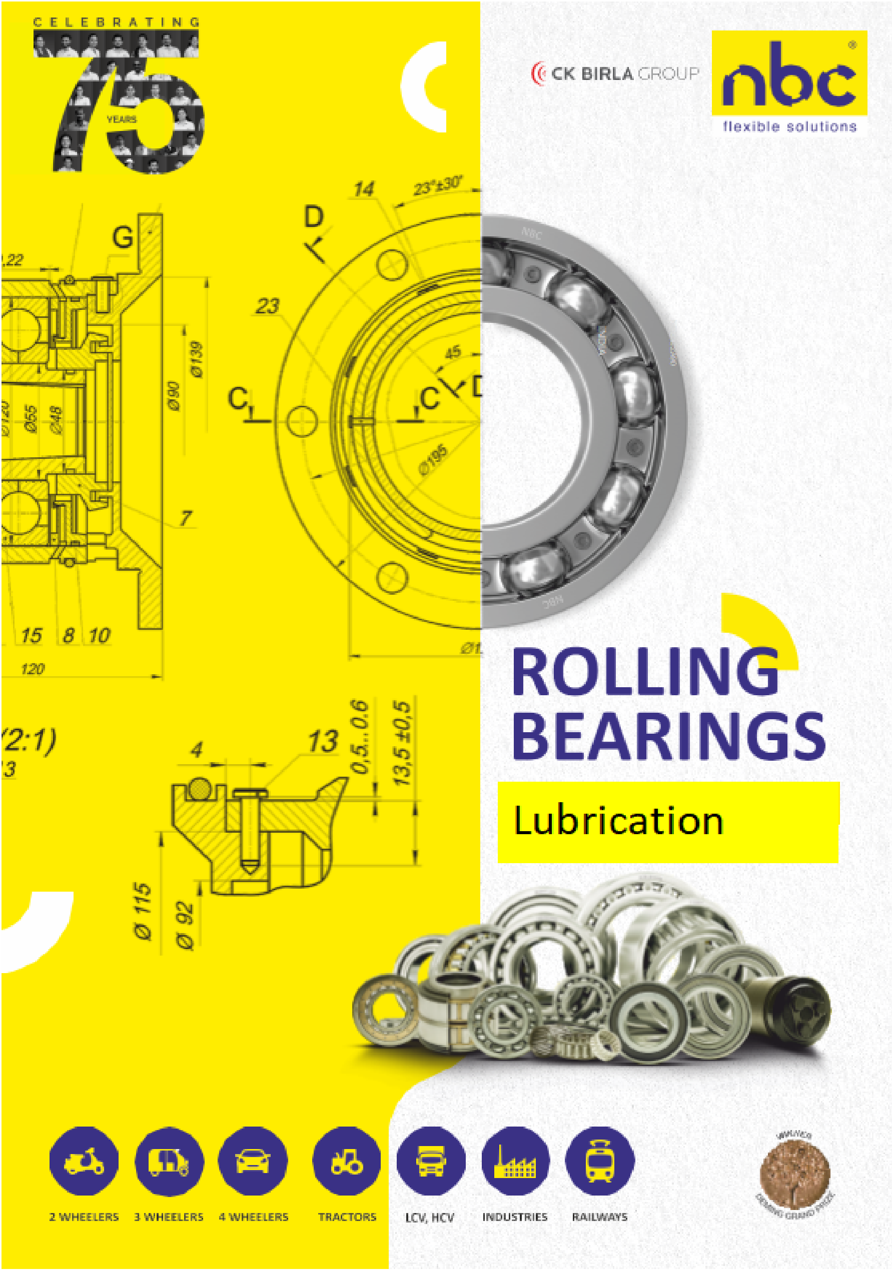

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About National Engineering Industries Ltd. (NBC Bearings)

A symbol of dependability and flexible engineering solutions, NBC Bearings is the brand of National Engineering Industries. Founded in 1946, National Engineering Industries Ltd (NEI) is India's leading bearings manufacturer and exporter, renowned for excellence in quality and delivery. In 2021, NBC bearings completed 75 years of its incorporation.

Headquartered in Jaipur, Having started with 30,000 bearings in 19 sizes in 1946, NBC has evolved to manufacture over 200 million bearings each year offering in 2300+ variants to serve a host of customers in India and over 30 other countries across five continents in automotive, railways and industrial segments. NBC also serves the Indian aftermarket through a countrywide network of 550+ authorized stockists and thousands of retailers.

