

TNT Motion

BEARINGS GENERAL CATALOGUE



Introduction to TNT Motion Bearings Catalogue

Welcome to the TNT Bearings Catalogue, your comprehensive guide to high-quality ball bearings designed to meet the diverse needs of various industries. Ball bearings are essential components in countless applications, from everyday household appliances to sophisticated industrial machinery. Their primary function is to reduce friction and wear between moving parts, ensuring smooth operation and extending the lifespan of equipment. Whether in automotive, aerospace, medical devices, or manufacturing, ball bearings clearance a critical role in enhancing performance, reliability, and efficiency.

At TNT Bearings, our mission is to design and deliver the most suitable solutions tailored to our clients' unique applications. We understand that every project presents its own set of challenges and requirements, and we are committed to providing bearings that meet these demands with precision and excellence.

Our mission goes beyond just supplying bearings; it embodies our dedication to innovation, quality, and customer satisfaction. We strive to push the boundaries of bearing technology through continuous research and

development, ensuring that our products remain at the forefront of the industry. Our expert team collaborates closely with clients to understand their specific needs, enabling us to offer customized solutions that enhance performance and drive success.

We believe in building lasting partnerships based on trust, integrity, and mutual growth. Our commitment to excellence is reflected in every aspect of our operations, from the materials we select to the rigorous quality control processes we implement. By choosing TNT Bearings, you are not just investing in a product, but in a promise of reliability, innovation, and unparalleled service.

Join us on this journey towards engineering excellence. Together, let's create solutions that not only meet the challenges of today but also anticipate the possibilities of tomorrow. Welcome to a world where precision meets passion, and where your success is our ultimate goal. Welcome to TNT Bearings.

For Any further question or request do not hesitate to contact the TNT Engineering team for a free consultation.

TNT Motion

Bearings General Catalogue



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1. Introduction

About TNT Bearings

TNT Bearings is a leading manufacturer and supplier of high-quality ball bearings. With a commitment to excellence and innovation, we provide a comprehensive range of bearing solutions designed to meet the diverse needs of our global clientele. Our state-of-the-art manufacturing facilities, coupled with stringent quality control processes, ensure that every bearing we produce meets the highest standards of performance and reliability.

Our Philosophy

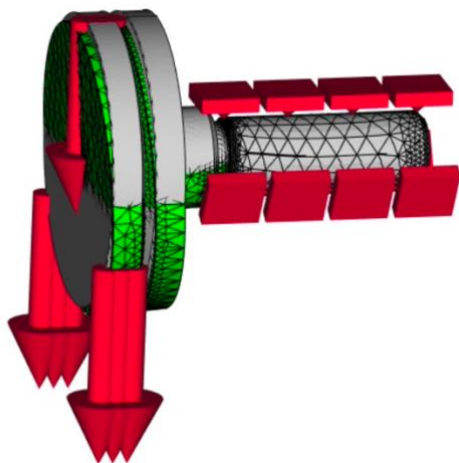
At TNT Bearings, we believe in creating value for our customers through precision engineering, cutting-edge technology, and unparalleled customer service. Our philosophy is centered on three core principles:

1. **Quality:** We are dedicated to delivering products that exceed our customers' expectations. Our rigorous quality assurance processes and continuous improvement initiatives ensure that our bearings offer superior performance and longevity.
2. **Innovation:** We are committed to staying at the forefront of bearing technology. Our research and development team constantly explores new materials, designs, and manufacturing techniques to enhance the capabilities of our bearings and meet the evolving demands of the market.
3. **Customer Focus:** Our customers are at the heart of everything we do. We strive to understand their unique challenges and provide tailored solutions that address their specific needs. From initial consultation to after-sales support, we are dedicated to building long-lasting relationships based on trust and mutual success.
4. **Commitment to Sustainability**
We recognize the importance of sustainability and are committed to minimizing our environmental impact. Our manufacturing processes are designed to be energy-efficient and environmentally friendly, and we continuously seek ways to reduce waste and promote the use of sustainable materials.

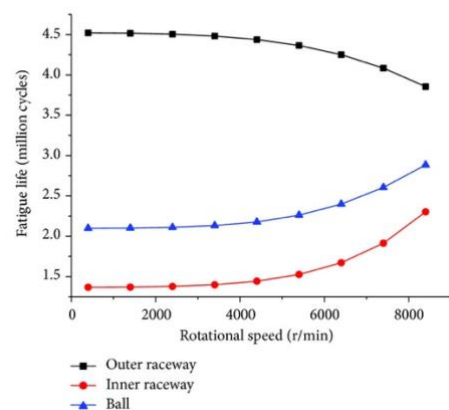
1.1. Our Added Value Services

At TNT we're dedicated to supporting our clients with a comprehensive range of services that go beyond simply supplying high-quality ball bearings. Our goal is to enhance our clients' operational efficiency, reliability, and cost-effectiveness by providing specialized engineering support tailored to their unique needs. In addition to our core products, we offer an array of value-added services designed to optimize bearing performance, extend lifespan, and reduce long-term maintenance costs.

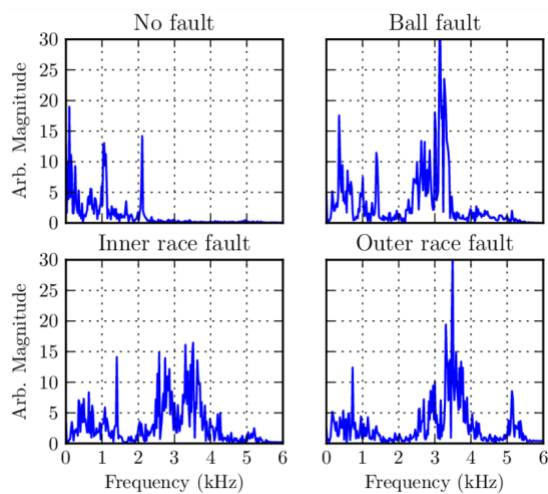
- **1.1.1 Finite Element Analysis (FEA):** Leveraging advanced FEA tools, we simulate real-world conditions to assess bearing performance under various loads, stresses, and temperatures. This service helps clients prevent costly breakdowns by ensuring each bearing is designed for the exact demands of the application, particularly in high-load or extreme environments.



- **1.1.2 Bearing Life Calculation and Dimensioning:** Proper bearing selection and dimensioning are critical for maximizing efficiency and longevity. Using specialized software and industry-standard calculations, we assess each application's load, speed, and operating environment to determine the optimal bearing size and type. This service ensures clients have the correct bearing dimensions and specifications to withstand their operating conditions, ultimately enhancing reliability and reducing replacement costs. Accurately dimensioned bearings help our clients avoid undersized components that lead to premature failures or oversized bearings that increase costs without added value.



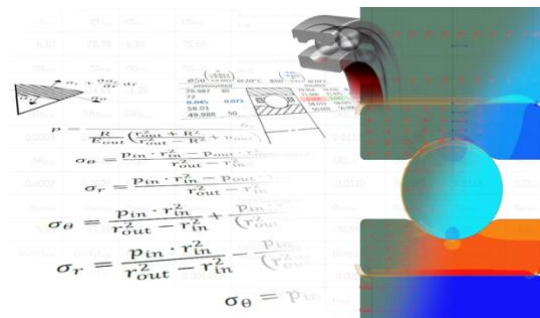
- 1.1.3 Bearing Noise and Vibration Analysis:** Our noise and vibration testing service helps clients identify potential issues that could compromise performance, especially in applications where quiet operation is essential. By minimizing unwanted vibrations and noise, we help extend bearing life and improve the overall quality of the end product, which is particularly valuable in industries such as medical devices, automotive, and precision machinery.



- 1.1.4 Bearing Inspection and Failure Analysis:** When issues arise, our in-depth inspection and failure analysis provides detailed insights into the causes of bearing failures. We examine wear patterns, lubrication, contaminants, and other factors to diagnose root causes. This helps clients improve maintenance practices, installation techniques, and operating conditions, significantly reducing the likelihood of repeat failures.

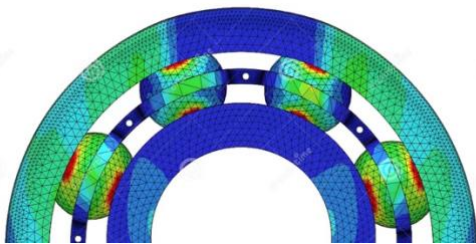


- 1.1.5 Bearing Fitting Calculation:** Proper fitting is crucial to prevent premature failure. Our fitting calculation service provides precise recommendations on tolerances, fits, and adjustments tailored to specific operational requirements. With the correct mounting conditions, clients can avoid common issues such as misalignment and improper load distribution, ensuring longer bearing life and smoother operation.



- 1.1.6 Special Bearings and application

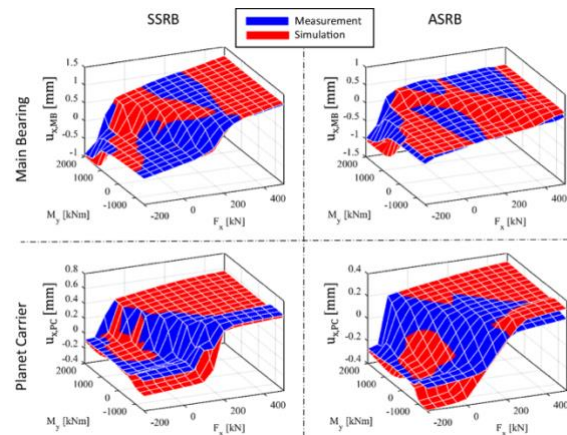
Design: For applications that require unique specifications, we offer custom bearing design services. Our engineering team collaborates with clients to develop specialized bearings tailored to exact requirements, including load capacity, speed, temperature range, and environmental factors. Custom bearings provide clients with reliable solutions for challenging conditions, enabling them to achieve their performance goals with confidence.



- 1.1.7 Bearing Selection and Sizing

Consultation: In applications where precise dimensions are critical, we provide consultation services to ensure the selected bearing dimensions align with the mechanical and load requirements of the system. This service is especially beneficial for

clients with high-performance equipment or custom machinery, as it helps eliminate the guesswork in selecting the right bearing dimensions and specifications.



By offering these services, TNT becomes a partner in each client's success. Our technical support enables clients to maximize bearing performance, reduce operating costs, and improve product reliability. Through our expertise and customized solutions, we empower clients to achieve optimal results, whether in standard applications or complex, high-demand environments.

2. Bearing Selection Guide

To select the appropriate bearing, consider the following factors:

- Load capacity requirements (dynamic and static)
- Speed limits and operating conditions
- Size constraints (bore, outer diameter, and width)
- Environmental factors (temperature, contamination)
- Lubrication and maintenance needs

Selecting the right bearing is a crucial step in ensuring optimal performance and longevity of machinery. The bearing selection process involves several factors, including load capacity, speed limits, environmental conditions, and application-specific requirements. Understanding these criteria and their interactions is key to making the best choice.

2.1. Load Capacity

Bearings are designed to support both radial and axial loads. The choice between radial and thrust bearings depends on the direction of the load. Additionally, bearings are classified by their dynamic and static load ratings, which are provided by manufacturers. These ratings are essential in determining the bearing's ability to withstand forces without failure.

- **Dynamic Load Rating (C):** Indicates the maximum load the bearing can endure for a defined number of revolutions (typically 1 million revolutions). It is used for bearings subjected to constant or variable dynamic loads. For more details see par. 3 below
- $L_{10} = \left(\frac{C}{P}\right)^3 10^6$ see par 3 below for more details

Where:

- L_{10} is the basic rating life in millions of revolutions.
- C is the dynamic load rating.
- P is the equivalent dynamic bearing load.
- **Static Load Rating (C₀):** Represents the maximum load the bearing can support without permanent deformation when stationary. For more details see par. 3 below.

2.2. Speed Limits

The operating speed of a bearing is influenced by its size, lubrication, and design. Bearings have both limiting speeds, determined by thermal and mechanical stresses, and reference speeds, based on the thermal conditions at moderate loads.

- **Reference Speed:** This is determined by the frictional heat generated and dissipated.
- **Limiting Speed:** This is determined by bearing type, size, cage design, and lubrication type.

2.3. Temperature and Environmental Conditions

Bearings are often exposed to harsh operating conditions such as high temperatures, dust, moisture, or corrosive environments. Choosing materials and seals that protect against these elements is crucial to avoid premature failure. For high-temperature applications, bearings with specialized lubricants or heat-resistant materials, such as ceramics, may be necessary.

2.4 Lubrication and maintenance needs

The primary purpose of lubricating rolling bearings is to prevent direct metal-to-metal contact between the rolling and sliding components. This is achieved by creating a thin film of oil or grease on the contact surfaces. Lubrication is essential for the efficient operation of rolling bearings and offers several key benefits:

1. **Reduction of Friction and Wear:** Lubrication helps to minimize direct contact between the rolling and sliding elements, reducing both friction and wear on the bearing components.
2. **Prolonged Bearing Life:** By forming a protective oil film on the rolling contact surfaces, lubrication enhances the rolling fatigue life of the bearing.
3. **Heat Dissipation and Cooling:** Circulating lubricants assist in dissipating heat generated by friction or from external sources, helping to maintain a stable operating temperature.
4. **Additional Benefits:** Lubrication also helps prevent foreign particles from entering the bearing and protects against corrosion by forming an oil coating on the bearing surfaces.

To ensure these benefits, it is crucial to choose a lubrication method that matches the specific operating conditions. Additionally, selecting a high-quality lubricant, using the correct amount, and designing the bearing to prevent contamination or leakage are vital steps. Insufficient lubrication can lead to increased friction, excessive heat, and abnormal wear, which can significantly reduce bearing performance and lifespan. Therefore, selecting the appropriate lubrication and method is critical to bearing reliability and maintenance scheduling.

2.5. Typical Bearings Applications

Bearings are vital components in a wide range of applications across industries, enabling smooth, efficient motion while supporting various types of loads. Different types of bearings are selected based on their ability to handle specific load conditions, speeds, and environmental factors. Below are some key examples of how different types of bearings are applied in various industries, along with their specific advantages and considerations.

2.5.1 Deep Groove Ball Bearings

Applications:

- **Electric Motors and Generators:** Due to their high-speed capabilities and ability to handle both radial and axial loads, deep groove ball bearings are widely used in electric motors and generators. Their low friction minimizes energy consumption, contributing to the efficiency of the equipment.
- **Household Appliances:** Appliances such as washing machines and vacuum cleaners benefit from the versatility and compact design of these bearings.
- **Automotive Transmissions:** In car transmissions, deep groove ball bearings handle the combined loads from gears, making them essential for smooth power transfer.

Key Considerations:

- **Load Type:** These bearings can accommodate both radial and axial loads, but they are more suited for moderate axial loads.

- **Speed:** They operate effectively at high speeds, making them ideal for electric motors and high-speed spindles.
- **Lubrication:** Proper lubrication is essential for ensuring long life, particularly in high-speed applications where the heat generation can be an issue.

