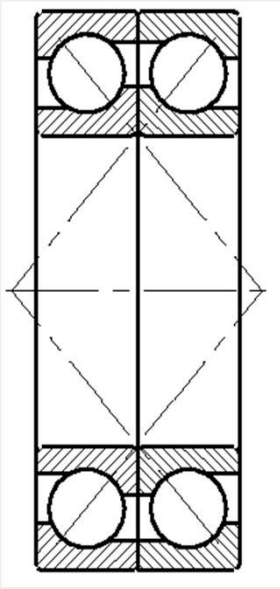
Ballscrew Support bearing

Rolling bearing technology

Angular contact ball bearings



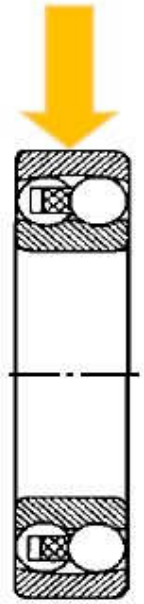
O arrangement

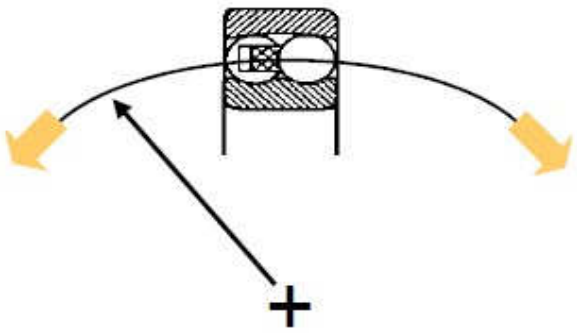


X arrangement

Rolling bearing technology

Self-aligning ball bearings





ISO Identification code on outer ring:

1 _ _ _

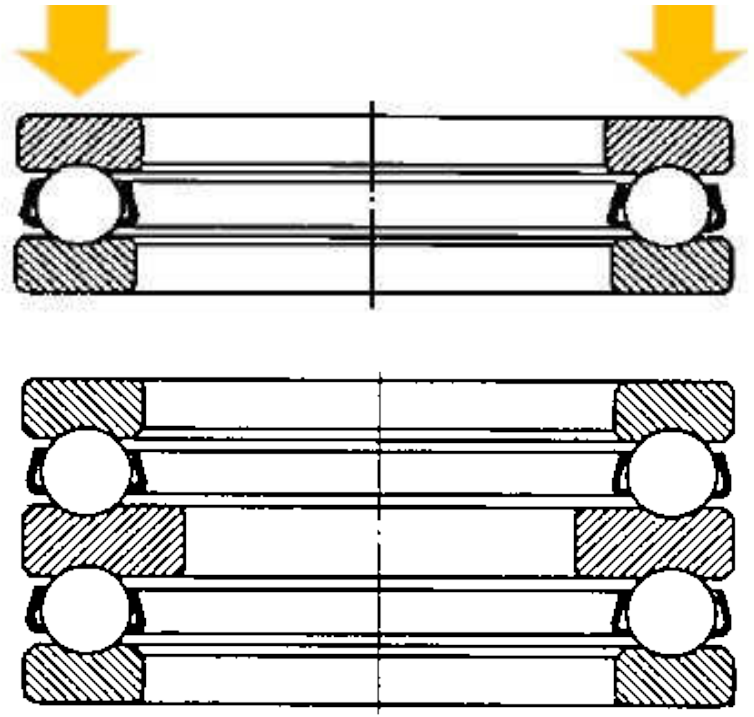
2 _ _ _

High speed industrial fan with Impeller shaft incorporating self aligning, grease filled, ball bearings.

Used Paper Industry Dryer Bearing

Rolling bearing technology

Thrust ball bearings

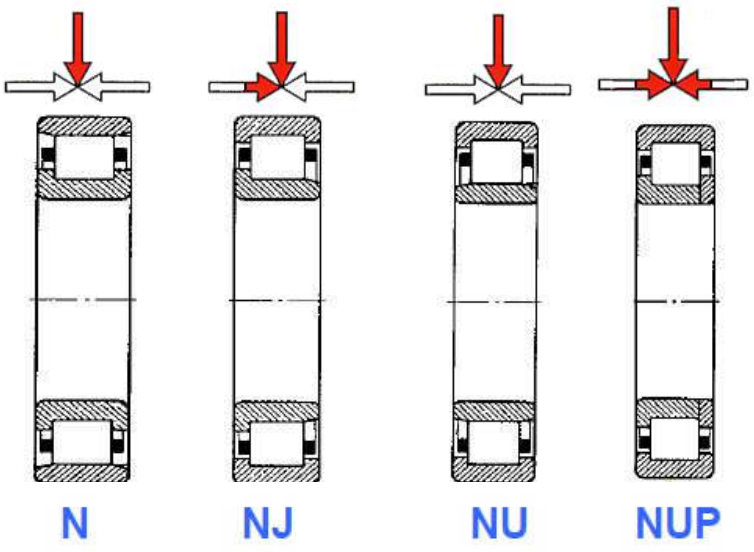


ISO Identification code on outer ring:

5 _ _ _ _

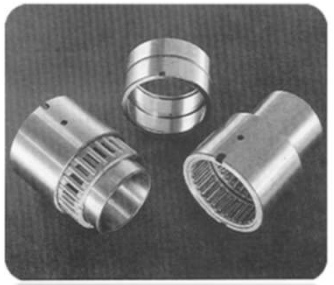
Rolling bearing technology

Cylindrical roller bearings



Water Pump assembly

Industrial Fan bearing –
split Cylindrical Roller Bearing



Corrugator Bearing

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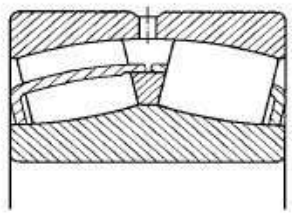
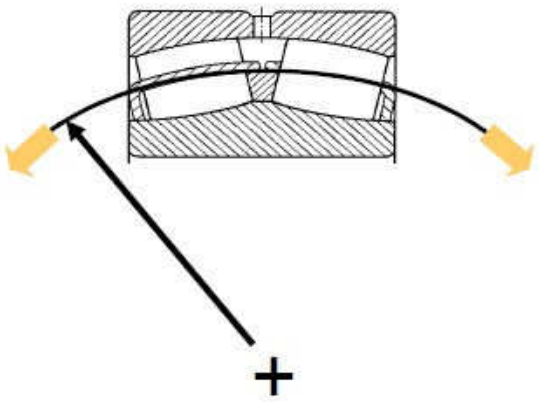
Rolling bearing technology

Spherical roller bearings





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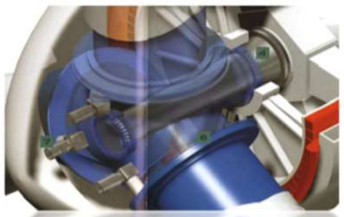
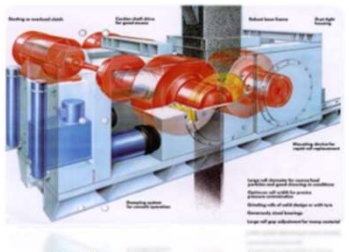
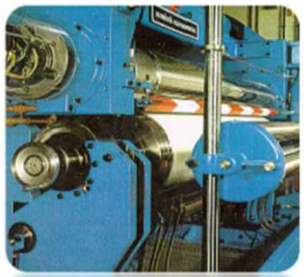