Award & Recognitions :

NBC has been the recipient of several award and accolades for its quality consciousness and manufacturing prowess. Most prominent being the coveted Deming Grand Prize which is the highest honour in quality awarded to a company for excellence in Total Quality Management (TQM). NBC bearings is the only bearing manufacturer to win both - The Deming Application Award and The Deming Grand Prize Award.

The award is given by the Japanese Union of Scientists and Engineers (JUSE) to companies for demonstrating practicing TQM in the areas of production, customer service, safety, human resource, corporate social responsibility, environment, etc. NBC stands committed to an endless journey of continuous improvement through TQM.

07 Lubrication

7.1 Function of the lubricant

The main function of lubricant is to provide a lubricating film between the rolling elements and the raceway of the bearing in order to prevent wear and allow smooth rotation of the contact surfaces to prolong the service life of the bearings.

The characteristics of lubricants are as follows:

(1) Reduction of Friction and Wear

Preventing direct metal to metal contact between the bearing elements and rings by providing a thin film. This film reduces the friction and wear in the contact areas.

(2) Extension of Fatigue Life

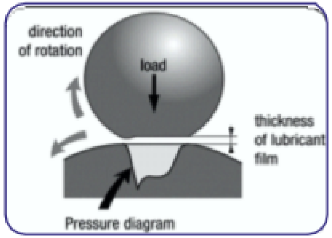
Lubricants improve the rolling fatigue life of bearings greatly by providing a thin film between the rolling contact surfaces.

(3) Dissipation of Frictional Heat

Lubricant acts as a coolant to carry away frictional heat from contact surfaces prevent the bearing from overheating.

(4) Others

Lubricants also helps to prevent foreign material from entering the bearings and protect against rusting.



The first step in the lubrication selection is to consider whether to use Oil lubrication or Grease lubrication for the particular application and should be decided in the design process.

7.2 Selection of the type of lubrication

The guideline is allowing the selection of the proper lubricant for the wide range of bearing types and operating conditions. The first consideration is method of lubrication is best for the particular application. Bearing lubrication method is broadly classified into three categories: Oil lubrication, Grease lubrication and solid lubrication. Satisfactory bearing performance can be achieved by adopting the most suitable for the application and operating condition. First two methods are being used in most of the applications. A comparison of grease and oil lubrication is given in Table 7.1 & 7.2.

Table 7.1 Comparison of grease and oil lubrication characteristics

Method	Grease Lubrication	Oil Lubrication
Handling	□	△
Reliability	O	□
Cooling Effect	X	O
Seal Structure	O	△
Power Loss	O	O
Environment Contamination	O	△
High speed rotation	X	O

□ : Very Good   O : Good   △ : Fair   X : Poor

Table 7.2 Comparison of grease lubrication and oil lubrication

	Oil lubrication	Grease lubrication
Advantages	• Good coverage in the bearing • Dissipating heat • Easy monitoring of the lubricant • Good physical and chemical stability	• Cleanliness of the system • Sealing easier • Assembly simplicity • Reduction or elimination of relubrication • Possibility of using pre-greased bearings
Disadvantages	• Necessary of a lubrication system • Poor protection against oxidation and moisture in case of long stops • Starting delay when circulation of oil is necessary prior to rotation	• Cost effectiveness • Higher friction coefficient than for oil • Poorer dissipation of heat • Replenishment (if necessary) difficulty • Grease leakage, contamination or ageing

7.3 Grease Lubrication

Thanks to its ability to dispense the lubricating film over time, grease lubricants offer an additional advantage when being used in maintenance-free applications. Most of NBC bearings are grease-lubricated, with different greases.

The following section will give broad guideline in selecting the appropriate lubricating grease. Before that let us discuss the characteristics of greases.

7.3.1 Characteristics of greases

Grease is a semi-fluid to solid and in which liquid lubricant is dispersing in a thickening agent called soap. Additives may also add to bring certain specific properties. The concept of fill for life in most of the applications has made grease as an integral component of the bearing. The service life of the bearing and its behaviour in diverse environments are largely determined by the properties of the grease.

7.3.1.1 Speed factor n. dm

The dm. N factor is the first step for choosing a bearing lubricant that will perform well under a given set of conditions. The factor is obtained by multiplying the bearing speed in rpms by the average of the outer diameter and bore diameter of the bearing in millimetres. DN factor of a bearing is critical to preventing lubricant starvation, which is characterized by decreasing lubricant film thickness. In case of outer ring rotation consider only outer diameter to calculate DN factor.