2.5.2 Tapered Roller Bearings

Applications:

- **Automotive Wheel Hubs:** Tapered roller bearings are standard in automotive applications, especially in wheel hubs, where they support high radial and thrust loads due to vehicle weight and cornering forces.
- **Gearboxes and Transmissions:** In heavy-duty trucks and machinery, tapered roller bearings are used in gearboxes and transmissions to handle combined loads.
- **Conveyor Systems:** These bearings are used in conveyor systems, especially in industries such as mining and bulk material handling, where they support heavy loads and resist impact forces.

Key Considerations:

- **Load Capacity:** Tapered roller bearings are specifically designed to support high radial loads combined with axial loads in one direction, making them suitable for demanding applications.
- **Preload Adjustment:** Proper adjustment of preload is critical to ensure optimal performance, as it affects both the bearing life and rigidity of the application.
- **Mounting:** These bearings are usually mounted in pairs (back-to-back or

face-to-face) to handle axial forces in both directions.

2.5.3 Cylindrical Roller Bearings

Applications:

- **Heavy Machinery:** Cylindrical roller bearings are ideal for heavy machinery that experiences high radial loads, such as crushers, rolling mills, and large electric motors.
- **Wind Turbines:** In wind turbine gearboxes, cylindrical roller bearings are used to handle the substantial radial forces generated by the blades.
- **Railway Applications:** These bearings are commonly used in railway axles and traction motors due to their high load capacity and ability to operate in harsh environments.

Key Considerations:

- **Radial Load Capacity:** Cylindrical roller bearings have a high radial load capacity but limited axial load support, so they are generally used in applications where the load is primarily radial.
- **Speed and Temperature:** These bearings perform well at moderate speeds but may require special lubrication to manage high temperatures in extreme applications.
- **Misalignment:** Unlike spherical roller bearings, cylindrical roller bearings are sensitive to misalignment, which can significantly affect performance.

2.5.4 Spherical Roller Bearings

Applications:

- **Mining and Construction Equipment:** Spherical roller bearings are used in mining, construction, and other heavy-duty industries where they can support large radial and axial loads, often under misaligned or contaminated conditions.
- **Pulp and Paper Mills:** These bearings are applied in large equipment used in paper mills, such as calenders, which experience high radial loads and shaft deflection.
- **Agricultural Machinery:** In the agricultural sector, spherical roller bearings are used in equipment like tractors and harvesters that experience severe misalignment and high-impact loads.

Key Considerations:

- **Self-Alignment:** Spherical roller bearings are designed to accommodate misalignment between the shaft and the housing, making them ideal for applications with shaft deflection or where alignment is difficult to maintain.
- **Load Capacity:** These bearings can handle extremely high radial loads as well as moderate axial loads in both directions.
- **Operating Conditions:** They are well-suited to environments with heavy contamination, moisture, or shock loads, where other bearing types might fail prematurely.

2.5.5 Thrust Ball Bearings

Applications:

- **Machine Tools:** Thrust ball bearings are used in machine tools to support axial loads, particularly in spindles, where they ensure precision and stability under heavy thrust forces.
- **Automotive Steering Systems:** In vehicle steering mechanisms, thrust ball bearings provide smooth and precise operation by handling axial forces in confined spaces.
- **Pumps and Compressors:** These bearings are applied in pumps and compressors where axial loads are present, ensuring the stable operation of rotating components.

Key Considerations:

- **Axial Load Capacity:** Thrust ball bearings are designed primarily for axial loads and offer minimal support for radial loads.
- **Speed:** They are more suitable for lower-speed applications as they do not perform as well at high speeds compared to other bearing types.

2.5.6 Needle Roller Bearings

Applications:

- **Automotive Powertrain Components:** Needle roller bearings are widely used in transmissions, rocker arms, and hydraulic pumps, where space is limited, and high load capacities are needed.
- **Two-Wheelers:** In motorcycles and bicycles, needle roller bearings are used in gearboxes, suspension systems,

and crankshafts, allowing compact design while maintaining strength.

- **Textile Machinery:** These bearings are used in high-speed textile machinery, where their low friction and compact design are advantageous.

Key Considerations:

- **Space Constraints:** Needle roller bearings are ideal for applications with limited space due to their thin cross-section, which allows them to handle high loads with minimal radial clearance.
- **Lubrication:** These bearings require adequate lubrication due to the high contact stress on the rollers, especially in high-speed applications.

- **Robotics and Automation:** These bearings are employed in robotic arms and automation systems, where high precision and the ability to handle combined loads are critical.

Key Considerations:

- **Load Handling:** Angular contact ball bearings are designed to handle combined radial and axial loads. When used in pairs, they can support axial loads in both directions.
- **High-Speed Operation:** Their design allows for high-speed performance, making them suitable for applications requiring precise movement and minimal friction.

2.5.7 Angular Contact Ball Bearings

Applications:

- **Aerospace Applications:** Angular contact ball bearings are used in aircraft engines and landing gear, where they handle both radial and thrust loads at high speeds.
- **Industrial Pumps:** In industrial pumps, these bearings support the combined loads resulting from pressure differentials and shaft misalignment.

3 Bearing Calculation Parameters

3.1 Static Load Rating (C_0)

The static load rating (C_0) is a critical parameter that defines the maximum load a bearing can support without causing permanent deformation to the rolling elements or raceways when the bearing is stationary or under very slow rotation. Unlike the dynamic load rating, which deals with continuous motion and fatigue life, the static load rating focuses on the load-bearing capacity of the bearing when it's either not moving or subjected to short-term extreme forces.

3.1.1 Definition of Static Load Rating

The static load rating (C_0) refers to the static radial or axial load that corresponds to a total permanent deformation of the bearing of approximately 0.0001 times the diameter of the rolling element. This deformation, although small, can significantly impact the operational performance of the bearing, causing increased friction, noise, and even catastrophic failure if not properly managed.

- **Radial Load (F_{0r}):** The load acting perpendicular to the axis of the shaft.
- **Axial Load (F_{0a}):** The load acting along the axis of the shaft.

3.1.2 Static Safety Factor (S_0)

To ensure reliability under high-load conditions, engineers often calculate the static safety factor (S_0) to compare the actual loads to the static load rating. The static safety factor ensures that the load applied does not exceed the bearing's safe static capacity.

$$S_0 = C_0/P_0$$

Where:

- S_0 = Static safety factor (recommended value is usually ≥ 1.5 for most applications).
- C_0 = Static load rating (provided by the manufacturer).
- P_0 = Equivalent static bearing load (calculated based on the actual applied load).

3.1.3 Equivalent Static Load Formula

The equivalent static load P_0 is an important concept in determining the effective load that acts on the bearing under a combination of radial and axial forces. The formula differs for radial and thrust bearings:

For **radial bearings**, the equivalent static load is calculated using the following formula:

$$P_0 = X_0 \cdot F_r + Y_0 \cdot F_a$$

Where:

- P_0 = Equivalent static load (N or lbf).
- F_r = Applied radial load (N or lbf).
- F_a = Applied axial load (N or lbf).
- X_0 and Y_0 = Static load factors, which are coefficients provided by the bearing manufacturer depending on the bearing type and configuration.

For **thrust bearings**, the calculation simplifies as the loads are primarily axial:

$$P_0 = F_a$$

For thrust ball bearings, the axial load F_a alone determines the equivalent static load, as these bearings are primarily designed to handle forces in the axial direction.

3.1.4 Importance of Static Load Rating

The static load rating is crucial in applications where bearings are subjected to:

1. **Shock Loads:** High impact or shock loads can occur in machines like crushers, presses, or in transportation equipment. Bearings in such environments need to have sufficient static load capacity to withstand momentary extreme forces.
2. **Slow Speed or Oscillatory Motion:** In slow-moving machinery or in applications with oscillating motion (like rotating joints or hinges), the static load rating becomes critical because the bearing spends most of its time under static conditions.
3. **Start-Stop Operations:** In applications such as elevators or heavy-duty industrial machinery, bearings may experience frequent stops under heavy loads. During the stationary phase, high loads can cause indentation on the raceways, leading to reduced service life.

3.1.4 Examples of Applications Where Static Load Rating is Critical:

- **Construction Machinery:** Equipment such as excavators, bulldozers, and cranes often encounter high loads while stationary or under slow movement, requiring bearings with high static load capacities.
- **Wind Turbines:** The bearings in wind turbines experience both static and dynamic loads, especially when the turbine is stopped and subjected to strong wind forces.
- **Railroad Equipment:** Railcars and locomotives exert significant static forces on their axle bearings during

loading and unloading or while stationary at rest stops.

Understanding the static load rating and calculating the equivalent static load accurately are essential in preventing permanent damage to the bearing. Proper consideration of the static load capacity ensures that the bearing can handle extreme forces without degradation, ensuring the reliability and longevity of the equipment.

3.2 Dynamic Load Rating (C)

The dynamic load rating (C) is one of the most crucial specifications for bearings, determining their ability to withstand constant or variable loads during operation over a long period of time. It represents the maximum load a bearing can carry for a specified number of revolutions (commonly 1 million revolutions) without experiencing significant wear or fatigue. The dynamic load rating is particularly important for bearings subjected to continuous motion, as it directly affects the bearing's lifespan under given operating conditions.

3.2.1 Definition of Dynamic Load Rating

The dynamic load rating (C) is defined as the constant radial or axial load that a bearing can theoretically endure for 1 million revolutions before the first signs of material fatigue appear. This rating assumes normal operating conditions, such as proper lubrication and alignment.

For radial bearings (e.g., ball bearings, roller bearings), the load is primarily perpendicular to the axis of rotation. In contrast, for thrust bearings, the load is mainly axial (along the shaft's axis).

Factors Influencing Dynamic Load Rating

The dynamic load rating of a bearing is influenced by several factors, including the bearing type, material, and design. It is critical to understand these variables to match the bearing to the specific application:

1. **Bearing Type:** Different types of bearings (e.g., ball bearings, cylindrical roller bearings, spherical roller bearings) have different dynamic load ratings due to their internal construction. For example, roller bearings generally have higher dynamic load ratings than ball bearings of the same size because the line contact between rollers and raceways can distribute loads over a larger area.
2. **Bearing Material:** The material of the bearing components—rolling elements, raceways, and cages—affects the dynamic load rating. Bearings made from high-quality steel, ceramics, or other advanced materials can handle higher dynamic loads due to improved wear resistance and fatigue life.
3. **Lubrication:** Proper lubrication is essential for achieving the bearing's rated dynamic load capacity. Insufficient or degraded lubrication can lead to increased friction, heat, and wear, significantly reducing the bearing's dynamic load capacity.
4. **Operating Conditions:** Factors like contamination, temperature, and misalignment can impact the dynamic load rating. Bearings operating in clean, well-lubricated environments can achieve their full dynamic load rating, while harsh conditions may lower the effective load rating due to accelerated wear.

Practical Importance of Dynamic Load Rating

The dynamic load rating is pivotal in determining the suitability of a bearing for high-load, high-speed, or high-cycling applications. Bearings that frequently operate under dynamic conditions must have sufficient load ratings to ensure long-term reliability and to avoid premature failure due to fatigue.

Example Applications Where Dynamic Load Rating is Critical:

- **Automotive Applications:** Bearings in automotive engines, gearboxes, and wheel hubs are subjected to continuous loads and high speeds. The dynamic load rating must account for constant mechanical stresses, especially in high-performance or heavy-duty vehicles.
- **Industrial Gearboxes:** Bearings used in gearboxes for wind turbines, conveyor systems, and heavy machinery are continuously loaded during operation. High dynamic load ratings are essential to ensure reliable function over extended periods without unexpected downtime due to bearing fatigue.
- **Electric Motors and Generators:** In electric motors, particularly those running at high speeds, bearings must sustain dynamic loads efficiently to ensure smooth and quiet operation. A bearing's dynamic load rating affects its longevity and performance under these conditions.
- **Aerospace Applications:** Bearings in aircraft engines, landing gear, and control systems operate under variable loads and speeds, requiring high dynamic load ratings.

3.3. Bearing Fatigue Life Calculation

The basic rating life (L10) of a bearing is the life at which 90% of a group of identical bearings will still be operational under specified conditions. The basic formula for calculating ball bearing life is:

$$L_{10} = \left(\frac{C}{P}\right)^3 10^6$$

where:

- L10 = Basic rating life in million revolutions
- C = Basic dynamic load rating (kN)
- P = Equivalent dynamic load (kN)

The equivalent dynamic load (P) can be calculated using:

$$P = X \cdot F_r + Y \cdot F_a$$

where:

- Fr = Radial load (kN)
- Fa = Axial load (kN)
- X and Y = Radial and axial load factors respectively

To account for lubrication and dirt level, the modified life (Lnm) can be calculated using:

$$L_{nm} = a_{ISO} \times a_1 \times L_{10}$$

where:

- a_{ISO} = Life modification factor for reliability, material, and operating conditions
- a_1 = Life modification factor for lubrication and contamination

The factor a_1 can be calculated using:

$$a_1 = \left(\frac{\nu}{\nu_1}\right)^p \cdot \left(\frac{\nu}{\nu_2}\right)^q$$

where:

- ν = Actual viscosity of the lubricant at operating temperature (mm²/s)
- ν_1 = Required viscosity at operating temperature (mm²/s)
- ν_2 = Reference viscosity at operating temperature (mm²/s)
- p and q = Contamination factors based on dirt level

The contamination factors p and q depend on the cleanliness of the lubrication system and can be determined from standardized tables.

The contamination factors p and q are typically determined from empirical data and standardized tables based on the cleanliness of the lubrication system and the operating environment of the bearings. These factors adjust the bearing life calculation to account for the presence of contaminants in the lubricant, which can significantly impact bearing life.

Here's a general guideline on how to calculate p and q:

1. Identify the Contamination Level:

- Determine the cleanliness level of the operating environment and lubrication system. This can be done through particle count analysis or referencing standard cleanliness codes such as ISO 4406.

2. Refer to Standardized Tables:

- Use standardized tables, such as those provided by bearing manufacturers or industry standards (e.g., ISO), which correlate contamination levels with ppp and qqq factors. These tables typically provide contamination factors based on particle count or cleanliness code.

3.3.1 Example Table for Contamination Factors

Contamination Level	Cleanliness Code	p	q
Very Clean	ISO 16/13	0.5	0.5
Clean	ISO 18/15	0.6	0.6
Moderate	ISO 20/17	0.7	0.7
Dirty	ISO 22/19	0.8	0.8
Very Dirty	ISO 24/21	0.9	0.9

Table 1 Example of p and q values

In this example, the cleanliness code is derived from the ISO 4406 standard, which measures the contamination level in terms of the number of particles present in a certain volume of fluid.

3.3.2 Steps to Calculate p and q:

1. Determine the Cleanliness Code:

- Measure the particle contamination level in the lubricant using a particle counter or similar method.
- Refer to the ISO 4406 cleanliness code to classify the contamination level.