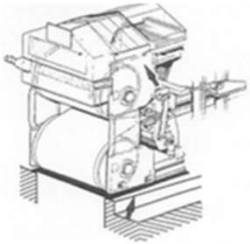
Wind Turbine Main Bearing



Roller Press bearings



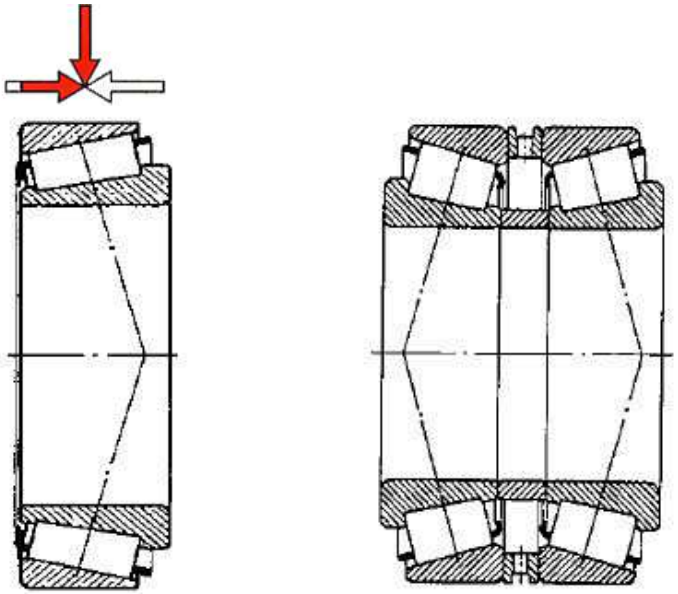
Calender Bearings



Continuous Particle Board Press, Belt Roller bearings

Rolling bearing technology

Taper roller bearings



ISO Identification code on outer ring:

3_ _ _ _

Labeller, Center Carousel Support Bearing

Machine Tool Live Centers

Can Seamer

Truck Wheel Hub Units

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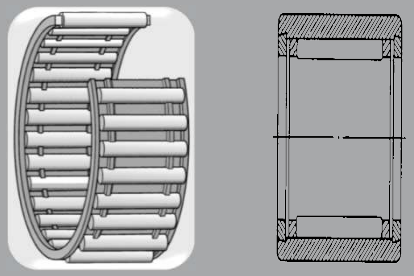
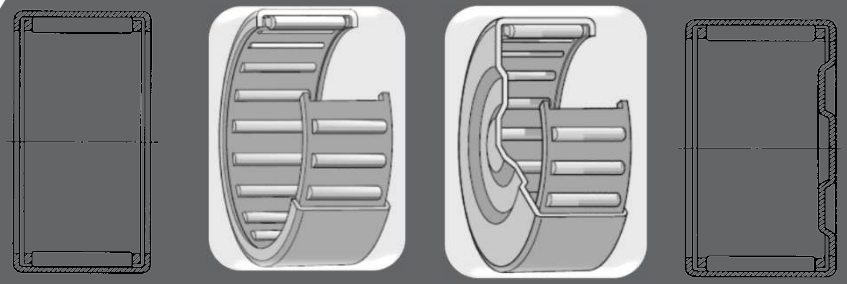
Rolling bearing technology

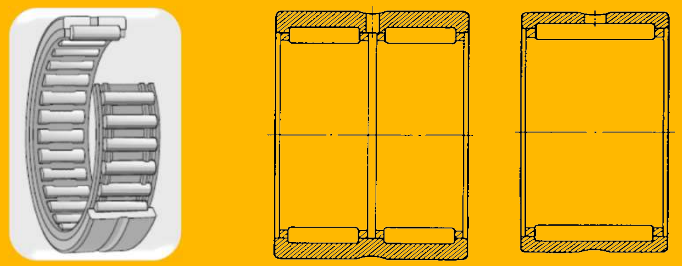
Needle roller bearings



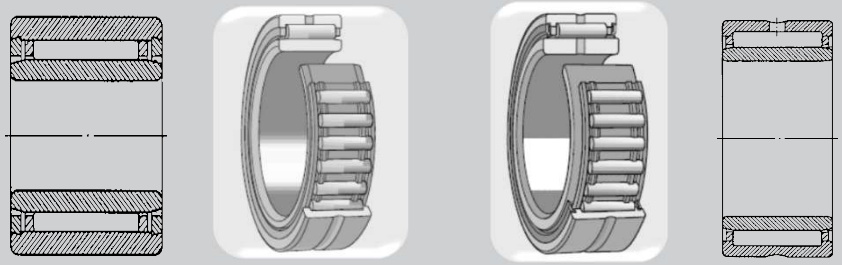
NK - Needle Roller Bearings with flanges, without inner ring



HK, BK - Drawn Cup Roller Bearings, without inner ring



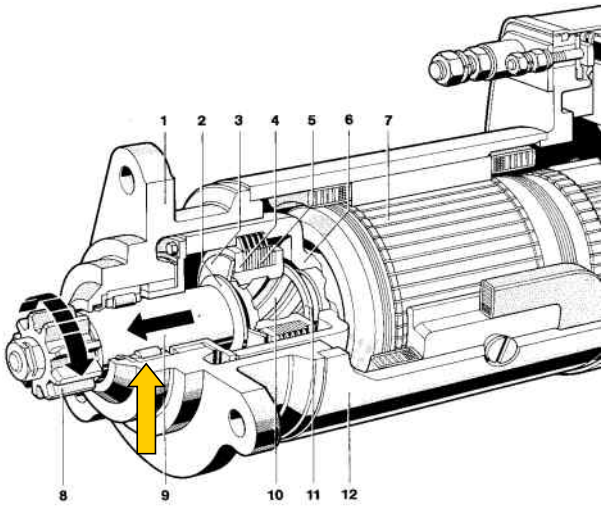
RNA - Drawn Cup Single & Double Row Bearings, without inner ring



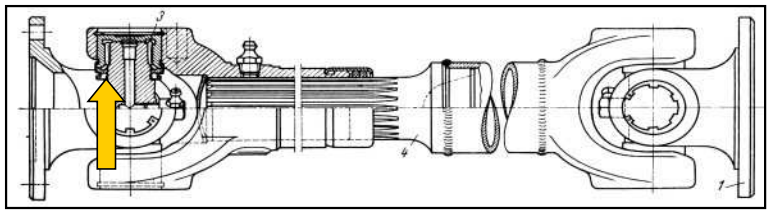
NKI, NA - Needle Roller Bearings with flanges and inner ring

Rolling bearing technology

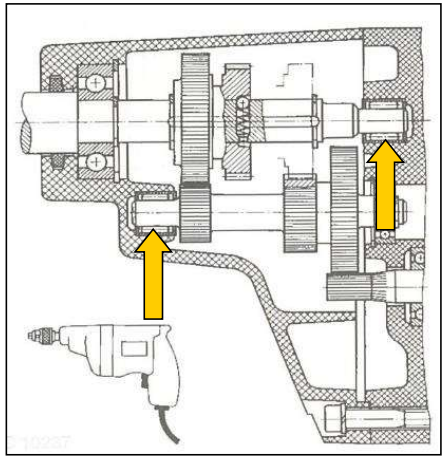
Needle roller bearings

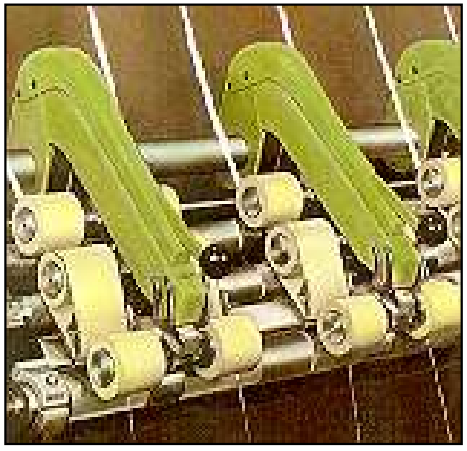


Automotive Starter Motor Bearings grease lubricated with ISOFLEX LDS 18 Special A