7.3.1.2 Base Oil Viscosity

The base oil of the grease provides the separation between two surfaces of mating parts. Therefore, selecting the correct viscosity is very important. Knowing the speed factor value and operating temperature, the minimum viscosity requirement can be selected.

Grease made with low viscosity base oils is more suitable for high speeds and low to medium load application, while greases made with high viscosity base oils are more suited for low speed and heavy loads. However, the thickener also influences the lubricating properties of grease; therefore, the selection criteria for grease is not the same as for lubricating oil.

7.3.1.3 Operating temperature range

Due to friction between the rolling elements and ring raceways, the operating temperature of a bearing is likely to increase; however, in some application, external process-related temperature can influence the bearing such that its final operating temperature may be much higher. Therefore, make sure that the operating temperature range of the grease must be within the range of operating temperatures as per grease manufacturers. Grease temperature ranges are defined by both the dropping point of the grease thickener and composition of the base oil. If the operating temperature range is wide, synthetic greases offer advantages.

The high temperature limit for lubricating greases is a function of the oxidation stability. Starting torque in a grease-lubricated bearing at low temperatures can also be critical. It is recommended that greases are not used below 20°C than the lower operating temperature of the grease as stated by the grease manufacturer

7.3.1.4 Base oil Type

Once the viscosity has been determined, it's time to consider additives and base oil types. Most greases are produced using API Group II and III mineral oil base stocks for most applications. Synthetic oils such as Polyalphaolefin (PAO), diester or silicone oil are mainly used as the base oil for grease.

Demanding applications like high or low operating temperatures, a wide ambient temperature range, or any application where extended relubrication intervals are desired, then synthetic base oil can be used.

7.3.1.5 Additives

Additives are primarily include enhancing the existing desirable properties, suppressing the existing undesirable properties, and imparting new properties. The most common additives are oxidation and rust inhibitors, extreme pressure, antiwear, and friction-reducing agents.

It is recommended that extreme pressure additives be used in heavy load applications. For long use without replenishment, an antioxidant should be added.

7.3.1.6 Thickener Type

Thickeners are a fibrous matrix that contains the base oil. Under load, oil is released into the contact surfaces to provide lubrication. When the load is released, the oil is drawn back into the thickener matrix. The thickener in a grease is the component that sets grease apart from fluid lubricants. Thickener consist of two types, metallic soaps and non-soaps. Metallic soap thickeners include lithium, sodium, calcium, etc. Non-soap base thickeners are divided into two groups; inorganic (silica gel, bentonite, etc.) and organic (polyurea, fluorocarbon, etc.).

Poly-urea and other non-metallic soaps are generally superior in high temperature properties. However, this type of grease does not have a high working temperature unless the base oil also must have heat resistant. The highest possible working temperature for grease should be determined considering the heat resistance of the base oil.

Lithium-complex and urea thickeners are commonly being used in wheel bearing applications. However, grease for EV wheel application required lower torque, hence, more shear-stable di-urea thickeners could perform better.

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7.3.1.7 Grease Consistency

The consistency of the grease is determined by the thickener concentration, thickener type and the viscosity of the base oil. In simple terms consistency expresses a measure of the relative hardness of a grease. The NLGI has established guidelines scale to indicate grease consistency as per Table 7.3. The consistency generally chosen for bearings is grade 2 & 3. Speed factor and operating temperature determine the best consistency for a given application.

Higher speed factors require higher consistency greases.

A common mistake when selecting a grease is to confuse between consistency and the base oil viscosity. The NLGI number relates to the consistency of the grease. It is possible to create NLGI #2 grease using ISO VG 10 base oil or ISO VG 1000 base oil. One would never use ISO VG 10 oil in an application that demands ISO VG 1000.

Table 7.3 Relationship between consistency and application of grease

	Worked Penetration	
0	355~385	For centralised greasing use When fretting is likely to occur
1	310~340	For centralised greasing use When fretting is likely to occur For low temperature
2	265~295	For general use For selected use For high temperature
3	220~250	For selected ball bearings
4	175~205	For high temperature For special use

Table 7.3 Relationship between consistency and application of grease

Working condition	Suitable Grease
Smooth running (Low noise level)	Grease with NLGI 2
Vertical mount	Good adhesion property with NLGI 3 or 4
Outer ring rotation or centrifugal force on bearing	NLGI between 2 to 4
High temperature	Synthetic base oil with NLGI 2 or 3
Low temperature	Low viscous base oil with NLGI 1 or 2
Contaminated environment	NLGI 3 grease

NBC supply pre-greased with sealed and shielded bearing that is appropriate for the application. Contact NBC team for assistance in choosing the grease for your application. The following page will help to make an initial choice.