2. Use the Table to Find p and q:

- Locate the corresponding p and q values from the standardized table based on the cleanliness code.

3.4. Lubrication Calculation

Proper lubrication is critical for maximizing the performance and life of bearings. The viscosity of the lubricant should match the operating conditions of the bearing. The required viscosity can be calculated as:

$$\nu_1 = \nu \left(\frac{T_1}{T} \right)^2$$

where:

- ν_1 = Required viscosity at operating temperature (mm²/s)
- ν = Viscosity at reference temperature (mm²/s)
- T_1 = Operating temperature (°C)
- T = Reference temperature (°C)

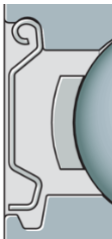
The following steps are recommended for selecting lubrication:

1. Identify the type of bearing and its operating conditions.
2. Calculate the required viscosity.
3. Choose a lubricant that meets the viscosity requirements.
4. Ensure proper lubrication intervals.

4. Bearing Features and Codes

4.1 Bearing Seals

Bearings come with different seals that indicate specific features. Here are some common seal types and their meanings:

Suffix	Type of seal		Seal characteristic			
	+++ = <i>excellent</i> ++ = <i>very good</i> + = <i>good</i> o = <i>satisfactory</i> – = <i>unsatisfactory</i>		Low-friction Running	Water Proof	Dust Retaining ability	Grease retaining ability
–		Open, without seals	+++	–	–	–
Z, 2Z		Non-contact (sheet metal),	++	o	o	o
RZ, 2RZ		Non-contact (elastomer)	++	o	o	o

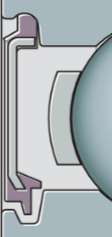
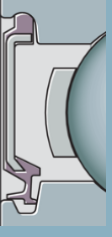
Suffix	Type of seal		Seal characteristic			
	+++ = <i>excellent</i> ++ = <i>very good</i> + = <i>good</i> o = <i>satisfactory</i> – = <i>unsatisfactory</i>		Low-friction Running	Water Proof	Dust Retaining ability	Grease retaining ability
BRS, 2BRS		non-contact (elastomer),	++	o	+	+
HRS, 2HRS		contact (elastomer),	o	++	++	++
RSR, 2RSR		contact (elastomer),	o	+	++	++
ELS, 2ELS		contact (elastomer),	+	++	+++	+++

Table 2 Main Bearing sealing types

Designs can vary according to the rings or application design.

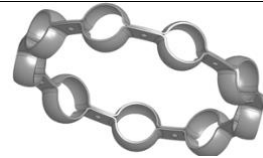
4.2 Bearing Cages

Bearing cages, also known as retainers or separators, play a crucial role in maintaining the proper spacing and alignment of rolling

elements within bearings. Different types of cages are designed to accommodate various operational requirements and environmental conditions.

4.2.1. Steel Cages

Steel cages are commonly used in high-speed applications due to their durability and strength. They ensure reliable performance under demanding loads, making them suitable for various industrial applications. Steel cages can withstand high temperatures and are resistant to deformation under heavy loads.



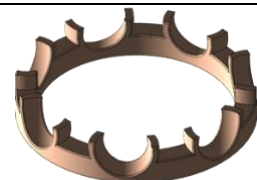
4.2.2. Brass Cages

Brass cages are prized for their corrosion resistance and ability to operate at high temperatures. These cages are ideal for industrial settings where heat and moisture are prevalent. Brass cages also provide excellent wear resistance, contributing to the longevity of the bearing.



4.2.3. Polymer Cages

Polymer cages offer noise reduction and vibration damping benefits, making them suitable for applications requiring quiet operation and minimal friction. These cages are lightweight and can operate in a wide range of temperatures, although they may not be as strong as metal cages. Polymer cages are often used in precision instruments and household appliances.



4.2.4. Phenolic Resin Cages

Phenolic resin cages are known for their lightweight properties and excellent wear resistance. They perform well in high-speed applications and have good chemical resistance. These cages are often used in aerospace and high-precision bearings due to their stability and low friction characteristics.



4.2.5. Nylon Cages

Nylon cages are a type of polymer cage known for their flexibility and shock absorption properties. They are resistant to many chemicals and have a low coefficient of friction, which helps in reducing wear and extending the bearing life. Nylon cages are commonly used in automotive applications and electric motors.



4.3 Bearing Precision Level

Bearing Precision Level Table

Precision Class	Dimension Range (mm)	Dimensional Tolerances (μm)	Radial Runout (μm)	Axial Runout (μm)
ABEC 1 / ISO P0 / DIN P0	0 - 18	±10	≤15	≤15
	18 - 30	±12	≤18	≤18
	30 - 50	±15	≤20	≤20
	50 - 80	±20	≤25	≤25
	80 - 120	±25	≤30	≤30
	120 - 150	±30	≤35	≤35
	150 - 180	±35	≤40	≤40
	180 - 250	±40	≤45	≤45
	250 - 315	±50	≤50	≤50
ABEC 3 / ISO P6 / DIN P6	0 - 18	±8	≤10	≤10
	18 - 30	±9	≤12	≤12
	30 - 50	±11	≤13	≤13
	50 - 80	±13	≤15	≤15
	80 - 120	±15	≤18	≤18
	120 - 150	±18	≤20	≤20
	150 - 180	±20	≤23	≤23
	180 - 250	±23	≤25	≤25
	250 - 315	±28	≤28	≤28
ABEC 5 / ISO P5 / DIN P5	0 - 18	±5	≤7	≤7
	18 - 30	±6	≤8	≤8
	30 - 50	±7	≤9	≤9
	50 - 80	±8	≤10	≤10
	80 - 120	±10	≤12	≤12
	120 - 150	±12	≤13	≤13
	150 - 180	±13	≤15	≤15
	180 - 250	±15	≤17	≤17
	250 - 315	±18	≤20	≤20
ABEC 7 / ISO P4 / DIN P4	0 - 18	±3	≤4	≤4
	18 - 30	±4	≤5	≤5
	30 - 50	±5	≤6	≤6
	50 - 80	±6	≤7	≤7
	80 - 120	±8	≤8	≤8
	120 - 150	±9	≤10	≤10
	150 - 180	±10	≤12	≤12
	180 - 250	±12	≤13	≤13
	250 - 315	±15	≤15	≤15
ABEC 9 / ISO P2 / DIN P2	0 - 18	±2	≤2	≤2
	18 - 30	±3	≤3	≤3
	30 - 50	±4	≤4	≤4
	50 - 80	±5	≤5	≤5
	80 - 120	±6	≤6	≤6
	120 - 150	±7	≤7	≤7
	150 - 180	±8	≤8	≤8
	180 - 250	±9	≤9	≤9
	250 - 315	±10	≤10	≤10
	315 - 400	±12	≤12	≤12

Table 3 precision level and parameters according to bearing sizes

Descriptions of Tolerance Classes

ABEC 1 / ISO P0 / DIN P0: General-purpose bearings with standard tolerances suitable for most applications where high precision is not critical. Typical uses include household appliances and light machinery.

ABEC 3 / ISO P6 / DIN P6: Bearings with higher precision than general-purpose bearings, providing better performance in terms of accuracy and speed. Suitable for industrial applications such as conveyors and gearboxes.

ABEC 5 / ISO P5 / DIN P5: High-precision bearings used in applications requiring superior performance, such as high-speed

machinery, electric motors, and pumps. These bearings offer lower friction and longer life.

ABEC 7 / ISO P4 / DIN P4: Precision bearings designed for demanding applications with high accuracy requirements, including machine tool spindles and high-speed instruments. These bearings provide excellent performance with minimal runout.

ABEC 9 / ISO P2 / DIN P2: Ultra-precision bearings used in the most critical applications where the highest accuracy and minimal runout are essential. Common in aerospace, medical devices, and high-precision instrumentation.

4.4 Bearing Noise and Vibrations

Bearings are classified based on their vibration levels. Here are some common noise vibration levels for the main bearings types:

Bearing Type	Z-Level (Noise)	Noise Level (dB)	V-Level (Vibration)	Vibration Level (µm/s)
Deep Groove Ball Bearings (DGBB)	Z1 - Standard	30-40	V1 - Standard	6-12
	Z2 - Improved	25-35	V2 - Improved	4-8
	Z3 - High Precision	< 25-30	V3-High Precision	2-4
Spherical Roller Bearings (SRB)	Z1 – Standard	35-45	V1 - Standard	8-16
	Z2 - Improved	30-40	V2 - Improved	6-10
	Z3 - High Precision	30-40	V3 - High Precision	4-8
Tapered Roller Bearings (TRB)	Z1 - Standard	35-45	V1 - Standard	6-12
	Z2 - Improved	30-40	V2 - Improved	5-10
	Z3 - High Precision	30-40	V3 - High Precision	4-8
Angular Contact Ball Bearings (ACBB)	Z1 - Standard	30-40	V1 - Standard	5-10
	Z2 - Improved	25-35	V2 - Improved	3-6
	Z3 - High Precision	< 25-30	V3 - High Precision	2-4

Table 4 Typical noise and vibration levels for different kind of bearings

4.5 Bearing Clearance

Bearing clearance refers to the internal clearance between the bearing's inner and outer rings. Here are some common clearance levels:

- **CN:** Normal internal clearance
- **C2:** Less than normal internal clearance
- **C3:** Greater than normal internal clearance
- **C4:** Greater than C3 internal clearance
- **C5:** Greater than C4 internal clearance

Nominal bore diameter d		Radial bearing clearance in μm							
		C2		CN		C3		C4	
Over	Includ.	min.	Max.	min.	Max.	min.	Max.	min.	Max.
1.5	6	0	7	2	13	8th	23	—	—
6	10	0	7	2	13	8th	23	14	29
10	18	0	9	3	18	11	25	18	33
18	24	0	10	5	20	13	28	20	36
24	30	1	11	5	20	13	28	23	41
30	40	1	11	6	20	15	33	28	46
40	50	1	11	6	23	18	36	30	51
50	65	1	15	8	28	23	43	38	61
65	80	1	15	10	30	25	51	46	71
80	100	1	18	12	36	30	58	53	84
100	120	2	20	15	41	36	66	61	97
120	140	2	23	18	48	41	81	71	114
140	160	2	23	18	53	46	91	81	130
160	180	2	25	20	61	53	102	91	

Table 5 radial clearance classes

Radial clearance has nothing to do with precision grade or tolerance. A loose bearing does not necessarily mean a low precision bearing. You can have a P4 (Abec7) grade bearing with a loose radial clearance just as you can have a P0 (Abec1) bearing with a tight radial clearance so too much clearance suggests a tighter radial play or an axial preload is needed.

In low noise or high speed applications, zero residual radial clearance is desirable. This gives greater rigidity, reduces noise, gives greater running accuracy and can eliminate ball skidding under acceleration. This is achieved by applying a **preload** to the bearing. This is an axial load applied to the inner or outer ring to offset the outer ring against the inner ring and eliminate radial clearance.

Preload is usually applied by the use of wave or spring washers and normally to the

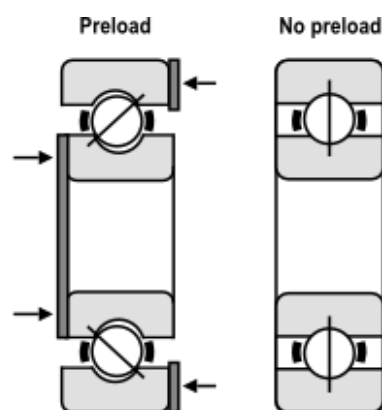


Figure 1 Preload visual explanation

stationary ring which should have a sliding fit to the shaft or housing to allow for axial movement. If the bearings are glued on to the shaft or housing, it may be possible to use weights to keep the bearing preloaded while the adhesive cures. The amount of preload should be as small as possible. Excessive preload can cause high frictional torque and rapid failure.

Preload Category	Preload Amount Miniature & Small Bearing (Cr = Basic Dynamic Load Rating)	Preload Amount Standard Bearing (Cr = Basic Dynamic Load Rating)	Features
Slight Preload	0.50% x Cr	0.15% x Cr	Bearing rigidity not required. Emphasis on low torque.
Light Preload	1.25% x Cr	0.58% x Cr	Bearing rigidity and low torque both required.
Medium Preload	1.75% x Cr	1.28% x Cr	Emphasis on bearing rigidity. Relatively high torque.
Heavy Preload	2.50% x Cr	2.64% x Cr	Emphasis on bearing rigidity. High torque.

Table 6 Preload typical values

4.6 Bearing applied Preload

Bearing preload is the process of applying a continuous load to a bearing to eliminate clearance and increase stiffness. Preloading can improve the performance and life of a bearing by reducing vibration, increasing

rigidity, and improving rotational accuracy. The following graph shows the qualitative relationship between bearing life and preload:

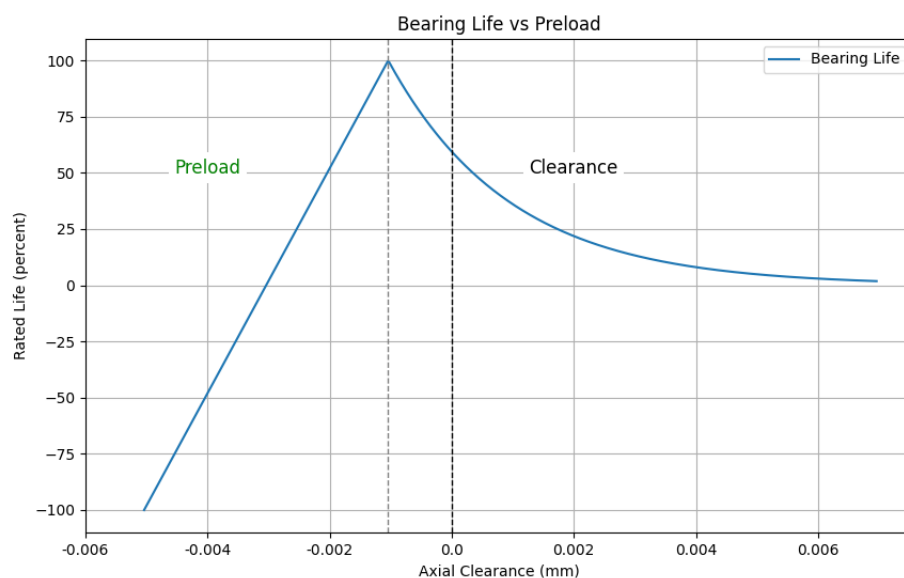


Figure 2 typical value of preload vs bearing life

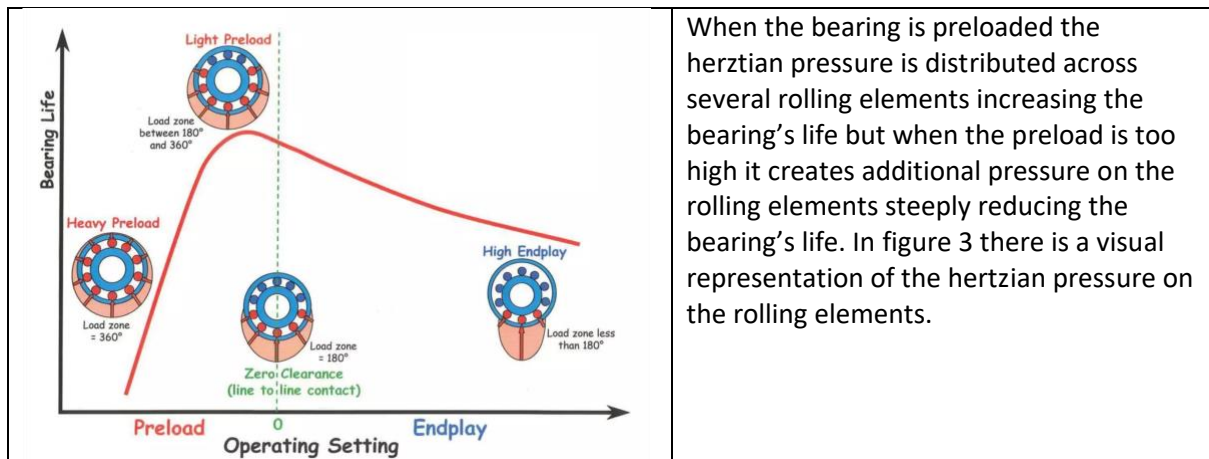


Figure 3 Qualitative Preload vs Bearing life with qualitative hertzian pressure distribution

Even though the operating clearance should (theoretically) ideally be slightly negative in order to achieve maximum bearing life, in practical everyday life under normal operating conditions, operating clearance is usually targeted at just above zero. The reason for this is that this negative operating clearance (preload) could increase if a rolling bearing is exposed to changing operating conditions. This would in turn lead to increased surface pressure, extremely high heat generation and an important shortening of the bearing service life.