Industrial Cardan Drive Shaft, Needle Roller Bearings grease lubricated with Kluberplex BEM 41-132 or STABURAGS NBU 12/300 KP

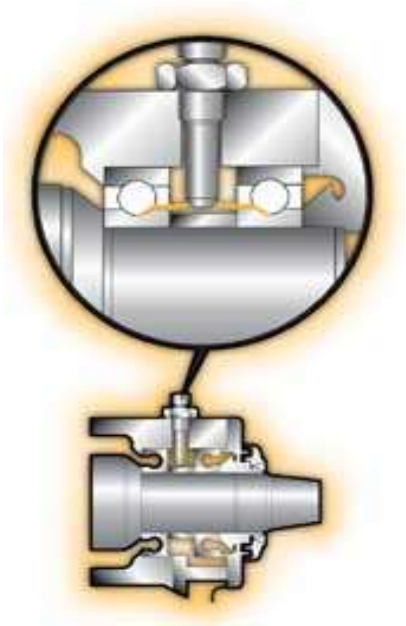




Spinning machine Draughting Roller Bearings grease lubricated with STABURAGS NBU 12/300KP

Lubrication Methods

LUBRICATION METHODS FOR ROLLING BEARINGS

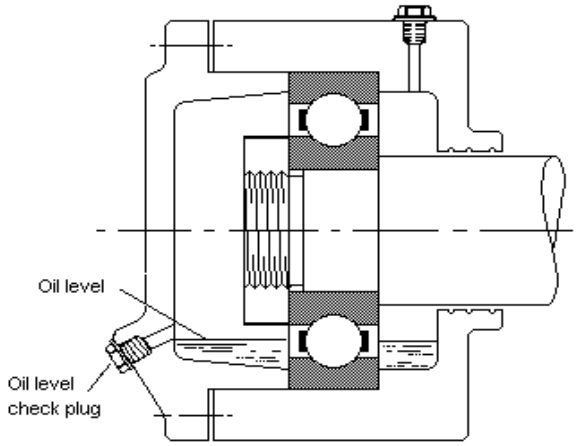


- Oil Bath lubrication
- Oil Splash lubrication
- Oil Injection lubrication
- Oil Circulation lubrication
- Oil / Air lubrication
- Lifetime Grease lubrication
- Manual Grease relubrication
- Automatic grease lubrication

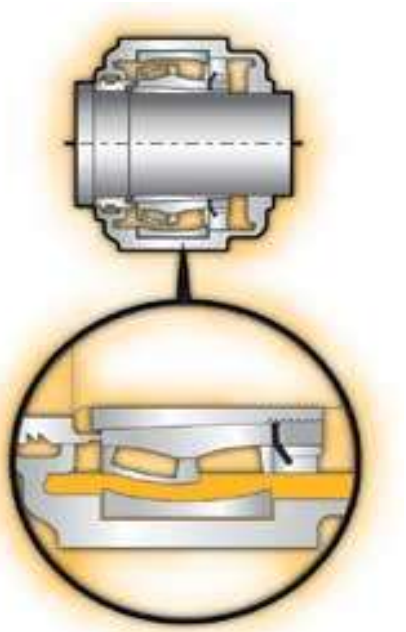
Lubrication of Bearings

Oil Bath Lubrication

Oil bath lubrication is the simplest form of lubrication for bearings subject to low or medium speeds. With the bearing at rest the desired oil level should be at the centre of the lowest rolling element. On rotation, the oil is drawn up by the bearing parts which runs through the bearing and returns by gravity to the oil bath. An oil sight level gauge is beneficial in this design to ensure the correct oil level can be checked and maintained.



Source: RHP Bearings

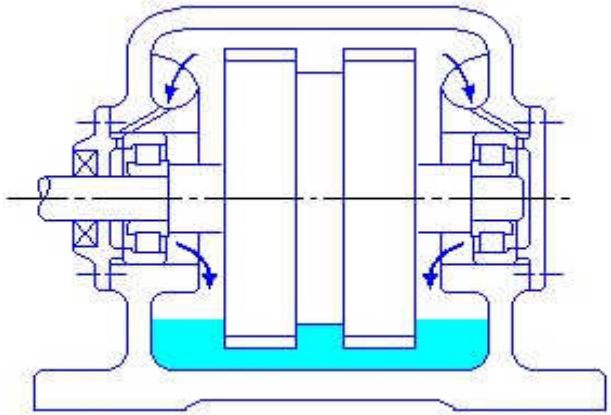


Lubrication of Bearings

Oil Splash Lubrication

Oil splash lubrication is commonly found in Industrial and Automotive gearboxes. With this lubrication method a continuous supply of oil is provided to the bearings by immersion of drive gears or alternatively via an oil flinger ring. (a rotating disc installed near the bearings in contact with the oil sump under stationary conditions) After use the oil returns to the sump by means of gravity.

If the operating temperature is over to use of oil bath / oil splash lubrication an oil circulation system or oil injection system must be used. This aids cooling of the bearing.
The following illustration outlines an oil splash lubrication regime in a reduction gearbox.

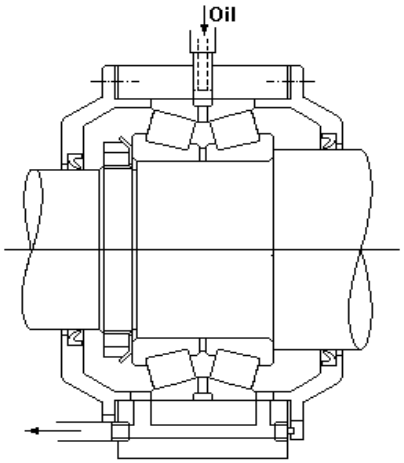


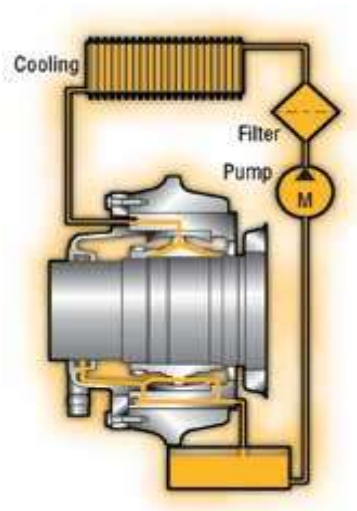
Lubrication of Bearings

Oil Circulation Lubrication

The higher the bearing service temperature the more rapidly a lubricating oil is likely to oxidize. The oil circulation method incorporating external oil cooling reduces the operating temperature of the circulating oil effectively extending oil-change intervals and oil lifetime.

Oil circulation lubrication is commonly used for low to medium speed operation and for bearings operating at high temperature. Oil is delivered under pressure to the top of the bearing (see illustrations below) and travels through the bearing draining away at the lowest point. After being cooled in a reservoir It returns to the bearing through a pump and filter.