Standard greases and their characteristics are listed in Table 7.5. As performance characteristics of even the same type of grease will vary widely from brand to brand.

E-mobility has brought new challenge into the bearing design and lubrication. One of the challenges is grease with little electrical conductivity could extend the life of the bearing against serious bearing damage. To choose lubricant for electric vehicle application, contact NEI technical cell.

Table 7.5 Grease varieties and characteristics

				Calcium grease (cup grease)	Sodium grease (fiber grease)
Thickener	Lithium Soap			Calcium Soap	Sodium Soap
Base Oil	Mineral oil	Synthetic oil (diester oil)	Synthetic oil (Silicon oil)	Mineral oil	Mineral oil
Dropping point (°c)	170 to 190	170 to 230	220 to 260	80 to 100	160 to 180
Operating temp. Range (°c)	-30 to +120	-50 to -130	-50 to -180	-10 to +70	0 to +110
Rotational range	Medium to high	High	Low to medium	Low to medium	Low to high
Mechanical stability	Excellent	Good to excellent	Good	Fair to good	Good to excellent
Water resistance	Good	Good	Good	Good	Bad
Pressure resistance	Good	Fair	Bad to fair	Fair	Good to excellent
Remarks	Most widely usable for various rolling bearings	Superior Low, Temperature & friction characteristics. Suitable for bearings for measuring instruments & extra small ball bearings for small electric motors.	Superior, High & low temperature characteristics.	Suitable for application at Low rotation speed & under light load. Not applicable at high temperature	Liable to emulsify in the presence of water. Used at relatively high temperature.

Table 7.5 Grease varieties and characteristics (contd.)

	Complex Base Grease		Non- Soap Base Grease		
Thickener	Lithium Complex Soap	Calcium Complex Soap	Bentone	Urea Compounds	Fluorine Compunds
Base Oil	Mineral Oil	Mineral Oil	Mineral Oil	Mineral Oil/Synthetic Oil	Synthetic Oil
Dropping point (°c)	250 or Higher	200 to 280	-	240 or higher	250 or Higher
Operating temp. Range (°c)	-30 to +150	-10 to +130	-10 to +150	-30 to +150	-40 to +250
Rotational range	Low to High	Low to Medium	Medium to High	Low to High	Low to Medium
Mechanical stability	Good to Excellent	Good	Good	Good to Excellent	Good
Water resistance	Good to Excellent	Good	Good	Good to Excellent	Good
Pressure resistance	Good	Good	Good	Good to Excellent	Good
Remarks	Superior mechanical stability and heat resistance. Used at relatively high temperature.	Superior pressure resistance when extreme pressure agents is added. Used In bearings for rolling mills.	Suitable for application at high temperature & under relatively heavy load	Superior water resistance, oxidation stability, and heat stability. Suitable for application at high temperature & high rotation speed.	Superior chemical resistance and solvent resistance. Usable upto 250 °C.

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7.3.2 Relubrication Intervals

Grease replenishment or exchange is required if the grease service life is shorter than the anticipated bearing life. In this case grease deteriorates with the passage of time, fresh grease must be re-supplied at proper intervals. The replenishment time interval depends on the type of bearing, dimensions, bearing's rotating speed, bearing temperature, and type of grease.

The bearings are re-lubricated by means of grease guns through lubricating nipples. If frequent re-lubrication is required, grease pumps and volumetric metering units must be used. It is essential that the fresh grease displace the spent grease, so that the grease get exchanged, but over greasing should be prevented.

Grease quantities for weekly to yearly relubrication [g]:

$m1 = D \cdot B \cdot X$

Table: 7.6 Reduction factor

Relubrication	X
weekly	0.002
monthly	0.003
yearly	0.004

Quantity m2 for extremely short relubrication intervals [g]:

$m2=(0.5\text{-}20)\cdot V[kg/h]$

Relubrication quantity m3 prior to restarting after several years of standstill [g]:

$m3 = D \cdot B \cdot 0.01$

Where

V = free space in the bearing

D = Outer dia of the bearing (mm)

B = Width of the bearing (mm)

Grease replenishment intervals can also be calculated by using following graph. This chart indicates the replenishment interval for standard rolling bearing grease when used under normal operating conditions.