To calculate the operating clearance, factors such as fits as well as temperature differences that occur between the inner and outer ring must be taken into account.

4.7 Bearing Installation Instructions

Installing a Bearing on a Shaft

Clean the Shaft and Bearing: Ensure that the shaft and the inner ring of the bearing are clean and free of any debris or contamination.

Check the Fit: Verify that the shaft diameter is within the tolerance range specified for the bearing.

Heat the Bearing (if necessary): If a tight fit is required, gently heat the bearing to approximately 80-100°C (176-212°F) to expand the inner ring. Use an induction heater or an oil bath, and avoid open flames.

Mount the Bearing: Align the bearing with the shaft and slide it into position. If the bearing is heated, allow it to cool and shrink onto the shaft for a secure fit. Always press on the inner ring to mount the bearing with interference on the shaft.

Secure the Bearing: Use appropriate retaining devices such as lock nuts, snap rings, or set screws to secure the bearing in place.

Installing a Bearing in a Housing

Clean the Housing: Ensure that the housing bore and the outer ring of the bearing are clean and free of any debris or contamination.

Check the Fit: Verify that the housing bore diameter is within the tolerance range specified for the bearing.

Chill the Bearing (if necessary): If a tight fit is required, chill the bearing using dry ice or a refrigerant spray to contract the outer ring.

Mount the Bearing: Align the bearing with the housing bore and press it into position using a bearing press or a soft mallet. Apply force evenly to avoid damaging the bearing. Always press on the Outer ring when mounting a bearing with interference on the outer ring.

Secure the Bearing: Use appropriate retaining devices such as housing

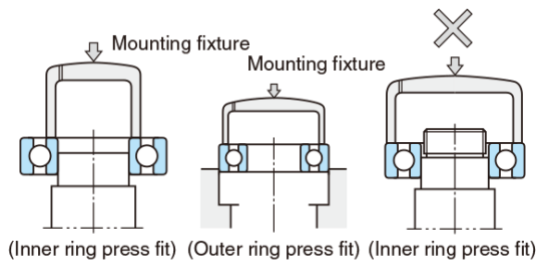


Figure 4 Bearing mounting Dos and don'ts

4.8 Bearing tolerances

Dimensional tolerances are critical in the performance of bearings applications, as they ensure the precise fit and function of each component within a mechanical system. These tolerances refer to the allowable variation in size and shape of bearing parts, such as the inner and outer diameters, width, and raceway geometry. Ensuring tight tolerances in bearings allows for smooth operation, reduced friction, and improved lifespan under varying loads and speeds.

Bearings are manufactured to standardized tolerance classes, which classify bearings by their precision levels (P0, P6, P5, P4, etc.). Higher precision classes, such as P5 and P4, are typically used in applications requiring extreme accuracy, such as high-speed spindles and precision instruments, while standard classes like P0 are used in general applications.

The most commonly measured dimensions include:

- Outer Diameter (OD): The bearing's external dimension, crucial for proper fit in housing.
- Inner Diameter (ID): Ensures the bearing's compatibility with the shaft.
- Width: Dictates axial space requirements and impacts load distribution.

Taking into account these tolerances ensures reliable performance, prevents premature

wear, and allows the bearing to withstand the operational demands of various machinery. Careful selection based on dimensional

tolerances is essential for achieving optimal performance in any engineering application.

Nominal Bore or Outside Diameter mm		Ddmp Single plane mean ID deviation		DDmp Single plane mean OD Deviation*		DBs Inner ring width deviation		DCS Outer ring width deviation	
Over	Incl.	Max	Min	Max	Min	Max	Min	Max	Min
2.5	6	0	-8	-	-	0	-120	0	-240
6	18	0	-8	0	-8	0	-120	0	-240
18	30	0	-10	0	-9	0	-120	0	-240
30	50	0	-12	0	-11	0	-120	0	-240
50	80	0	-15	0	-13	0	-150	0	-300
80	120	0	-20	0	-15	0	-200	0	-400
120	150	0	-25	0	-18	0	-200	0	-450
150	180	0	-25	0	-25	0	-250	0	-500
180	250	0	-30	0	-30	0	-300	0	-600
250	315	0	-35	0	-35	0	-350	0	-700
315	400	0	-40	0	-40	0	-400	0	-800

Table 7 ISO Dimensional tolerances for bearings except taper-roller bearings

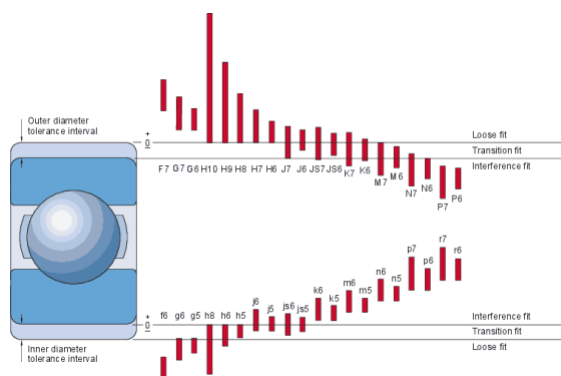


Figure 5 fitting table

4.9 Bearing fitting and mounting

The most important factors to be considered when selecting bearing fits are as follows:

4.9.1 Conditions of rotation – The conditions of rotation refer to the direction of the load in relation to the bearing rings.

If the bearing ring rotates and the load is stationary, or if the ring is stationary and the load rotates so that all points on the raceway are loaded in the course of one revolution, the load on the ring is defined as a rotating load. Heavy oscillating loads such as apply to the outer rings of connecting rod bearings are generally considered as rotating loads.

If the bearing ring is stationary and the load is also stationary, or if the ring and load rotate at the same speed so that the load is always directed toward the same point on the raceway, the load on the ring is defined as a 'stationary load'.

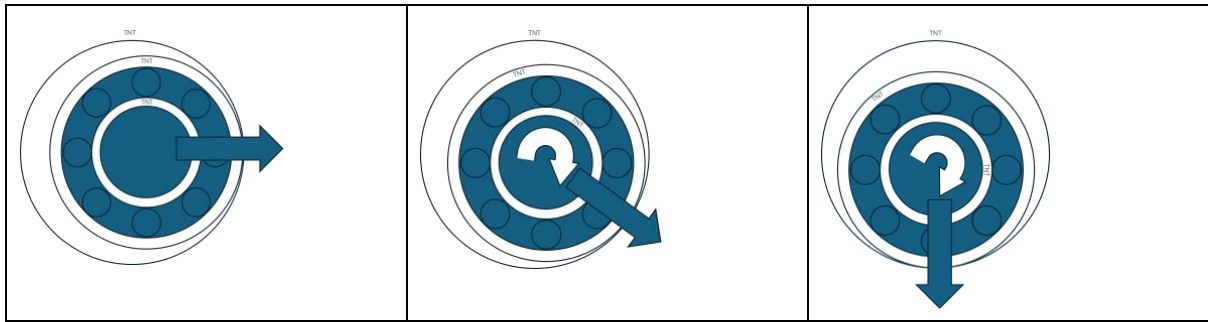


Figure 6 Example of rotating inner ring with load rotating at the same speed of the inner ring

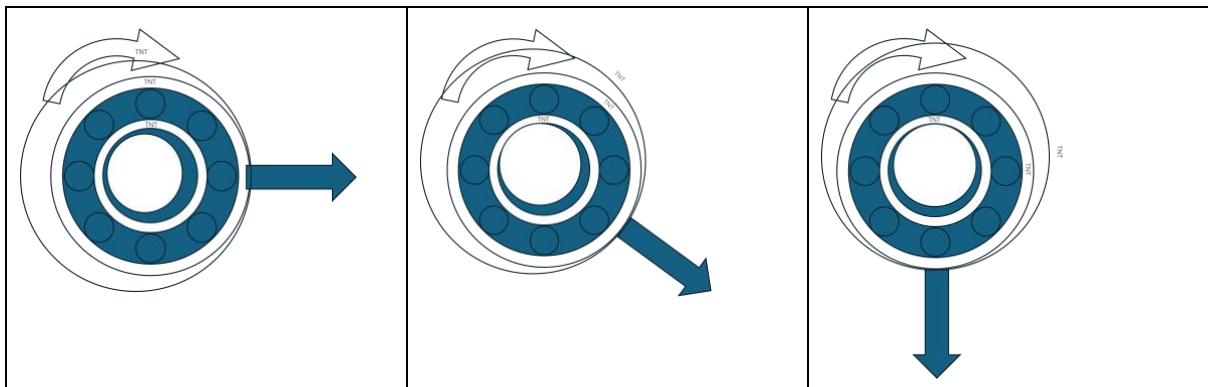


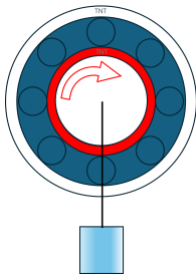
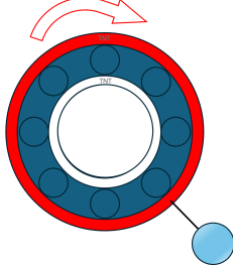
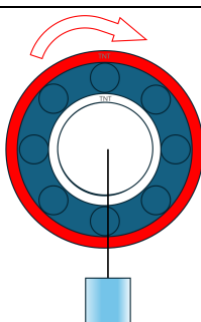
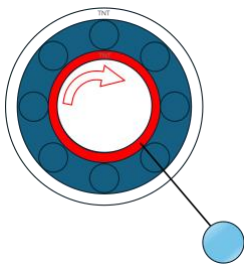
Figure 7 Example of rotating Outer ring with load rotating at the same speed of the outer ring. Outer ring is loose on its seat

A bearing ring subjected to a rotating load will creep on its seating if mounted with a clearance fit, and wear of the contacting surfaces will occur (fretting corrosion). To prevent this, an interference fit should be used. The degree of interference required is dictated by the operating conditions referred to below in the notes on internal clearance and temperature conditions. A bearing ring subjected to a stationary load will not normally creep on its seating and an interference fit is not therefore necessary unless dictated by other requirements of the application.

Variable external loading, shock loading, vibrations and out of balance forces in high speed machines, giving rise to changes in the direction of the load which cannot be

accurately established, are classified under the term 'direction of load indeterminate'.

When the direction of loading is indeterminate, and particularly where heavy loading is involved, it is desirable that both rings have an interference fit. For the inner ring the fit recommended for a rotating inner ring is normally used. However, when the outer ring must be axially free in its housing or if the loading is not heavy a somewhat looser fit than that recommended for rotating loads may be used.

Schema	Loading Condition	Example	Load Case	Fitting
	Rotating Inner Ring Stationary Outer Ring Load in a fixed direction	Shaft Loaded by its own mass	Rotating Load for inner ring Stationary Load for Outer Ring	Inner Ring: Necessary Press Fit Outer Ring: Loose fit admitted
	Stationary Inner Ring Rotating Outer ring Rotating load together with Outer ring	Unbalanced hub, rader	Rotating Load for inner ring Stationary Load for Outer Ring	Inner Ring: Necessary Press Fit Outer Ring: Loose fit admitted
	Stationary Inner Ring Rotating Outer ring Load in a fixed direction	Car Wheel, Pulley	Stationary Load for Inner Ring Rotating Load for Outer Ring	Inner Ring: Admitted Loose fit Outer Ring: Necessary Press Fit
	Rotating Inner Ring Stationary Outer ring Rotating load together with Inner ring	Washing Machine	Stationary Load for Inner Ring Rotating Load for Outer Ring	Inner Ring: Admitted loose fit Outer Ring: Necessary Press Fit

4.9.2 Magnitude of the load – The load on a bearing inner ring causes it to expand resulting in an easing of the fit on the seating; under the influence of a rotating load, creep may then develop. The amount of interference between the ring and its seating must therefore be related to the magnitude of the load: the heavier the load the greater the interference required.

4.9.3 Internal clearance – When bearing rings are mounted with an interference fit, the bearing radial internal clearance is reduced because of the expansion of the inner ring and/or contraction of the outer ring. A certain minimum clearance should however remain. The initial clearance and permissible reduction depend on the type and size of bearing. The reduction in clearance due to the interference fit can be such that bearings with radial internal clearance greater than normal may be necessary.

4.9.4 Temperature conditions – In service, the bearing rings normally reach a higher temperature than the component parts to which they are fitted. This can result in an easing of the fit of the inner ring on its seating or alternatively the outer ring may expand and take up its clearance in the housing thereby limiting its axial freedom. Temperature differentials and the direction of heat flow must therefore be carefully considered in selecting fits.

4.9.5 Requirements regarding running accuracy – Where bearings are required to have a high degree of running accuracy, elastic deformation and vibration must be minimized and clearance fits avoided. Bearing seatings on shafts should be at least to tolerance IT5 and housing seatings to tolerance IT6. Accuracy of form (ovality and taper) is also very important and deviations from true form should be as small as possible.