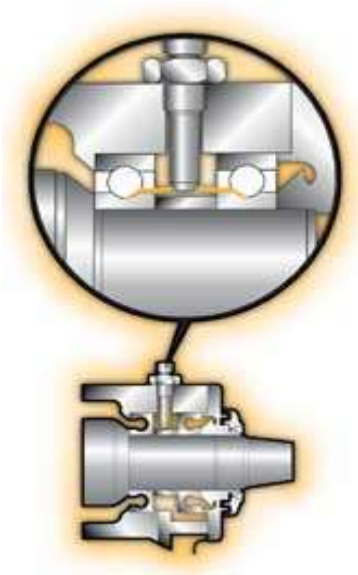


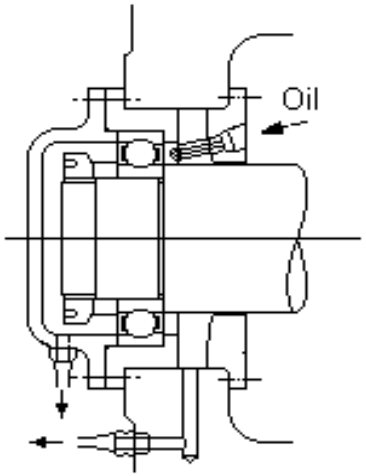


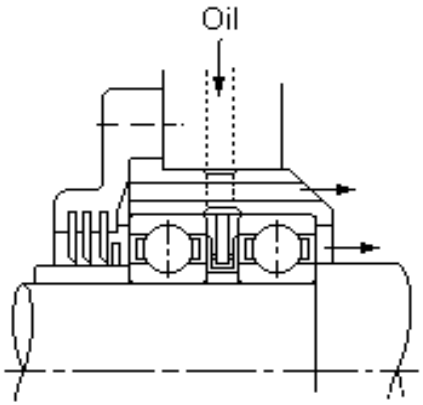
Lubrication of Bearings

Oil Injection Lubrication

Oil jet lubrication is used for ultra high speed lubrication of bearings such as those found in Jet engines and Machine Tools. (n. dm > 1,000.000) Lubricating oil is sprayed under pressure from one or more nozzles directly into the bearing ball / raceway zones. The major advantage of this system is that a stable bearing temperature can be achieved under high speed conditions due to the cooling effect of the force fed oil passing through the bearing. Oil viscosity selection may be critical in with this system.





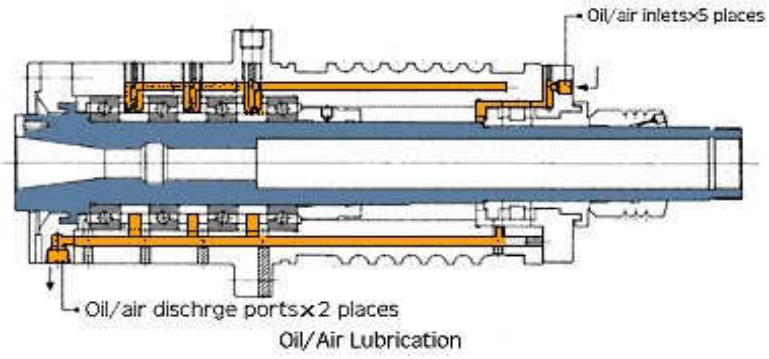


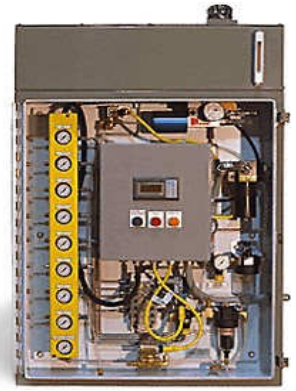
Lubrication of Bearings

Oil/Air Lubrication

Oil/Air Lubrication is a method of supplying micro quantities of oil to the friction point without the negative formation of oil mist or oil fog.

The major advantages of oil/air lubrication are:
It is suitable for ultra high speed conditions whereby minimum quantities of oil are applied to the bearing resulting in cool operation.
Since compressed air delivers a positive pressure to the bearings, dust cutting fluid and other contaminants are prevented from entering via the “air curtain effect”. For these reasons, Oil / Air lubrication is used for lubrication of bearings in the spindles of Machine Tools and other high speed equipment. (n.dm up to ~ 3 million) as well as high speed Guide Rolls in steel production (Continuous Casting plants etc)

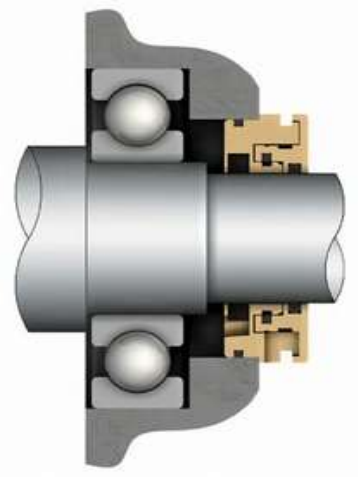


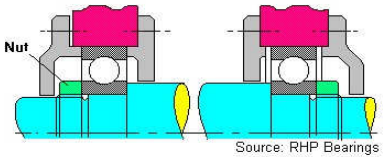


Lubrication of Bearings

Lifetime Grease Lubrication

Lifetime grease lubrication is the major aim of today’s machine builder's and designers. Lifetime lubrication enables a “fit and forget” lubrication strategy whereby the machine operator / end user neither considers or implements any secondary form of relubrication. For this reason most lubricated for life bearing assemblies are sealed and cannot be relubricated by external means. Naturally the possibilities for sales of Kluber special greases are limitless considering this basic requirement.

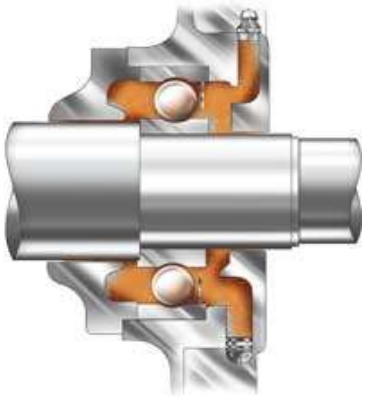


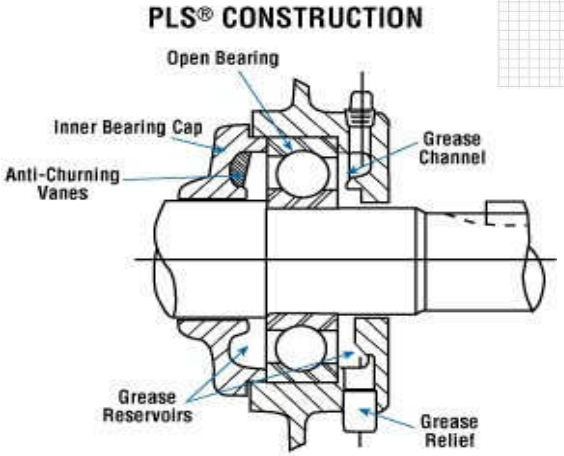


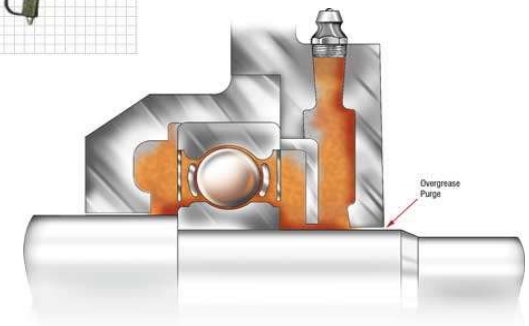
Lubrication of Bearings

Manual Grease Lubrication

Due to the extreme nature of certain industrial applications it is not always possible to achieve a lifetime “fit and forget” grease lubrication strategy. In such cases, and in order to achieve operational reliability, intermittent relubrication becomes necessary. In a manual grease relubrication design the bearing housing serves as a secondary lubricant reservoir and is filled with grease. This system, as well as enabling a supply of fresh lubricant to the bearing, allows the bearing friction zones to be “purged” thus expelling any unwanted foreign contaminants or fluid media. Care should be taken to ensure the correct grease is used during the relubrication process!