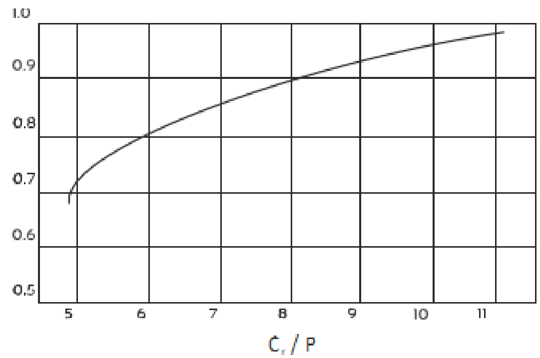


Fig. 7.1 Value of adjustment factor FL depends on bearing load

Example:

Find the grease lubrication interval for ball bearing 6205 with a radial load 1.4 kN operating at 4800 r/min

From the bearing tables the allowable speed for bearing 6205 is 13000 r/min & numbers of revolutions at a radial load of 1.4 kN are

Cr/Pr = 14/1.4 kN = 10

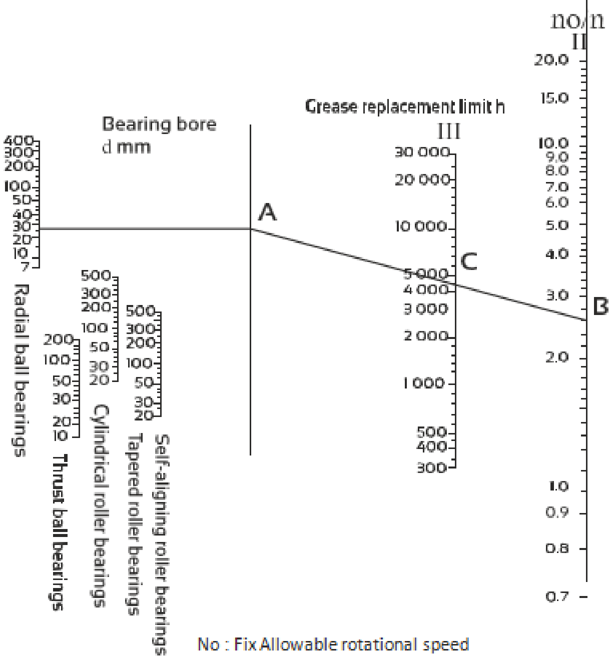
from fig. 7.1 adjusted load fL is 0.98

n0 = 0.98x13000 = 12740 r/min

therefore n/n0 = 12740/4800 = 2.6

Using the chart in fig.7.2 locate the point corresponding to bore diameter d=25 mm on the vertical line for radial ball bearings. Draw a straight- horizontal line to vertical line I. After that draw a straight-line from that point (A in example) to a point on the line II which corresponds to the n0 /n value (2.6 in example). Point C, where this line intersects vertical line indicates the lubrication interval 'h' which is approximately 4500 hours.

Relubrication should be done to avoid grease deterioration having an adverse effect on the bearing life. However, High performance greases can extend relubrication intervals and grease life. The grease used for relubrication must be the same as that used in initial greasing. If other greases are used, the miscibility and compatibility of the greases must be checked.



No : Fix Allowable rotational speed (dimensions table)

n : Operating rotational speed

Fig. 7.2 Diagram for grease interval

7.3.6 Grease quantity for initial fill and relubrication

The amount of grease used in any given situation will depend on many factors relating to the size and shape of the housing, space limitations, bearing's rotating speed, grease characteristics, and ambient temperature.

The quantity of grease for ordinary bearings is determined as follows. Enough grease must be packed inside the bearing including the cage guide face. The available space inside the housing to be packed with grease depends on the speed as follows:

Table: 6 Speed factor with % filled quantity of grease

Speed	Speed factor	Grease fill
very slow	<50 000	60-80 %
slow to normal	50 000 to 200 000	25-60 %
high	200 000 to 600 000	15-30 %
very high	>600 000	15-20 %

It must be in mind that excessive grease will generate heat when churned and will consequently cause temperature rise which in turn causes the grease to soften and may allow leakage. With excessive grease fills oxidation and deterioration may cause lubricating efficiency to be lowered. Where speeds are high and temperature rises need to be kept to a minimum, a reduced amount of grease should be used.