4.9.6 Design and material of shaft and housing – The fit of the bearing ring on its seating must not lead to uneven distortion (out of round) of the bearing ring, which may for example be caused by surface irregularities of the seatings. Split housings are not suitable when outer rings are to have an interference fit and the limits of tolerance selected should not give a tighter fit than that obtained when tolerance groups H or J apply. To ensure adequate support for bearing rings mounted in thin walled housings, in light alloy housings or on hollow shafts, heavier interference fits must be used than would normally be selected for thick walled steel or cast iron housings or solid shafts.

4.9.7 Ease of mounting and dismounting – Bearings having clearance fits are preferred for many applications to facilitate installation and removal. When operating conditions necessitate the use of interference fits and ease of mounting and dismounting is also essential, separate bearings or bearings having a tapered bore and an adapter or withdrawal sleeve can often provide a solution.

4.9.8 Displacement of a non-locating bearing – When a non-separable bearing is used at the non-locating position, it is necessary that under all conditions of operation one of the rings is free to move axially. This is ensured by using a clearance fit for that ring which carries a stationary load. Where for example, light alloy housings are used, it may sometimes be necessary to fit a hardened intermediate bush between the outer ring and the housing. If certain types of cylindrical roller bearings, or where needle roller bearings are used at the non-locating position, then both inner and outer rings can be mounted with an interference fit.

5 Lubrication and Lubricants Selection

5.1 Oil vs Grease Lubrication

The main lubricants in bearings are Oil and Grease. The key differences between grease and oil lubrication for bearings lie in their composition, application, and performance characteristics:

5.1.1 Composition:

- **Grease** is a semi-solid lubricant made of oil and a thickening agent (usually soap-based). It also often contains additives to enhance performance under specific conditions.
- **Oil** lubrication consists of a liquid lubricant, typically mineral or synthetic oils, without thickening agents. It may also include additives to improve performance, such as anti-wear or anti-oxidant agents.

5.1.2 Application:

- **Grease** is preferred for bearings that operate at moderate speeds and do not require frequent re-lubrication. It is commonly used in pre-lubricated, sealed, or shielded bearings, where maintenance access is limited, or in environments where the lubrication system needs to be simple.
- **Oil** is typically used in applications with higher speeds, temperatures, or loads, as it flows more easily and provides better heat dissipation. It is often applied in systems with circulating oil baths, oil mist, or oil drip lubrication methods, and can be replenished more easily in continuous operation settings.

5.1.3 Lubrication Life:

- **Grease** tends to last longer than oil in sealed or semi-sealed applications, as it doesn't leak or evaporate as quickly. However, it can become ineffective if it dries out or is contaminated.
- **Oil** may require more frequent changes or replenishments due to evaporation, contamination, or degradation at high temperatures. However, it is easier to replace or filter during maintenance.

5.1.4 Friction and Wear Protection:

- **Grease** provides better protection in terms of sealing out contaminants like dust and water because of its thicker consistency. However, it may generate more friction than oil in high-speed applications, leading to higher temperatures and energy consumption.
- **Oil** provides better lubrication for high-speed applications by reducing friction more effectively and dissipating heat more efficiently. It is also better for applications with higher loads where fluid film lubrication is crucial.

5.1.5 Heat Dissipation:

- **Grease:** Due to its semi-solid nature, grease does not dissipate heat as effectively as oil. In high-speed or high-temperature applications, grease can harden, potentially leading to bearing failure.
- **Oil:** is more effective at dissipating heat, especially in systems where the oil is circulated and cooled, making it suitable for high-speed, high-temperature operations.

5.1.6 Sealing Requirements:

- Grease: Requires simpler sealing systems because it is less likely to leak compared to oil. Grease seals are more robust in preventing contamination and leakage in dusty or wet environments.
- Oil: Requires more complex sealing arrangements to prevent leaks and keep contaminants out, especially in high-speed or high-temperature environments.

5.1.7 Maintenance:

- Grease: Grease-lubricated bearings are typically low-maintenance, requiring less frequent re-lubrication, especially in sealed or shielded systems.
- Oil: Oil-lubricated systems require more frequent monitoring and maintenance, including oil level checks, filtering, and replenishment.

In summary, grease is favored for simplicity, longevity, and moderate-speed operations, whereas oil is preferred for high-speed, high-temperature, or heavy-load applications where better cooling and lubrication efficiency are required.

Lubrication Method	Grease Lubrication	Oil Lubrication
Handling	◎ (Very Good)	△ (Fair)
Reliability	○ (Good)	◎ (Very Good)
Cooling effect	× (Poor)	○ (Good) (Circulation necessary)
Seal structure	◎ (Very Good)	△ (Fair)
Power loss	○ (Good)	△ (Fair)
Environmental contamination	○ (Good)	△ (Fair)
High speed rotation	× (Poor)	○ (Good)

Table 8 Summary of Oil and grease properties

5.2 Grease Lubrication and its component

Grease lubricants are easy to handle and typically require only simple sealing mechanisms. Because of this, grease is the most commonly used lubricant for rolling bearings. It is often used in pre-sealed bearings (sealed or shielded), but if using unsealed bearings, the bearing and housing should be filled with an appropriate amount of grease, with regular replenishment or replacement

In sealed bearings, the correct amount of grease generally prevents leakage. However, in certain conditions, such as environments with significant vibration (which can cause grease to move more freely) or high-speed outer ring rotation (which applies large centrifugal forces on the grease), there may be rare cases where the grease might leak.

Lubricating grease is typically made from either a mineral or synthetic base oil. To this base, a thickening agent and various additives are incorporated. The characteristics of grease are determined primarily by the type of base oil, the combination of thickening agents, and the additives used. Table 11 provides general grease varieties, characteristics, and brand-specific properties. It's important to check the manufacturer's specifications when selecting grease, as the performance of greases from different brands can vary widely, even for the same type.

5.2.1. Base Oil

The base oil used in grease can either be mineral oil or synthetics such as ester oil, synthetic hydrocarbon oil, or ether oil.

- Low viscosity base oils are more suitable for low-temperature and high-speed applications.
- High viscosity base oils are better for high-temperature or heavy-load applications due to their superior performance in these conditions.

5.2.2. Thickening Agents

Thickening agents are mixed with base oils to keep the grease in a semi-solid state. They can be classified into two broad categories:

- Metallic soaps: Include lithium, sodium, calcium, etc.
- Non-soaps: These are further divided into:
 - Inorganic: Such as silica gel and bentonite.
 - Organic: Such as polyurea and fluorocarbon.

The thickening agent largely determines the grease's specific characteristics, such as its temperature limits, mechanical stability, and water resistance.

-Sodium-based greases tend to have poor water resistance.

-Non-metallic soap thickeners, such as bentone or polyurea, typically perform well in high-temperature conditions.

5.2.3. Additives

Additives are used in grease formulations to enhance performance for specific applications. Common types of additives include:

- Antioxidants: Prevent oxidation and prolong the life of the grease.
- Extreme Pressure (EP) Additives: Improve grease performance under high-load or shock-load conditions.
- Rust and Corrosion Preventatives: Protect the bearing surfaces from corrosion and rust.

For bearings subjected to heavy or shock loads, greases with EP additives are recommended, while antioxidants are commonly used in most rolling bearings.

5.2.4. Consistency

Consistency refers to the hardness and fluidity of the grease, measured by its NLGI (National Lubricating Grease Institute) number.

- A higher NLGI number indicates harder grease.

-Greases used for rolling bearings typically have NLGI consistency numbers of 1, 2, or 3, with higher numbers reflecting a stiffer grease.

This consistency is critical in determining the appropriate grease for a given application, as it affects the ability to flow and lubricate effectively under various conditions.

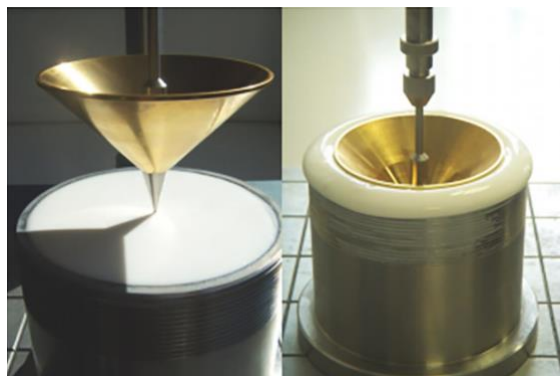


Figure 8 viscosity measuring device

NLGI Consistency No.	JIS (ASTM) 60 Times Blend Consistency	Application
0	355 to 385	For centralized greasing use
1	310 to 340	For centralized greasing use
2	265 to 295	For general use and sealed bearing use
3	220 to 250	For general use, high temperature use, and sealed bearing use
4	175 to 205	For special use

Table 9 Grease consistency classification

Category	Soap-based						Non-soap-based			
Type	Lithium (Li) grease		Calcium (Ca) grease		Sodium (Na) grease		Organic		Inorganic	
Thickening agent	Li soap	Li complexed soap	Ca soap	Ca complexed soap	Na soap	Na complexed soap	Urea	Urea	PTFE	Silica gel
Base oil	Mineral oil	Ester oil	Silicone oil	Mineral oil	Mineral oil	Mineral oil	Synthetic oil	Fluorinated oil	Fluorinated oil	Ester oil
Dropping point (°C)	170 to 190	170 to 190	200 to 210	>250	80 to 100	200 to 280	170 to 200	>260	None	>260
Operating temperature range (°C)	-30 to 120	-50 to 130	-50 to 160	-30 to 130	-20 to 70	-20 to 130	-30 to 140	-40 to 180	-40 to 250	-70 to 150
Mechanical stability	Good	Good	OK	Good	Poor	Good	Good to Excellent	Good to Excellent	OK to Good	Good
Pressure resistance	Good	Good	Poor	Good	OK	Good to Excellent	Good to Excellent	Good to Excellent	Good	Good
Water resistance	Good	Good	Good	Good	Poor	Good to Excellent	Good to Excellent	Good to Excellent	Good	Good
Characteristics Application	Balanced performance with less disadvantages	All purpose grease	Excellent low temperature and wear characteristics	Suitable for miniature and small size ball bearings	Poor load resistance	Balanced performance with less disadvantages	Usable for relatively high temperature	Used for low speed and light loads	Excellent pressure resistance	Some emulsification when water is introduced

Brand	Thickener	Base Oil	Base Oil Visc mm ² /s (40°C)	Base Oil Visc mm ² /s (100°C)	Consistency	NLGI No.	Dropping Point °C	Operating Temp °C	Characteristics
Alvania Grease S2	Li soap	Mineral oil	131	12.2	283	2	181	-25 to 120	All-purpose (standard grease for deep groove ball bearings)
Alvania Grease S3	Li soap	Mineral oil	131	12.2	242	3	182	-20 to 135	All-purpose (standard grease for ball bearings of bearing units)
Alvania EP Grease 2	Li soap	Mineral oil	220	15.9	284	2	184	-20 to 110	Heavy load all-purpose
Multemp PS No. 2	Li soap	Ester + PAO	15.9	—	270	2	190	-50 to 130	For low temperature and low torque
Multemp SRL	Li soap	Ester	24.1	—	250	2 to 3	192	-40 to 150	All-purpose (standard grease for small size ball bearings)
SH44M	Li soap	Silicone	80	19	260	2 to 3	204	-40 to 160	For high temperature
ISOFLEX NBU15	Ba complexed soap	Diester + mineral oil	23	5	280	2	220 or above	-40 to 130	For high speed
SHC POLYREX 462	Urea	PAO	460	40	280	2	270	-20 to 170	For food machinery
SE-1	Urea	PAO + ester	22	5	265	2	220 or above	-50 to 120	For high speed
ME-1	Urea	Ester + PAO	61.3	9.3	231	3	250 or above	-30 to 160	For high temperature and high speed
EP-1	Urea	PAO	46.8	—	220	3	260 or above	-40 to 160	For high temperature and high speed
NA103A	Urea	PAO + ether	53.5	—	270	3	260 or above	-40 to 180	Brittle separation
MP-1	Urea	Synthetic oil	40.6	7.1	243	3	250 or above	-40 to 150	For high temperature and high speed
Grease J	Urea	Ester	75	10	305	1 to 2	280 or above	-20 to 180	For high temperature
Cosmo Wide Grease WR3	Na terephthalate	Diester + mineral oil	31.6	6	238	3	230 or above	-40 to 150	For low temperature to high temperature, all-purpose
Mobilgrease 28	Bentonite	PAO	30.0	5.7	293	1 to 2	307	-54 to 177	MIL-PRF-81322, for low temperature to high temperature
Aeroshell Grease 7	Microgel	Diester	10.3	3.1	296	1 to 2	260 or above	-73 to 149	MIL-PRF-23827C

Table 11 Selected commercial greases and their properties

Table 10 Summary of different Grease components and properties

5.3 Oil lubrication

Oil lubrication is suitable for applications requiring that bearing-generated heat or heat applied to the bearing

from other sources be carried away from the bearing and dissipated to the outside. Table 12 shows the main methods of oil lubrication.

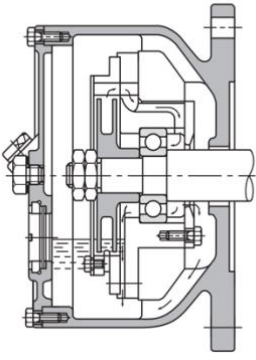
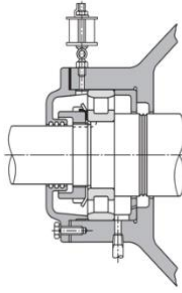
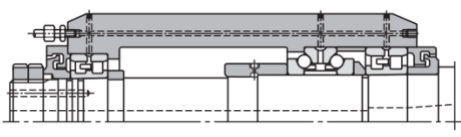
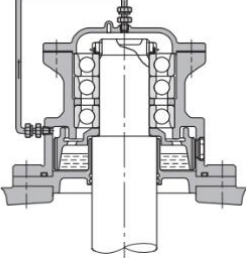
Lubrication Method	Example	Lubrication Method	Example
Oil bath lubrication	- Oil bath lubrication is the most commonly used lubrication method, suitable for low to moderate rotational speed applications. - For horizontal shaft applications, oil level should be maintained at approximately the center of the lowest rolling element. - For vertical shafts, oil level should be 50% to 80% of rolling element submersion.		Disc lubrication
Drip lubrication	- Oil is collected above the bearing and drips down, becoming a mist as it strikes the rolling elements. - Used for light to normal loads at relatively high speeds. - Oil volume is a few drops per minute.		Air-oil lubrication
Oil spray lubrication	- An impeller or similar device mounted on the shaft draws up oil and sprays it onto the bearing. - This method is suitable for considerably high speeds.		Oil mist lubrication
Circulating lubrication	- Used for cooling or automatic systems where oil is centrally located. - Filters maintain purity, and inlets and outlets are required for thorough lubrication.		Oil jet lubrication

Table 12 oil lubrication methods

5.3.1 Selection of lubricating Oil

Under normal operating conditions, machine oil, turbine oil, and other **mineral oils** are widely used for the lubrication of rolling bearings. However, for temperatures below - 30 °C or above 150 °C, **synthetic oils** such as ester oil, silicone oil, and fluorinated oil are used. For lubricating oils, viscosity is one of the most important properties and determines an oil's lubricating efficiency. If viscosity is too low, formation of the oil film will be insufficient, and damage to the rolling surface will occur. If viscosity is too high, viscous resistance will also be great, resulting in temperature increase and friction loss. In general, for higher speed applications, a lower viscosity oil should be used; for heavier load applications, a higher viscosity oil should be used. Lubrication of rolling bearings requires viscosity shown in Table 13, which is dependent on the use conditions. For more information on the oil selection please refer to TNT Engineering team.