Lubrication of Bearings

Automatic Grease Lubrication

In cases where frequent relubrication is necessary the use of an automatic grease lubrication system provides the required solution. Modern total loss grease lubrication systems can deliver specific quantities of grease to multiple outlets at pre set intervals. Systems may incorporate foolproof warning devices to inform the operator of a fault in the system allowing corrective action to be taken before the bearing lubrication regime is jeopardised. Most grease lubrication systems will deliver NLGI grade greases from 000 to 2.

Fluid grease pump

A total loss grease lubrication system under installation on a filling machine in the food industry

A grease lubrication system on a Can Seaming machine

KLÜBER LUBRICATION

How to choose the right lubricant

- Key Factors to Consider
- Calculate the n.dm speed factor of the bearing
- Determine the approximate bearing free space
- Determine the correct grease quantity
- Determine base oil viscosity

How to choose the right lubricant

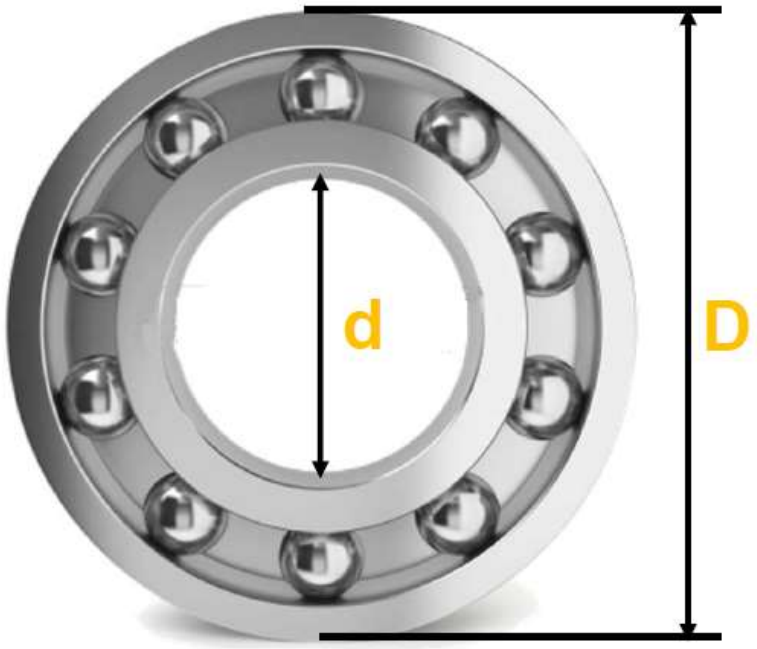
Key Factors to Consider

- Operating conditions (temperature, load, speed).
- Compatibility with bearing material.
- Environmental conditions (humidity, exposure to contaminants).
- Type of bearing (e.g., ball, roller, thrust).

Consult Manufacturer Recommendations:
Always check lubrication specifications from bearing and lubricant manufacturers.

How to choose the right lubricant

Speed factor



d = Bearing bore diameter (mm)

D = Outer bearing diameter (mm)

n = Speed in rpm (rpm)

$$\frac{D+d}{2} \times n$$

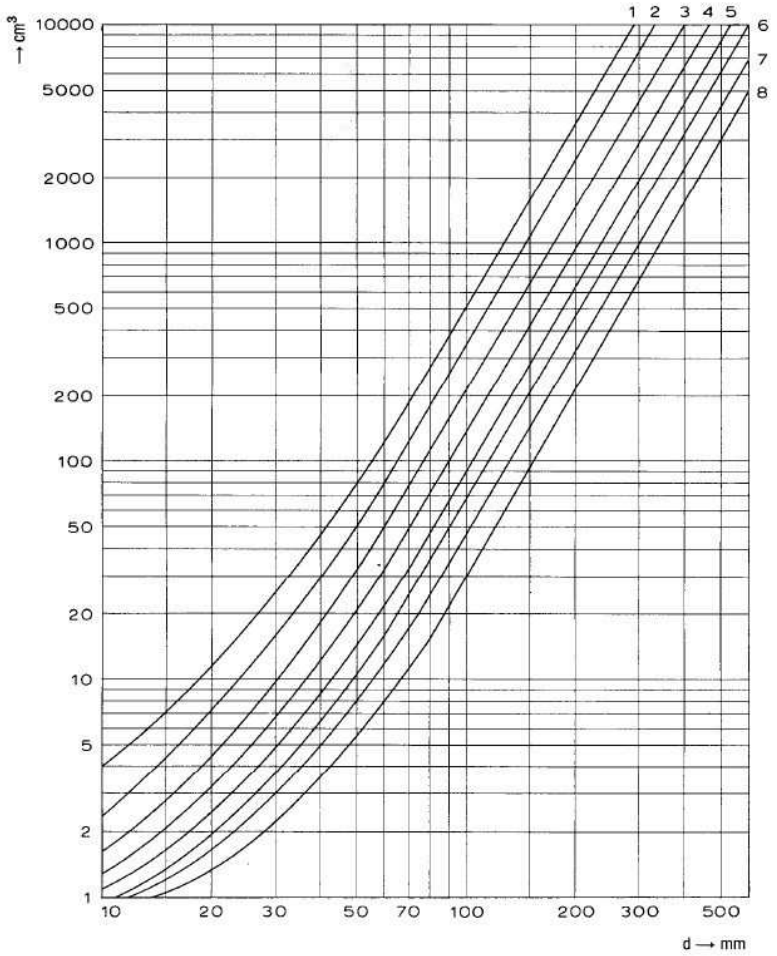
Actually, dm is the mean diameter of bearing

How to choose the right lubricant

Bearing free space

Free space can be get from the following:

- Bearing OEM
- Measure by weight of clean bearing and full filled bearing with grease
- Use the FAG table on right hand side



a	b
7	160
6	60
4	62
2...3	63
1	64
5	B70
3...4	B72
3...4	302
2	303
2	313
6	320X
3...4	322
1...2	323
7...8	329
5	330
4	331
4	332
7	NU10
5	NU2
4	NU22
2	NU23
3	NU3
2	NU4
5	NN30K
7	NNU49
3	213
4	222
2	223
6	230
4	231
3...4	232
8	239
5	240
3	241

How to choose the right lubricant

Determine the correct grease quantity

The correct grease fill quantity is critically important to ensure complete coverage of all contact surfaces. Overlubrication is just as detrimental as underlubrication. Excessive grease fill may cause heat generation and increased running torque!