The standard bearing space can be found by below formula V=K.W

where,

V : Quantity of bearing space open type (approx.) cm3

K : Bearing space factor (Table 7.7)

W: Mass of bearing kg

Table 7.7 Bearing space ratio (K)

Bearing Type	Retainer Type	K
Ball Bearings [1]	Pressed Retainer	61
NU-cylindrical Roller Bearings [2]	Pressed Retainer	50
	Machined Retainer	36
N-cylindrical Roller Bearings [3]	Pressed Retainer	55
	Machined Retainer	37
Tapered Roller Bearings	Machined Retainer	46
Spherical Roller Bearings	Pressed Retainer	35
	Machined Retainer	28

Notes:

[1] Remove 160 Series

[2] Remove NU4 Series

[3] Remove N4 Series

In general, the permissible working temperature is limited by the degree of mechanical agitation to which the grease is subjected, and we shall be pleased to recommend suitable lubricants for varying conditions on receipt of necessary particulars, before the bearings are set to work, they should be thoroughly charged with grease in such a manner as to ensure the efficient coverage of all working surfaces. The housing should also be lightly packed with grease, it being important that a reserve supply of lubricant should be maintained in actual contact with the bearing to promote satisfactory and continuous lubrication. if two bearings are mounted in the same housing, they, for this reason, should be separated by distance pieces. If correctly applied, one charge of grease will last for a very long period, varying with the condition of working.If the bearing temperature exceeds 70 °C, the replenishment time interval must be reduced by half for every 15 °C temperature rise of the bearings.

7.3.7 Mixing Different Types of Grease

In general, mixing grease with different types of thickneners may destroy its composition and physical properties. Even if the thickeners are of the same type, possible differences in the additive may cause detrimental effects. Different brands of grease must not be mixed even same physical properties as the additives may differ. In cases where change of the grease used becomes necessary, all remaining old grease must be removed. Also, the remaining lubricant in housing cavities, lubrication pipes or grooves must be carefully removed. Especially in the changer over period, special attention should be paid to the lubrication situation in the bearing arrangement. If required, the defined relubrication intervals should be shortened during such a conversion period.

7.3.8 Compatibility

Grease formulated with base oil, the additives and the thickener. For higher performance from grease Lubricants must always be checked for their compatibility with other lubricants, seal and the environment.

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7.4 Oil lubrication

Oil lubrication is generally used when the bearing is adapted in a mechanism that is already lubricated (gear reducer, gearbox) or else when it canbenefit from a central lubrication system.

- Oil is a better lubricant for high speeds or high temperatures. It can be cooled to help reduce bearing temperature.
- It is easier to handle and control the amount of lubricant reaching the bearing.
- Oil can be introduced to the bearing in many ways, such as drip-feed, pressurized circulating systems, oil bath or air-oil mist. Each is suited for certain types of applications.

In this section, the properties and characteristics of lubricants for typical roller bearing applications are listed. These general characteristics have resulted from long, successful performance in these applications

Types of oils

Lubricating oils are commercially available in many. Oils are classified Animal & Vegetable oils, Mineral oil and Synthetic oil.

7.4.1 Mineral oil

Oils are refined from crude petroleum oil, with additives to improve certain properties. Petroleum oils mostly used for oil-lubricated applications of bearings.

7.4.2 Synthetic oils

Synthetic oils cover a broad range of categories and include polyalphaolefins (PAO), Silicon oil, Fluorinated oil, Polyglycols and various esters. In general, synthetic oils are less prone to oxidation and can operate at extreme temperatures.

The polyalphaolefins (PAO) have a long straight hydrocarbon chain chemistry provide superior performance. Therefore, PAO oil is mostly used in the oil-lubricated applications of bearings when severe temperature or when extended lubricant life is required.

Selection of the proper type of oils depends on bearing speed, load, operating temperature and lubrication method.

7.4.3 Additives

Additives are substances formulated for improvement of chemical and physical properties of base oil, which results in enhancing the lubricant performance and extending the equipment life. The most commonly used additives are the Friction modifiers, Anti-wear additives, Extreme pressure (EP) additives, Rust and corrosion inhibitors, Anti-oxidants, Detergents, Dispersants, Pour point depressants and Viscosity index improvers. Great care must be used in choosing an additive. One must check with the lubricant manufacturer to check the influence of the additive on the bearing performance.

- Extreme pressure

  Protects metal surfaces against micro-welding and necessary when the bearing is highly loaded.

- Anti-wear

  Reduces the wear of the metal surfaces by forming a protective surface layer.

- Anti-corrosion

  Protects metal surfaces against corrosive attacks.