Bearing Type	Dynamic Viscosity mm ² /s
Ball bearings, Cylindrical roller bearings, Needle roller bearings	13 or above
Spherical roller bearings, Tapered roller bearings, Thrust needle roller bearings	20 or above
Thrust spherical roller bearings	30 or above

Table 13 Recommended oil viscosity



TNT PRODUCT RANGE

While we present here a selection of our most widely used bearings, we are always happy to make special designs for our clients.

For further queries or comments do not hesitate to contact TNT Engineering team.

6 Deep Groove Ball Bearings (DGBB) and Angular Contact Ball Bearings (ACBB)

Ball bearings are essential components in a wide range of machinery and equipment. They facilitate smooth rotation by reducing friction between moving parts, allowing for efficient operation and longevity of the machinery. Ball bearings are characterized by their design, which includes an inner ring, an outer ring, and a set of rolling elements (balls) that distribute loads and reduce wear. The main types of ball bearings include:

- **Deep Groove Ball Bearings (DGBB):** Suitable for high-speed and high-load applications, these bearings can handle radial and axial loads in both directions.
- **Angular Contact Ball Bearings (ACBB):** Designed to handle both radial and axial loads, these bearings are used in applications where high precision and rigidity are required.
- **Thin Section Bearings:** These bearings have a smaller cross-section than standard bearings, making them ideal for applications with limited space and weight constraints.
- **Super Precision Bearings:** These bearings are designed for high precision applications, offering high speed, accuracy, and rigidity.

6.1 General Specifications

- **Material:** High-quality bearing steel
- **Bore Diameter:** 1 mm to 145 mm
- **Outer Diameter:** 3 mm to 240 mm
- **Width:** 1 mm to 200 mm
- **Load Capacity:** Dynamic and static load capacities available
- **Sealing:** See paragraph 4.1
- **Cages:** Steel, brass, or plastic

6.2 Features and Benefits

- High load-carrying capacity
- Ability to bear axial and radial load
- Low friction and high-speed performance
- Long service life with low maintenance
- Versatile for various applications
- High precision and reliability
- Available in a wide range of sizes and designs

6.3 Typical Applications

Electric Motors and Generators: Deep groove ball bearings (DGBB) are essential in electric motors and generators, where they provide high-speed performance and low friction, enabling efficient energy conversion. Their ability to handle both radial and axial loads ensures smooth, reliable operation, making them ideal for a wide range of motor-driven applications, from industrial machinery to power generation systems. Their durability and low maintenance needs help enhance motor efficiency and prolong operational life.



Automotive Industry: due to their versatility, high-speed capabilities, and ability to handle both radial and axial loads DGBB are commonly applied in critical components such as wheel hubs, transmissions, alternators, and electric motors, where smooth rotation, low friction, and durability are essential. DGBBs offer a compact design that supports efficient power transmission and reduced energy consumption, making them ideal for automotive systems that require long life and reliable performance under various load and speed conditions.



Industrial Machinery: Deep groove ball bearings (DGBB) are widely used in industrial machinery for applications such as electric motors, pumps, and conveyor systems, where they ensure smooth, high-speed operation and support both radial and axial loads. Their reliability and efficiency make them essential for minimizing downtime and optimizing performance in heavy-duty environments.



Household Appliances: Deep groove ball bearings (DGBB) are commonly used in household appliances like washing machines, vacuum cleaners, and fans, ensuring smooth, quiet operation and durability. Their ability to handle high-speed rotation and moderate loads makes them ideal for improving appliance efficiency and longevity.



Agricultural Machinery: Deep groove ball bearings (DGBB) are widely used in agricultural machinery, such as tractors, harvesters, and plows, where they provide reliable performance under heavy loads and harsh conditions. Their ability to handle both radial and axial loads, combined with resistance to dirt, moisture, and vibrations, makes them ideal for ensuring the smooth and efficient operation of equipment in demanding agricultural environments.



Conveyors and Material Handling Equipment: DGBB high-speed capability, durability, and low maintenance requirements ensure reliable performance in continuous, heavy-duty operations. DGBBs are ideal for reducing friction and wear, optimizing the efficiency and longevity of material handling systems in industries such as manufacturing, mining, and logistics



Pumps and Compressors: DGBB high-speed performance and ability to handle the stresses of fluctuating pressures make them ideal for these applications. DGBBs help reduce friction and energy consumption, contributing to the reliability and longevity of pumps and compressors in industries such as oil and gas, water treatment, and HVAC systems.



Fans and Blowers: Deep groove ball bearings (DGBB) are essential in fans and blowers, providing smooth, high-speed rotation with minimal friction. Their ability to handle both radial and axial loads ensures stable performance under varying airflow pressures. DGBBs contribute to efficient operation, reduced energy consumption, and longer service life in industrial and HVAC applications where consistent air movement is critical.



6.4 Deep Groove Ball bearings Dimensions and key features

6.4.1 Single Row Deep Groove Ball Bearings (DGBB)



Bearing Type	Bore Diameter (mm)	Outer Diameter (mm)	Width (mm)	Dynamic Load Rating (kN)	Static Load Rating (kN)	Speed Limit (RPM)	Mass (g)	Seal Type	Cage Material
603	3	9	3	0.4	0.15	45,000	1	Open	Steel
693	3	8	3	0.38	0.13	45,000	0.8	Open	Steel
623	3	10	4	0.58	0.24	45,000	1.5	Open	Steel
604	4	12	4	0.64	0.29	40,000	2	Open	Steel
624	4	13	5	0.68	0.32	40,000	2.2	Open	Steel
634	4	16	5	0.78	0.37	35,000	3	Open	Steel
605	5	14	5	0.9	0.43	35,000	3.1	Open	Steel
625	5	16	5	1.1	0.55	35,000	4	Open	Steel
635	5	19	6	1.3	0.65	30,000	5.6	Open	Steel
606	6	17	6	1.3	0.65	30,000	6	Open	Steel
626	6	19	6	1.7	0.83	30,000	7	Open	Steel
636	6	22	7	2.0	1.1	28,000	9	Open	Steel
607	7	19	6	1.6	0.8	28,000	7	Open	Steel
627	7	22	7	2.2	1.1	28,000	10	Open	Steel
637	7	26	9	3.0	1.5	25,000	15	Open	Steel
608	8	22	7	2.3	1.2	25,000	12	Open	Steel
628	8	24	8	2.9	1.4	25,000	15	Open	Steel
638	8	28	9	3.2	1.6	25,000	17	Open	Steel
609	9	24	7	2.6	1.4	22,000	15	Open	Steel
629	9	26	8	3.5	1.8	22,000	18	Open	Steel
639	9	30	10	4.0	2.0	22,000	25	Open	Steel
6000	10	26	8	5.0	2.4	24,000	19	Open	Steel
6200	10	30	9	6.1	2.8	22,000	28	2RS	Polyamide
6300	10	35	11	9.5	4.6	19,000	45	2RS	Brass
61700	10	15	4	1.4	0.6	40,000	3	Open	Steel
61800	10	19	5	2.2	0.9	30,000	7	Open	Steel
6001	12	28	8	5.6	2.8	22,000	21	2RS	Brass
6201	12	32	10	7.0	3.4	20,000	34	Z	Steel
6301	12	37	12	11.2	5.5	18,000	54	Z	Polyamide
61701	12	18	4	1.6	0.7	38,000	4	Open	Steel
61801	12	21	5	2.8	1.1	28,000	9	Open	Steel
6002	15	32	9	6.7	3.5	20,000	30	Z	Polyamide
6202	15	35	11	8.3	4.2	18,000	45	2Z	Brass
6302	15	42	13	13.8	6.8	16,000	75	2Z	Steel
61702	15	21	4	2.0	0.9	35,000	5	Open	Steel
61802	15	24	5	3.5	1.3	28,000	10	Open	Steel
6003	17	35	10	7.5	4.2	19,000	37	2Z	Steel
6203	17	40	12	9.5	5.0	17,000	68	Open	Polyamide
6303	17	47	14	16.3	8.5	15,000	105	Open	Brass
61703	17	23	4	2.3	1.1	33,000	6	Open	Steel
61803	17	26	5	4.1	1.5	26,000	12	Open	Steel
6004	20	42	12	9.2	5.8	17,000	68	Open	Brass
6204	20	47	14	12.3	7.8	15,000	128	2RS	Steel
6304	20	52	15	18.9	10.2	14,000	130	2RS	Polyamide
61704	20	27	4	2.6	1.3	30,000	8	Open	Steel
61804	20	32	7	4.9	1.8	25,000	30	Open	Steel
6005	25	47	12	10.7	7.2	15,000	80	2RS	Polyamide
6205	25	52	15	14.5	9.6	14,000	152	Z	Brass
6305	25	62	17	24.8	14.5	12,000	215	Z	Steel
61705	25	32	4	3.0	1.6	28,000	10	Open	Steel
61805	25	37	7	5.6	2.0	23,000	40	Open	Steel
6006	30	55	13	13.8	9.6	14,000	118	Z	Steel
6206	30	62	16	19.0	12.3	12,000	250	2Z	Polyamide
6306	30	72	19	31.0	18.6	11,000	350	2Z	Brass
61706	30	37	4	3.5	2.0	26,000	13	Open	Steel
61806	30	42	7	6.8	2.5	21,000	50	Open	Steel
6007	35	62	14	17.5	12.3	12,000	160	2Z	Brass

Bearing Type	Bore Diameter (mm)	Outer Diameter (mm)	Width (mm)	Dynamic Load Rating (kN)	Static Load Rating (kN)	Speed Limit (RPM)	Mass (g)	Seal Type	Cage Material
6207	35	72	17	23.2	15.8	11,000	348	Open	Steel
6307	35	80	21	37.2	22.8	10,000	470	Open	Polyamide
61707	35	45	5	4.2	2.5	24,000	18	Open	Steel
61807	35	47	7	7.5	3.0	20,000	70	Open	Steel
6008	40	68	15	20.5	14.8	11,000	200	Open	Polyamide
6208	40	80	18	27.7	19.5	10,000	426	2RS	Brass
6308	40	90	23	44.8	27.6	9,000	650	2RS	Steel
61708	40	52	7	5.5	3.5	22,000	35	Open	Steel
61808	40	52	7	8.3	3.5	19,000	80	Open	Steel
6009	45	75	16	24.0	17.8	10,000	250	2RS	Steel
6209	45	85	19	31.8	22.8	9,000	476	Z	Polyamide
6309	45	100	25	52.0	32.8	8,500	800	Z	Brass
61709	45	58	7	6.0	3.8	20,000	40	Open	Steel
61809	45	58	7	9.2	4.0	17,000	100	Open	Steel
6010	50	80	16	28.5	21.0	9,000	280	Z	Brass
6210	50	90	20	36.0	26.2	8,500	526	2Z	Steel
6310	50	110	27	60.5	38.6	8,000	1050	2Z	Polyamide
61710	50	65	7	6.5	4.5	18,000	50	Open	Steel
61810	50	65	7	10.2	9.2	16,000	120	Open	Steel
6211	55	100	21	40.0	29.0	8,000	630	Open	Steel
6311	55	120	29	68.0	42.5	7,000	1300	2RS	Polyamide
61811	55	72	9	11.2	10.8	12,000	170	Open	Steel
6212	60	110	22	45.0	33.5	7,500	800	Open	Steel
6312	60	130	31	76.0	47.5	6,500	1600	Z	Steel
61812	60	78	10	12.3	12.5	11,000	200	Open	Steel
6213	65	120	23	50.5	37.5	7,000	1000	Open	Steel
6313	65	140	33	85.0	52.5	6,000	1950	2RS	Polyamide
61813	65	85	10	13.6	14.2	10,000	240	Open	Steel
6214	70	125	24	54.0	40.0	6,500	1100	Open	Steel
6314	70	150	35	90.0	56.0	5,500	2300	Z	Steel
61814	70	90	10	14.8	15.8	9,000	260	Open	Steel
6215	75	130	25	57.5	43.5	6,200	1250	Open	Steel
6315	75	160	37	98.0	61.5	5,000	2700	2RS	Polyamide
61815	75	95	10	16.0	17.5	8,000	280	Open	Steel
6216	80	140	26	63.0	48.0	5,800	1400	Open	Steel
6316	80	170	39	106.0	67.0	4,500	3200	Z	Steel
61816	80	100	10	17.2	19.2	7,000	300	Open	Steel
6217	85	150	28	69.0	52.5	5,500	1700	Open	Steel
6317	85	180	41	112.0	72.0	4,000	3700	2RS	Polyamide
61817	85	110	13	19.8	22.8	6,000	450	Open	Steel
6218	90	160	30	75.0	57.5	5,200	2000	Open	Steel
6318	90	190	43	120.0	77.5	3,800	4200	Z	Steel
61818	90	115	13	21.5	25.0	5,000	480	Open	Steel
6219	95	170	32	82.0	63.0	4,800	2400	Open	Steel
6319	95	200	45	128.0	83.0	3,500	4900	2RS	Polyamide
61819	95	120	13	23.0	27.5	4,000	500	Open	Steel
6220	100	180	34	90.0	69.0	4,500	2700	Open	Steel
6320	100	215	47	135.0	90.0	3,200	5700	Z	Steel
61820	100	125	13	24.5	30.0	3,000	520	Open	Steel
6221	105	190	36	97.0	75.0	4,200	3200	Open	Steel
6321	105	225	49	140.0	96.0	3,000	6700	2RS	Polyamide
61821	105	130	13	26.0	32.5	2,800	540	Open	Steel
6222	110	200	38	105.0	81.5	4,000	3700	Open	Steel
6322	110	240	50	150.0	103.0	2,800	7800	Z	Steel
61822	110	135	13	27.5	35.0	2,600	560	Open	Steel
6224	120	215	40	118.0	92.0	3,600	4600	Open	Steel
6324	120	260	55	170.0	115.0	2,500	10000	2RS	Polyamide
61824	120	150	16	31.0	40.0	2,200	850	Open	Steel
6226	130	230	40	130.0	102.0	3,400	5700	Open	Steel
6326	130	280	58	190.0	128.0	2,200	12000	Z	Steel
61826	130	165	18	36.0	46.0	2,000	1100	Open	Steel
6228	140	250	42	140.0	115.0	3,200	7200	Open	Steel
6328	140	300	62	220.0	140.0	2,000	14400	2RS	Polyamide
61828	140	175	18	39.0	50.0	1,800	1200	Open	Steel
6230	150	270	45	160.0	128.0	3,000	9000	Open	Steel