Method

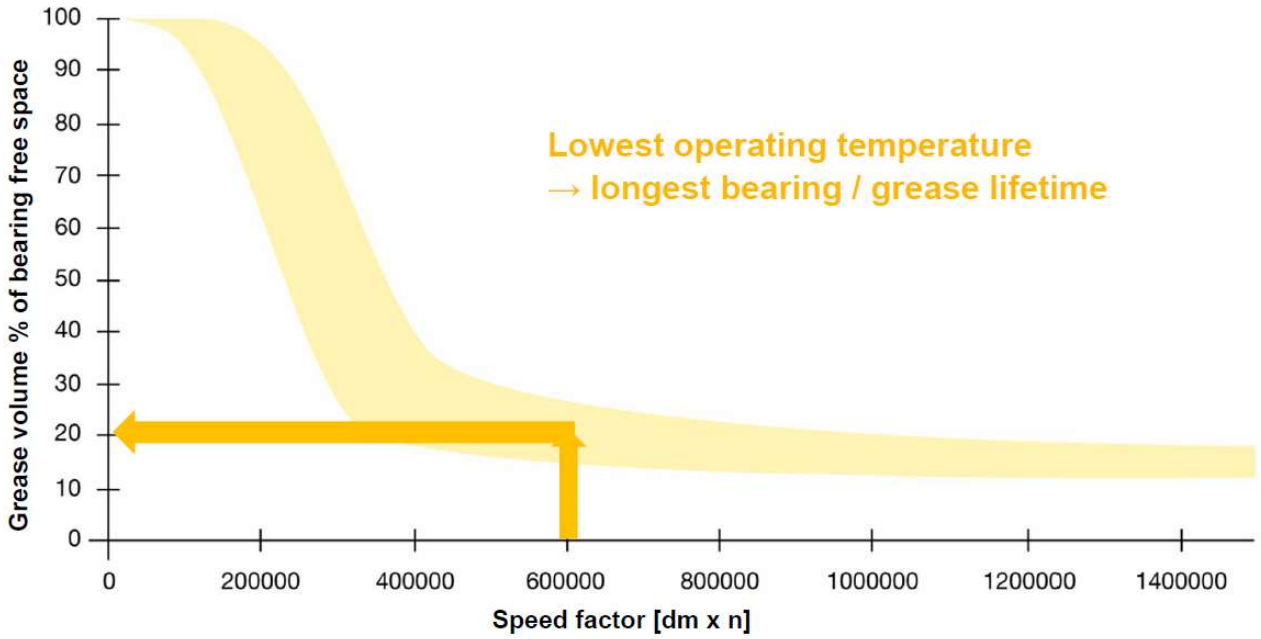
- Determine the approximate bearing free space
- Calculate the n.dm speed factor of the bearing
- Lubricate the bearing with the correct grease quantity (see following guidelines)
- Implement a running in procedure for medium to high speed bearings

Low Speed	Medium Speed	High Speed
For n.dm < 200.000 fill 90 - 100% of the bearing free space	**For n.dm 300.000 - 500.000 fill 30% of the bearing free space**	**For n.dm > 600.000 fill 15% of the bearing free space**

How to choose the right lubricant

Requirements of grease lubrication of bearings

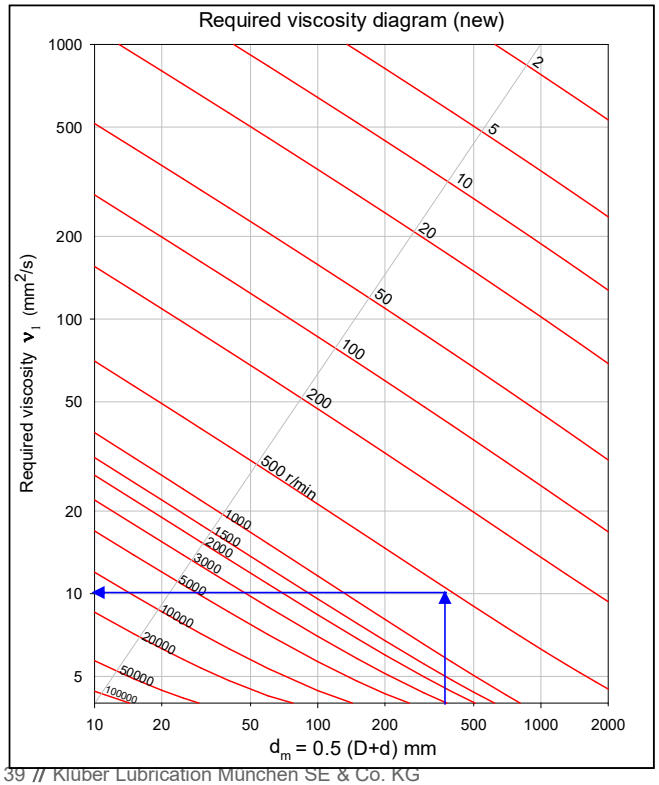
The correct grease fill quantity is critically important to ensure complete coverage of all contact surfaces.
Excessive grease fill may cause heat generation and increased running torque!

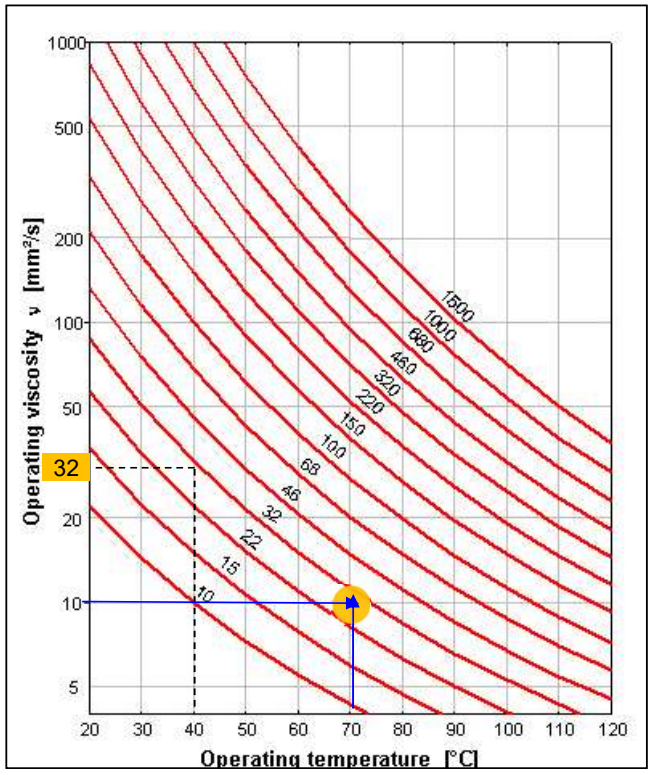


How to choose the right lubricant

Determination of base oil viscosity

Example of determining the minimum oil viscosity for bearing
bore:340 mm O.D: 420 mm mean diameter:380 m speed:500 rpm temperature:70 ° C