7.4.4 Viscosity

When selecting a lubricating oil, the viscosity at the operating conditions is important. If the viscosity is too low, a proper oil film is not formed and abnormal wear and seizure may occur. On the other hand, if the viscosity is too high, excessive viscous resistance may cause heating or large power loss. In general, low viscosity oils should be used at high speed; however, the viscosity should increase with increasing bearing load and size.

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In regard to operating temperature and lubrication, Table 7.8 lists the required oil viscosity for different types of rolling bearings under normal operating conditions. Fig. 7.4 is an oil viscosity - operating temperature comparison chart for the purpose of selecting a lubrication oil with viscosity characteristics appropriate to an application.

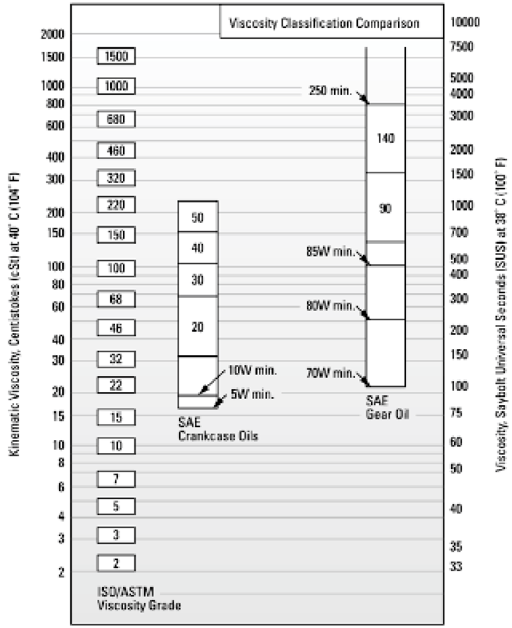
Table 7.8 Bearing Types and Proper Viscosity of Lubricating Oils

Bearing Type	**Proper Viscosity at Operating Temperature**
Ball Bearings and Cylindrical Roller Bearings	Higher than 13 mm^2/s
Tapered Roller Bearings and Spherical Roller Bearings	Higher than 20 mm^2/s

Note: $1mm^{2/s}$=1cSt (centistokes)

Since oil viscosity varies inversely with temperature, a viscosity value must always be stated with the temperature at which it was determined. There are several classifications of oils based on viscosity grades. The most familiar are the Society of Automotive Engineers (SAE) classifications for automotive engine and gear oils.

VISCOSITY CLASSIFICATION COMPARISON



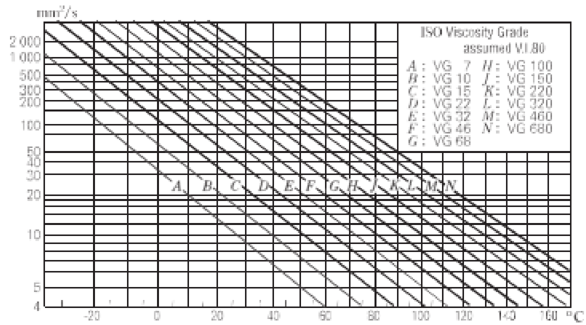
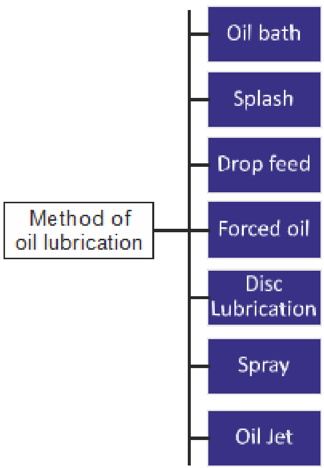


Fig. 11.5 Relation between lubricating oil viscosity and temperature

Table 7.9 Selection standards for lubricating oils (Reference)

Bearing operating temperature	Speed factor	Lubricating oil ISO viscosity grade (VG)		Suitable bearing
		Normal load	Heavy load or shock load	
−30 to 0	Up to allowable revolutions	22, 32	46	All types
0 to 60	15,000 Up to	46, 68	100	All types
	15,000 to 80,000	32, 46	68	All types
	80,000 to150,000	22, 32	32	All types but thrust ball bearings
	150,000 to 500,000	22, 32	10	Single row radial ball bearings, cylindrical roller bearings
60 to100	15,000 Up to	220	150	All types
	15,000 to 80,000	150	100	All types
	80,000 to 150,000	100, 150	68	All types but thrust ball bearings
	150,000 to 500,000	68	32	Single row radial ball bearings, cylindrical roller bearings
100 to 150	Up to allowable revolutions	320		All types
0 to 60	Up to allowable revolutions	46, 68		Self-aligning roller bearings
60 to 100	Up to allowable revolutions	150		-

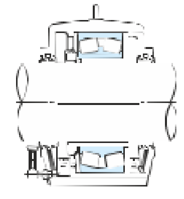
Please consult NEI technical cell in cases where operating conditions fall outside the range covered by this table.