Bearing Type	Bore Diameter (mm)	Outer Diameter (mm)	Width (mm)	Dynamic Load Rating (kN)	Static Load Rating (kN)	Speed Limit (RPM)	Mass (g)	Seal Type	Cage Material
6330	150	320	65	240.0	153.0	1,800	17000	Z	Steel
61830	150	190	20	45.0	80.0	1,600	1,800	Open	Steel
6232	160	290	48	180.0	145.0	2,800	10800	Open	Steel
6332	160	340	68	260.0	168.0	1,600	20000	2RS	Polyamide
61832	160	200	20	49.0	91.0	1,500	2,000	Open	Steel
6234	170	310	52	190.0	155.0	2,600	12800	Open	Steel
6334	170	360	72	280.0	185.0	1,400	23500	Z	Steel
61834	170	215	22	53.0	105.0	1,400	2,200	Open	Steel
6236	180	320	52	200.0	170.0	2,400	14000	Open	Steel
6336	180	380	75	300.0	200.0	1,200	27000	2RS	Polyamide
61836	180	225	22	58.0	120.0	1,200	2,500	Open	Steel
6238	190	340	55	220.0	180.0	2,200	16000	Open	Steel
6338	190	400	78	320.0	215.0	1,000	30500	Z	Steel
61838	190	240	24	62.0	135.0	1,100	2,800	Open	Steel
6240	200	360	58	240.0	200.0	2,000	18000	Open	Steel
6340	200	420	80	340.0	230.0	900	34000	2RS	Polyamide
61840	200	250	24	67.0	150.0	1,000	3,000	Open	Steel

6.4.2. Double Row Deep Groove Ball Bearings (DGBB)



Bearing Type	Bore Diameter (mm)	Outer Diameter (mm)	Width (mm)	Dynamic Load Rating (kN)	Static Load Rating (kN)	Speed Limit (RPM)	Mass (g)	Seal Type	Cage Material
4200	10	30	14	11.0	6.1	18,000	64	Open	Steel
4201	12	32	14	12.5	7.0	17,000	74	2RS	Brass
4202	15	35	14	14.5	8.5	16,000	86	Z	Polyamide
4203	17	40	16	17.3	10.5	15,000	115	2Z	Steel
4204	20	47	18	21.0	13.5	13,000	185	Open	Brass
4205	25	52	20	25.5	17.0	12,000	245	2RS	Polyamide
4206	30	62	20	28.5	20.0	11,000	335	Z	Steel
4207	35	72	23	34.0	24.8	10,000	510	2Z	Brass
4208	40	80	23	39.0	29.0	9,000	590	Open	Polyamide
4209	45	85	25	43.5	33.0	8,500	650	2RS	Steel
4210	50	90	25	48.0	37.0	8,000	710	Z	Brass
4300	10	35	17	15.2	8.4	16,000	100	Open	Steel
4301	12	37	17	17.4	10.0	15,000	110	2RS	Brass
4302	15	42	17	20.0	12.0	14,000	140	Z	Polyamide
4303	17	47	19	23.5	14.5	13,000	190	2Z	Steel
4304	20	52	21	27.0	17.0	12,000	240	Open	Brass
4305	25	62	24	34.0	22.0	10,000	360	2RS	Polyamide
4306	30	72	27	40.5	27.0	9,000	520	Z	Steel
4307	35	80	31	47.0	32.0	8,500	680	2Z	Brass
4308	40	90	33	54.0	37.5	8,000	880	Open	Polyamide
4309	45	100	36	61.0	43.0	7,500	1100	2RS	Steel
4310	50	110	40	68.0	49.0	7,000	1350	Z	Brass

6.4.3. Angular Contact Ball Bearings (ACBB) and Super Precision Bearings



Bearing Type	Bore Diameter (mm)	Outer Diameter (mm)	Width (mm)	Dynamic Load Rating (kN)	Static Load Rating (kN)	Speed Limit (RPM)	Contact Angle (°)	Precision Class	Mass (g)	Seal Type	Cage Material
7000	10	26	8	9.2	4.4	40,000	15	P4	26	Open	Brass
7001	12	28	8	10.3	5.2	38,000	15	P4	32	2RS	Polyamide
7002	15	32	9	12.4	6.8	36,000	15	P4	42	Z	Steel
7003	17	35	10	13.8	7.8	34,000	15	P4	50	2Z	Brass
7004	20	42	12	17.0	9.8	32,000	15	P4	80	Open	Polyamide
7005	25	47	12	19.8	12.3	30,000	15	P4	90	2RS	Steel
7006	30	55	13	24.0	15.5	28,000	15	P4	125	Z	Brass
7007	35	62	14	29.0	19.3	26,000	15	P4	160	2Z	Polyamide
7008	40	68	15	34.5	23.0	24,000	15	P4	200	Open	Steel
7009	45	75	16	40.5	27.5	22,000	15	P4	250	2RS	Brass
7010	50	80	16	46.5	32.0	20,000	15	P4	280	Z	Polyamide
7011	55	90	18	55.0	38.0	19,000	15	P4	360	2Z	Steel
7012	60	95	18	63.0	45.0	18,000	15	P4	390	Open	Brass
7013	65	100	18	68.0	49.0	17,000	15	P4	420	2RS	Polyamide
7014	70	110	20	82.0	60.0	16,000	15	P4	520	Z	Steel
7015	75	115	20	88.0	64.0	15,000	15	P4	570	2Z	Brass
7016	80	125	22	100.0	73.0	14,000	15	P4	700	Open	Polyamide
7017	85	130	22	105.0	77.0	13,000	15	P4	750	2RS	Steel
7018	90	140	24	118.0	86.0	12,000	15	P4	880	Z	Brass
7019	95	145	24	123.0	90.0	11,000	15	P4	940	2Z	Polyamide
7020	100	150	24	130.0	95.0	10,000	15	P4	1000	Open	Steel
7021	105	160	26	145.0	105.0	9,500	15	P4	1180	2RS	Brass
7022	110	170	28	150.0	110.0	9,000	15	P4	1270	Z	Polyamide
7023	115	180	30	160.0	120.0	8,500	15	P4	1370	2Z	Steel
7024	120	190	32	180.0	135.0	8,000	15	P4	1500	Open	Brass
7025	125	200	34	195.0	145.0	7,500	15	P4	1650	2RS	Polyamide
7026	130	210	36	210.0	155.0	7,000	15	P4	1800	Z	Steel
7027	135	220	38	225.0	165.0	6,500	15	P4	1950	2Z	Brass
7028	140	230	40	240.0	175.0	6,000	15	P4	2100	Open	Polyamide
7029	145	240	42	255.0	185.0	5,500	15	P4	2250	2RS	Steel

6.4.4. Thin Section Bearings



Bearing Type	Inner Diameter (mm)	Outer Diameter (mm)	Width (mm)	Dynamic Load Rating (kN)	Static Load Rating (kN)	Speed Limit (RPM)	Mass (g)
6700	10	15	3	0.9	0.5	24000	3
6701	12	18	4	1.1	0.6	22000	5
6702	15	21	4	1.3	0.8	20000	7
6703	17	23	4	1.5	1.0	18000	9
6704	20	27	4	1.7	1.2	16000	11
6800	10	19	5	3.2	1.5	30000	8
6801	12	21	5	3.6	1.8	28000	10
6802	15	24	5	4.1	2.0	26000	12
6803	17	26	5	4.6	2.3	24000	14
6804	20	32	7	5.2	2.6	22000	18
6900	10	22	6	2.0	0.9	32000	6
6901	12	24	6	2.3	1.1	30000	8

Bearing Type	Inner Diameter (mm)	Outer Diameter (mm)	Width (mm)	Dynamic Load Rating (kN)	Static Load Rating (kN)	Speed Limit (RPM)	Mass (g)
6902	15	28	7	2.7	1.3	28000	12
6903	17	30	7	3.1	1.5	26000	14
6904	20	37	9	3.6	1.8	24000	20
6705	25	32	4	2.0	1.2	16000	13
6706	30	37	4	2.2	1.4	14000	15
6805	25	37	7	5.8	3.0	20000	20
6806	30	42	7	6.5	3.5	18000	25
6905	25	42	9	4.0	2.0	22000	25
6906	30	47	9	4.5	2.5	20000	30
6707	35	42	4	2.4	1.6	14000	17
6807	35	47	7	7.2	4.0	16000	30
6808	40	52	7	7.9	4.5	14000	35
6907	35	55	10	5.0	3.0	18000	35
6908	40	62	12	5.5	3.5	16000	40
6708	40	52	4	2.6	1.8	12000	20
6809	45	58	7	8.5	5.0	12000	40
6810	50	65	7	9.0	5.5	10000	45
6909	45	68	12	6.0	4.0	14000	45
6910	50	72	12	6.5	4.5	12000	50
6709	45	58	4	2.8	2.0	10000	22
6710	50	65	4	3.0	2.2	8000	25
6811	55	72	9	9.5	6.0	10000	50
6812	60	78	10	10.0	6.5	9000	55
6911	55	80	13	7.0	4.8	8000	55
6912	60	85	13	7.5	5.2	7000	60
6813	65	85	10	10.5	7.0	8000	60
6814	70	90	10	11.0	7.5	7000	65
6913	65	90	13	8.0	5.8	6000	65
6914	70	95	13	8.5	6.2	5000	70
6815	75	100	10	12.0	8.0	6000	70
6816	80	110	10	13.0	9.0	5000	75
6915	75	105	16	9.0	6.8	4000	75
6916	80	110	16	10.0	7.5	3000	80
6817	85	110	10	14.0	10.0	4000	80
6818	90	115	10	15.0	11.0	3500	85
6917	85	120	18	11.0	8.0	3000	85
6918	90	125	18	12.0	9.0	2500	90
6819	95	125	10	16.0	12.0	3000	90
6820	100	130	10	17.0	13.0	2500	95
6919	95	130	18	13.0	10.0	2000	95
6920	100	135	18	14.0	11.0	1500	100
6821	105	140	12	18.0	14.0	2400	110
6822	110	145	12	19.0	15.0	2200	115
6823	115	150	13	20.0	16.0	2000	120
6824	120	160	14	21.0	17.0	1800	125
6825	125	165	15	22.0	18.0	1600	130
6826	130	170	16	23.0	19.0	1500	135
6827	135	180	17	24.0	20.0	1400	140
6828	140	190	18	25.0	21.0	1300	145
6829	145	200	19	26.0	22.0	1200	150
6830	150	210	20	27.0	23.0	1100	160
6921	105	145	20	15.0	12.0	2000	110
6922	110	150	21	16.0	13.0	1900	115
6923	115	155	22	17.0	14.0	1800	120
6924	120	160	23	18.0	15.0	1700	125
6925	125	165	24	19.0	16.0	1600	130
6926	130	170	25	20.0	17.0	1500	135
6927	135	180	26	21.0	18.0	1400	140
6928	140	190	27	22.0	19.0	1300	145
6929	145	200	28	23.0	20.0	1200	150
6930	150	210	29	24.0	21.0	1100	160

7 Tapered roller bearings (TRB)

Tapered roller bearings are a unique type of rolling-element bearing designed to handle both axial and radial loads. These bearings are characterized by their conical shape, with the inner and outer ring raceways and rollers tapering towards a common point. This design allows them to support heavy loads and resist forces in both directions axially and radially, making them highly efficient in various demanding applications.

7.1 Key Features and Advantages

1. **Load Capacity:** Tapered roller bearings are ideal for applications that involve both radial and axial (thrust) loads. The tapered design enables them to handle high radial loads while simultaneously managing thrust loads in one direction.
2. **High Durability:** These bearings are made from high-quality materials that provide superior resistance to wear, shock loads, and heavy impacts. They are often used in environments where strength and longevity are critical.
3. **Low Friction:** Tapered roller bearings are designed to minimize friction between rolling elements, allowing for smooth operation and reduced energy loss. This makes them efficient for high-speed applications.
4. **Adjustability:** The design of tapered roller bearings allows for a certain degree of adjustability in clearance and preload, which can be beneficial for extending bearing life and optimizing performance.

7.2 Typical Applications

Tapered roller bearings are widely used across various industries due to their robustness and versatility. Common applications include:

Automotive Industry: In vehicle axles, gearboxes, and differential gears, tapered roller bearings handle the combined radial and thrust loads generated by both turning and moving parts.



Heavy Machinery: Construction equipment, mining machinery, and agricultural equipment often utilize tapered roller bearings for their ability to withstand heavy loads and harsh operating conditions.



Railways Applications: These bearings are commonly used in railcar axles and traction motors due to their reliability and strength under heavy loads and varying speeds.



Wind Turbines: Tapered roller bearings are employed in wind turbine gearboxes and rotors, where they are essential for handling combined axial and radial forces during wind-driven rotation.



Industrial Gearboxes: In heavy-duty gearboxes, tapered roller bearings manage the loads associated with high-speed rotations and heavy torque.



7.3 Advantages of Tapered Roller Bearings

Versatility: Capable of managing high combined loads (both radial and axial), tapered roller bearings are well-suited for a broad range of applications.

Precision and Efficiency: The tapered geometry provides accurate load distribution across the rollers, ensuring smooth and efficient operation.

High Load-Carrying Capacity: These bearings excel in applications requiring the management of heavy radial and thrust loads, making them particularly valuable in industries like construction and transportation.

Customization: Depending on specific operational requirements, tapered roller bearings can be customized in terms of size, materials, and lubrication to suit different environments and performance needs.