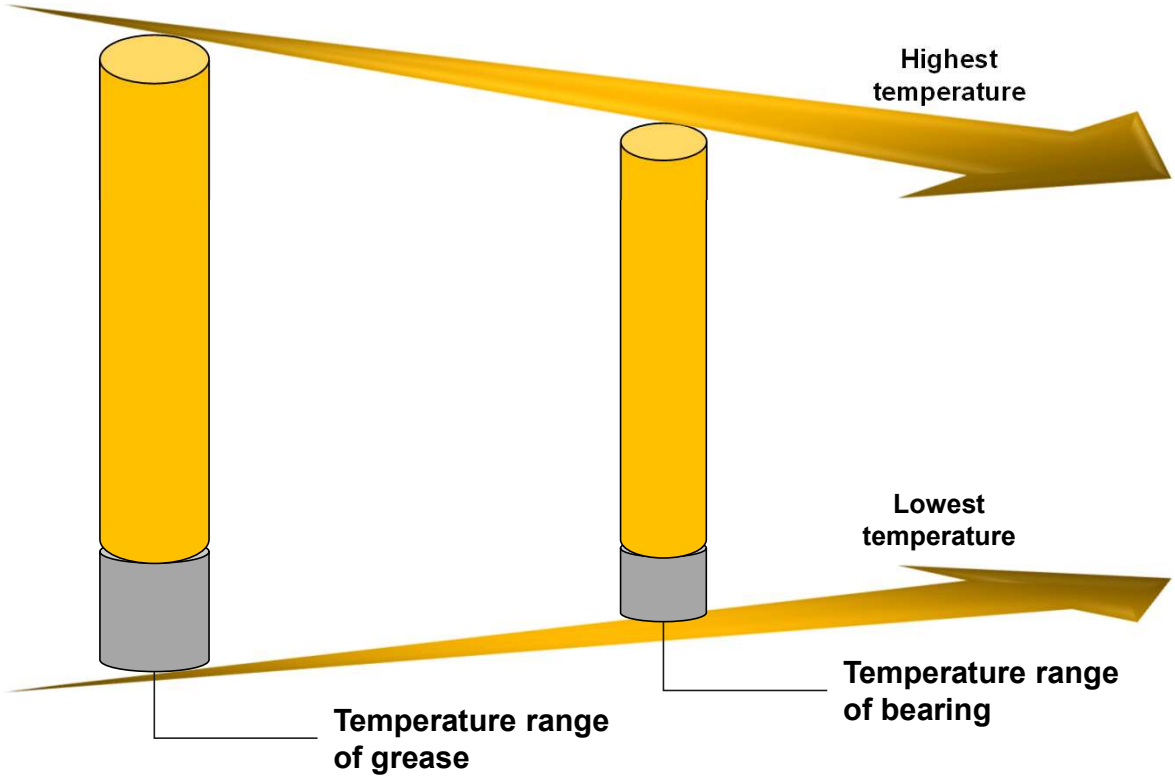


KLÜBER LUBRICATION

How to choose the right lubricant

Determination of grease temperature range

- The working temperature range of bearing should be within that of grease
- The highest working temperature of bearing should be lower than that of grease



Special Lubricants for Bearing Reliability

Separate surfaces

Increase Efficiency

Reduce noise

Reduce friction

Lower environmental impact

Avoid down-time

Prevent wear

Increase service life

Special Lubricants for Bearing Reliability

High-Performance Oils and Greases:

- Designed to withstand high temperatures, loads, and pressures.
- Example: Synthetic oils with superior thermal stability and viscosity index.

Additives in Special Lubricants:

- Anti-wear agents (e.g., zinc dialkyldithiophosphate - ZDDP)
- Extreme pressure additives
- Anti-corrosion agents
- Friction modifiers (e.g. molybdenum disulfide)

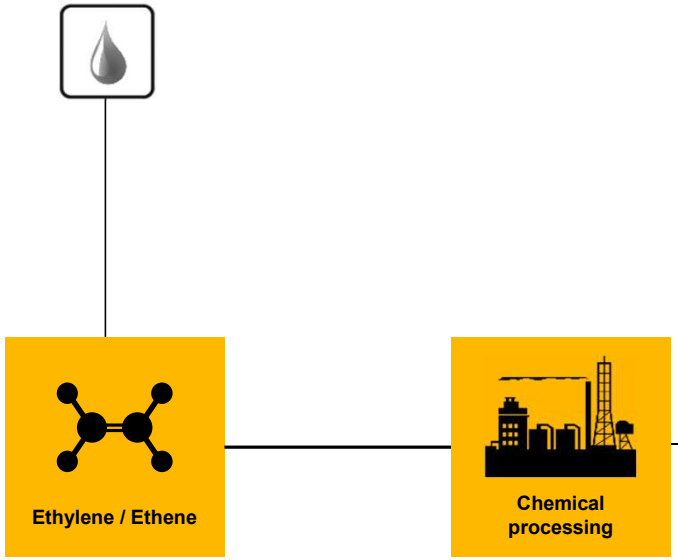
Special Lubricants for Bearing Reliability

Benefit of specialty lubricant

1. Extended bearing life
2. Reduce wear and tear
3. Improved load-bearing capacity
4. Enhance efficiency and reduce energy consupmtion

Special Lubricants for Bearing Reliability

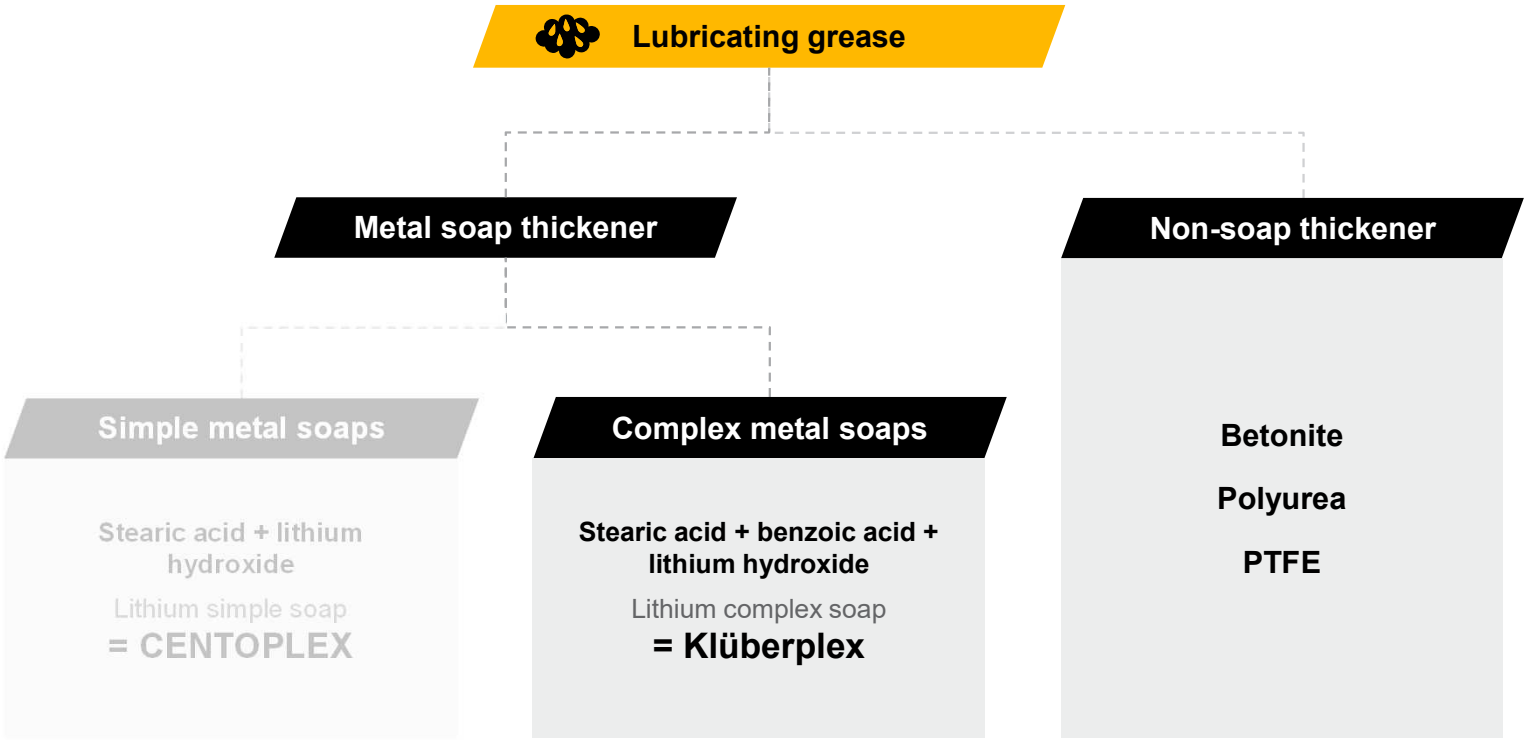
Synthetic oils



PAO Synthetic Hydrocarbon	catalyst
Ester Polyester	<O> <O>
Polyglycol	<O>
Silicon oil	<Si> <O>
PFPE Perfluoralkyl ether	<F> <O>