7.4.5 Methods of Oil Lubrication

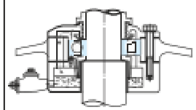
Oil bath lubrication

- This method is mostly used for slow and intermediate speed operation.
- The bearing operates in an oil bath made by filling the housing with oil.
- Too much oil causes excessive temperature rise (through agitation) while too little oil may cause seizing.
- It is desirable to install an oil gauge so that the oil level can easily be checked.
- In the case of a vertical shaft, 50-80% of the ball / roller bearing should be submerged when the bearing is idle.



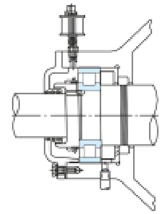
Splash lubrication

- In this method oil is splashed by impellers attached to a shaft without direct submersion
- This method is effective for high speeds.
- One example, bearings and gears in a gear box. Where the gears may splash the oil.
- A magnet should be placed at the bottom to prevent worn particles entering the bearings.



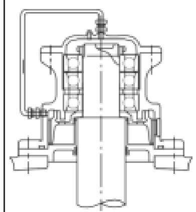
Drop-Feed lubrication

- This is a lubrication method where an oil pot (called "oiler") is installed at the upper portion of housing and oil drips from the oiler through a tiny hole.
- The dripping oil is converted to fog or mist on collisions with the rotating shaft / bearing parts.
- This method is more effective for comparatively high speeds and light loads rather than medium loads.
- Although application capability is great irrespective of shaft mounting (vertical or horizontal)
- Always remember to top off the oiler before it runs dry.



Forced oil circulation

- This method is commonly used for high speed operation requiring bearing cooling and for high temperatures environment.
- Oil is travelled through the bearing and drains out through the pipe on the left.
- After being cooled in a reservoir, it returns to the bearing through a pump and filter.
- The oil discharge pipe should be larger than the supply pipe so an excessive amount of oil will not back up in the housing



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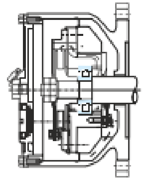
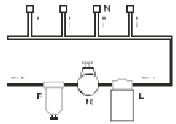
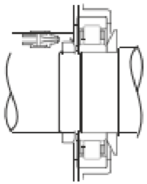
Methods of Oil Lubrication (contd.)

Disc Lubrication • In this method, a partially submerged rotating disc rotates and picks up oil from the casing then drains down through the bearing, lubricating it.	
Spray lubrication (oil-mist lubrication) • Filtered oil is blown through a lubrication sprayer (using dry compressed air), emerging in an atomized form. • This lubrication method is high effectiveness of cooling and prevention of bearings from dust or water invasion due to high internal pressure associated. • This method has often been used for bearings with high speed main spindle bearings or grinding machines. • Also it recently has become popular for bearings mounted on metal rolling mills.	
Oil Jet lubrication • This method lubricates by injecting oil under high pressure directly into the side of the bearing. • This is a reliable system for high speed, high temperature or otherwise severe conditions. • Used for lubricating the bearings in jet engines, gas turbines and other high-speed equipment. • Machine tools is one example of this type of lubrication.	

7.4.6 Compatibility

Performance of the lubricating oil also depends on compatibility with contact parts. Their behaviour must be checked in relation to plastics, seal materials (elastomers) at operating temperature. Though Synthetic oils enhance performance must always be checked for their compatibility.

7.5 Solid and Dry Lubrication

Solid lubricants are materials, which in solid phase reduce friction between surfaces sliding against each other, without the need for a liquid medium. Generally, these lubricants are applied on the contact surfaces by different coating process are adopted to use Molybdenum disulphide (MoS_2) and tungsten disulphide (WS_2).

For more details, please contact NEI technical cell.

7.6 Oil impregnated ball bearing

Oil impregnated ball bearing is a type of polymer lubricant composed lubricating oil in the matrix. The special solution works similar to grease but by applying a special treatment process, the polymer solidifies retaining a large proportion of the lubricant within the bearing. Unlike grease, the OIBB is solid polymer matrix can prevent dirt or foreign particles entering into the contact.

For more details, please contact NEI technical cell.

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