Special Lubricants for Bearing Reliability

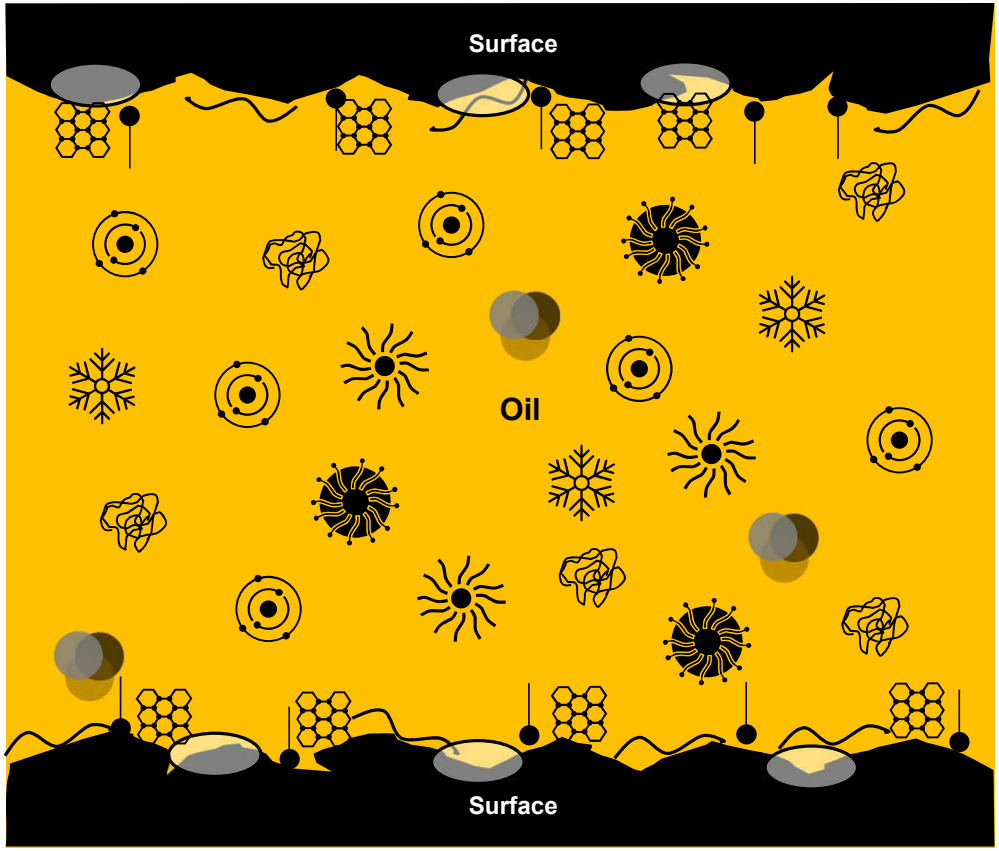
Soap thickeners



Special Lubricants for Bearing Reliability

Additives in lubricating oils

- Antioxidants
- VI-Improvers
- Pour point depressants
- Detergents & Dispersants
- AW-Additives
- EP-Additives
- Corrosion inhibitors
- Foam inhibitors
- Solid lubricants (no additive)
- UV-Indicators



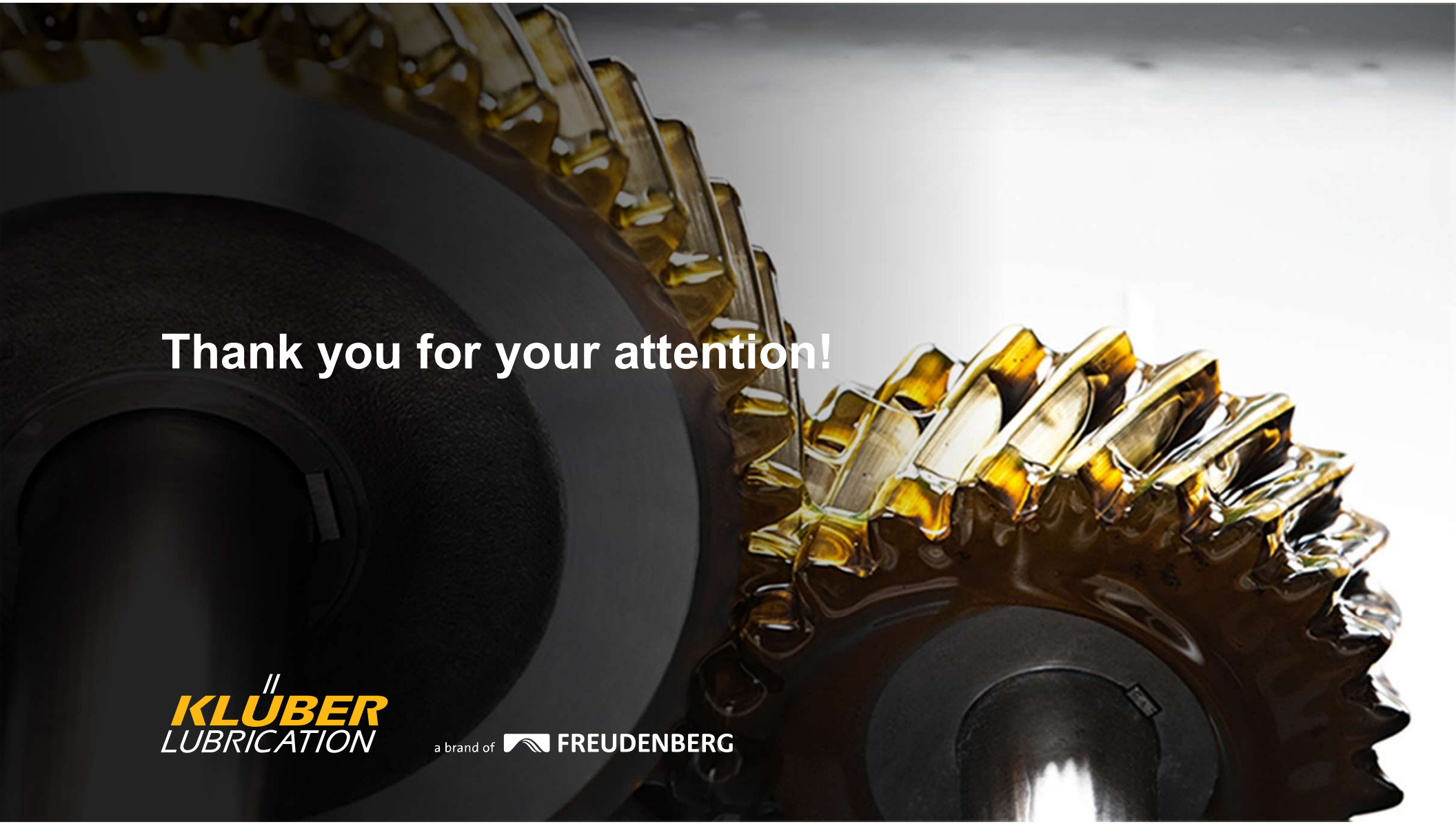
Conclusion

Summary:

- Special lubricants play a crucial role in improving bearing reliability.
- The right lubricant enhances bearing life, reduces friction, and minimizes downtime.
- Regular maintenance and monitoring are key to ensuring optimal bearing performance.

Call to Action:

- Ensure the correct selection and application of lubricants for improved bearing reliability.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