7.4 Tapered Roller Bearings Dimensions and key features

Code	Bore Diameter (mm)	Outer Diameter (mm)	Width (mm)	Dynamic Load Rating (kN)	Static Load Rating (kN)	Speed Limit (RPM)	Mass (g)	Seal Type	Cage Material
30202	15	35	11	12.1	9.50	15,000	70	None	Steel
30302	17	40	12	16.0	13.0	14,500	90	None	Steel
32003X	17	35	13	17.0	14.0	14,500	75	None	Steel
30203	17	40	13.25	16.7	14.5	14,000	100	None	Steel
30303	17	47	14	20.5	17.5	13,000	125	None	Steel
32004X	20	47	15	23.5	19.5	12,500	160	None	Steel
32204	20	47	15.25	23.0	18.8	12,000	180	None	Steel
30204	20	47	14	21.0	18.0	12,500	150	None	Steel
30304	20	52	16	28.5	22.0	11,500	220	None	Steel
32005X	25	52	16.25	28.5	22.0	11,000	240	None	Steel
32205	25	52	15.25	25.0	21.5	11,500	200	None	Steel
32905	25	42	10	20.5	17.0	11,500	90	None	Steel
30205	25	62	16.25	25.5	21.0	11,000	210	None	Steel
30305	25	62	17.25	30.8	25.0	10,000	320	None	Steel
32206	30	62	17.25	35.0	28.5	9,500	340	None	Steel
32006X	30	62	17.25	36.0	29.0	9,000	330	None	Steel
32306	30	72	19.25	41.5	35.5	8,500	400	None	Steel
32906	30	47	12	26.0	21.5	11,000	160	None	Steel
30207	35	72	18.25	42.0	35.0	8,500	420	None	Steel
32207	35	72	18.25	45.0	38.0	8,500	450	None	Steel
32008X	40	80	19.75	50.5	42.0	8,000	490	None	Steel
32908	40	62	15	40.5	34.0	8,500	330	None	Steel
32208	40	80	18.25	56.0	45.0	8,000	490	None	Steel
30209	45	85	19.75	60.5	50.0	7,000	560	None	Steel
32210	50	90	25	75.5	61.5	7,000	750	None	Steel
32912	60	110	29	110.0	85.0	6,000	950	None	Steel
32014X	70	125	29	130.0	105.0	5,500	1,100	None	Steel
30214	70	125	26.25	103	152	4600	1.2	None	Steel
32214	70	125	33.25	114	162	4300	1.5	None	Steel
33214	70	125	41	127	184	4000	2.0	None	Steel
32016X	80	125	29	119	184	4500	1.18	None	Steel
30216	80	140	28.25	126	187	4000	1.8	None	Steel
32216	80	140	35.25	140	200	3800	2.3	None	Steel
33216	80	140	46	156	225	3600	3.0	None	Steel
32018X	90	140	32	142	224	4100	1.7	None	Steel
30218	90	160	32.5	157	237	3600	2.6	None	Steel
32218	90	160	42.5	170	250	3300	3.4	None	Steel
33218	90	160	52	188	270	3100	4.6	None	Steel
32020X	100	150	32	167.5	266	3200	2.6	None	Steel
30220	100	180	37	182	280	2900	4.25	None	Steel
32220	100	180	49	192	290	2800	5.5	None	Steel
33220	100	180	63	218	330	2600	7.2	None	Steel
32022X	110	170	38	190	310	3000	4.3	None	Steel
30222	110	200	41	210	325	2700	6.5	None	Steel
32222	110	200	53	225	340	2600	7.9	None	Steel
33222	110	200	69	256	390	2400	10.2	None	Steel
32024X	120	180	38	201	320	2900	5.1	None	Steel
30224	120	215	43	230	350	2500	8.2	None	Steel
32224	120	215	58	255	375	2400	9.9	None	Steel
33224	120	215	73	275	410	2200	12.5	None	Steel
32026X	130	200	45	236	370	2800	7.1	None	Steel
30226	130	230	40	249	385	2400	9.9	None	Steel
32226	130	230	64	292	415	2300	12.2	None	Steel

33226	130	230	80	310	450	2100	14.9	None	Steel
32028X	140	210	45	260	405	2700	8.6	None	Steel
30228	140	250	42	282	430	2300	11.8	None	Steel

8 Spherical Roller Bearings (SRB)

Spherical roller bearings are designed to handle very demanding environments, where heavy loads, shocks, misalignment, and varying speeds are common. These bearings have two rows of symmetrical rollers with a common spherical raceway in the outer ring. This unique construction allows the bearing to operate under misalignment and high-load conditions, making them highly versatile and durable in harsh applications.

8.1 Key Features and Advantages

Self-Aligning Capability: One of the most significant advantages of spherical roller bearings is their ability to accommodate angular misalignment. This makes them ideal for applications where shaft deflection or misalignment is expected, without compromising performance.

High Load-Carrying Capacity: Spherical roller bearings are designed to handle both radial and axial loads in both directions. The large contact area between the rollers and raceways enables them to support heavy radial loads, while the dual row of rollers can efficiently manage axial forces.

Shock and Vibration Resistance: Due to their robust design and construction, spherical roller bearings are highly resistant to shocks and vibrations, making them suitable for use in equipment subject to heavy-duty and fluctuating load conditions.

Long Operational Life: These bearings are manufactured from high-quality materials, which ensure long-lasting performance and reliability, even in the toughest environments.

8.1.1 Conical Bore SRB

Conical bore SRBs are primarily used in applications where high radial and axial loads occur simultaneously, and misalignment is a concern. The tapered bore allows for quick and easy mounting and dismounting, which is especially beneficial in large industrial machinery or equipment that requires regular maintenance. The bearing can be mounted with an adapter sleeve on cylindrical shafts or directly onto a tapered shaft.

8.1.2 Advantages of Conical Bore SRB

Adjustable Clearance: The conical bore design allows for the adjustment of radial internal clearance during installation. This feature ensures optimal fit and can extend the bearing life by reducing stress concentrations and uneven load distribution.

Easy Mounting and Dismounting: Conical bore SRBs are easier to mount compared to cylindrical bore bearings. The use of adapter or withdrawal sleeves enables quick mounting on both straight and tapered shafts, simplifying installation and reducing maintenance time, especially in large equipment.

Compensation for Misalignment: Like all spherical roller bearings, conical bore SRBs can compensate for angular misalignment between the shaft and housing. This is particularly useful in applications with shaft deflection or mounting inaccuracies.

Higher Load Capacity: Due to their robust design and ability to adjust internal clearance, conical bore SRBs can handle higher radial and axial loads compared to cylindrical bore bearings. They are especially useful in heavy-duty applications where shock loads and high stresses are common.

Versatile Mounting: The use of adapter sleeves with conical bore SRBs allows for versatility in mounting onto different shaft diameters, reducing the need for exact matching of bearing and shaft sizes.

8.2 Typical Applications

Spherical roller bearings are used in a wide range of industries, particularly where heavy loads and harsh operating conditions are present. Typical applications include:

Mining and Quarrying: The high load capacity and shock resistance of spherical roller bearings make them ideal for use in mining and quarrying equipment such as conveyors, crushers, and vibrating screens.



Paper Mills: Spherical roller bearings are used in the rolls of paper-making machinery, where they handle heavy loads, misalignment, and high speeds.



Wind Turbines: In the rapidly expanding renewable energy sector, spherical roller bearings are used in wind turbines, where they accommodate misalignment caused by rotor movements while managing high loads.



Steel Mills: The ability of spherical roller bearings to resist heat and handle heavy loads makes them suitable for use in steel mill equipment such as continuous casting machines and rolling mills.



Construction Machinery: Equipment such as cranes, bulldozers, and other construction machines benefit from spherical roller bearings' ability to handle combined radial and axial loads in rough conditions.



8.3 Advantages of Spherical Roller Bearings

Misalignment Tolerance: The self-aligning feature allows the bearings to continue functioning even when there are alignment issues, reducing maintenance needs and the risk of premature failure.

Dual Load Capacity: Spherical roller bearings are capable of supporting both high radial and axial loads, making them adaptable for various demanding applications.

Durability in Harsh Conditions: These bearings can endure extreme conditions, including exposure to contaminants, vibrations, shocks, and heavy impacts, making them suitable for tough industrial environments.

Reduced Maintenance: Due to their robust design and high durability, spherical roller bearings often require less frequent maintenance, which can reduce downtime and operational costs in critical applications.

8.4 Spherical Roller Bearings Dimensions and key features



Bearing Code	Bore Diameter (mm)	Outer Diameter (mm)	Width (mm)	Dynamic Load Rating (kN)	Static Load Rating (kN)	Speed Limit (RPM)	Mass (g)	Seal Type	Cage Material
22205 E	25	52	18	42.5	41.0	12,000	170	None	Brass
22206 E	30	62	20	55.0	50.0	11,000	300	None	Brass
22207 E	35	72	23	65.0	55.0	10,000	400	None	Brass
22208 E	40	80	23	90.5	75.0	9,000	600	None	Brass
22209 E	45	85	23	110.0	88.0	8,500	680	None	Brass
22210 E	50	90	23	130.0	100.0	8,000	750	None	Brass
22211 E	55	100	25	155.0	120.0	7,500	950	None	Brass
22212 EK	60	110	28	180.0	145.0	6,500	1,200	None	Brass
22310 EK	50	110	40	220.0	185.0	6,000	1,600	None	Brass
22312 EK	60	130	46	290.0	250.0	5,500	2,300	None	Brass
22313 EK	65	140	48	315.0	270.0	5,000	2,700	None	Brass
22314 EK	70	150	51	360.0	310.0	4,500	3,200	None	Brass
22315 EK	75	160	55	420.0	365.0	4,000	3,800	None	Brass
22316 EK	80	170	58	480.0	420.0	3,800	4,300	None	Brass
22318 EK	90	190	67	600.0	520.0	3,500	6,200	None	Brass
22320 EK	100	215	73	710.0	620.0	3,000	8,200	None	Brass
23218 CC	90	160	52	340.0	290.0	4,000	2,500	None	Brass
23222 CC	110	200	69	520.0	460.0	3,000	6,100	None	Brass
23226 CC	130	230	80	640.0	550.0	2,800	8,200	None	Brass
24026 CC	130	200	69	590.0	500.0	3,200	6,000	None	Brass
24030 CC	150	225	75	720.0	600.0	3,000	8,000	None	Brass
24036 CC	180	280	100	1,180.0	960.0	2,200	12,000	None	Brass

9 Cylindrical Roller Bearings

Cylindrical roller bearings are a highly efficient and versatile type of bearing designed to handle heavy radial loads. These bearings consist of cylindrical rollers placed between inner and outer raceways. Due to the straight geometry of the rollers, cylindrical roller bearings can support high radial loads and perform well under high-speed conditions. They are widely used in various industrial applications due to their robustness, precision, and ability to accommodate different operational needs.

9.1 Types of Cylindrical Roller Bearings: NU, NUP, and NJ

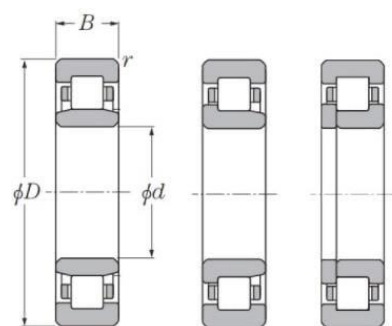
Cylindrical roller bearings are available in different configurations, such as NU, NUP, and NJ, each designed to meet specific operational requirements. Here's a brief explanation of the differences between these types:

- **NU Bearings:** In an **NU** type bearing, the outer ring has two integral flanges, while the inner ring has no flanges. This design allows for free axial displacement of the shaft concerning the housing, making it suitable for applications where thermal expansion or shaft misalignment occurs.
- **NUP Bearings:** **NUP** type cylindrical roller bearings have two integral flanges on the outer ring, one integral flange on the inner ring, and one loose flange. This arrangement allows the bearing to carry axial loads in both directions, providing axial location for the shaft.
- **NJ Bearings:** **NJ** bearings have two integral flanges on the outer ring and one flange on the inner ring. This design allows the bearing to support radial loads as well as limited axial loads in one direction, making them ideal for applications where axial displacement in one direction is required.

Each of these types offers distinct advantages based on their specific load-handling and axial displacement capabilities, which makes them suitable for different applications.

9.2 Key Features and Advantages

1. **High Radial Load Capacity:** Cylindrical roller bearings are well-suited to support heavy radial loads due to the large contact area between the cylindrical rollers and the raceways. This makes them highly effective in applications involving heavy machinery and high-load operations.
2. **Axial Load Handling (NUP and NJ Types):** Depending on the configuration, certain types of cylindrical roller bearings, such as NUP and NJ, can also support axial loads. NUP bearings can handle axial loads in both directions, while NJ bearings are designed to accommodate axial loads in one direction.
3. **High-Speed Performance:** The geometry of the cylindrical rollers minimizes friction, enabling these bearings to operate at high speeds without generating excessive heat, ensuring smooth and efficient performance.
4. **Resistance to Misalignment:** Although



Type NU Type NJ Type NUP

cylindrical roller bearings generally do not tolerate much misalignment, the NU type allows for axial displacement, which makes it suitable for

applications where slight misalignments may occur due to thermal expansion or other factors.

5. **Modular Designs:** Different designs (NU, NUP, NJ) provide flexibility,

allowing engineers to select the most suitable bearing for their specific needs. These bearings are available in single-row, double-row, and multi-row configurations.

9.3 Typical Applications

Cylindrical roller bearings are commonly used in a wide range of industrial applications where

heavy radial loads and high speeds are required. Some typical applications include:

Gearboxes: In industrial and automotive gearboxes, cylindrical roller bearings are used to support high radial loads and ensure the smooth transmission of power.



Electric Motors: Due to their ability to handle high speeds and radial loads, cylindrical roller bearings are frequently found in electric motors and generators.



Machine Tools: Precision cylindrical roller bearings are used in machine tools, ensuring smooth rotation and reducing friction under heavy loads.



Pumps and Compressors: These bearings are commonly employed in pumps and compressors, where they handle high loads and ensure efficient operation.



Wind Turbines: Cylindrical roller bearings, especially in multi-row configurations, are used in wind turbine gearboxes to support radial loads and ensure reliable operation under varying wind conditions.



9.4 Advantages of Cylindrical Roller Bearings

- **Heavy Load Capacity:** Cylindrical roller bearings can support high radial loads, making them suitable for demanding applications involving heavy machinery and industrial equipment.
- **Flexibility in Axial Displacement:** The NU-type bearings can handle axial displacement, which is useful in applications where thermal expansion or shaft misalignment may occur.
- **High-Speed Performance:** Due to their low friction design, cylindrical roller bearings are ideal for applications where high-speed rotation is required, providing efficient operation with minimal energy loss.
- **Durability and Longevity:** Constructed from high-quality materials, cylindrical roller bearings offer long-lasting performance, even in harsh environments with heavy loads and high speeds.
- **Precision and Stability:** The straight-line contact between the rollers and raceways ensures precise and stable rotation, which is crucial for maintaining efficiency in high-performance machinery.

9.5 Cylindrical Roller Bearings Dimensions and key features



Bearing Code	Bore Diameter (mm)	Outer Diameter (mm)	Width B (mm)	Dynamic Load Rating (kN)	Static Load Rating (kN)	Speed Limit (RPM)	Mass (g)	Seal Type	Cage Material
NU204 ECP	20	47	14	25.0	22.0	15,000	120	None	Steel
NJ204 ECP	20	47	14	24.0	21.0	14,000	130	None	Steel
NUP204 ECP	20	47	14	25.5	23.0	14,500	140	None	Steel
NU205 ECP	25	52	15	31.0	25.5	13,000	180	None	Steel
NJ205 ECP	25	52	15	30.0	24.0	13,000	190	None	Steel
NUP205 ECP	25	52	15	32.0	26.0	12,500	200	None	Steel
NU206 ECP	30	62	16	40.0	30.5	12,500	230	None	Steel
NJ206 ECP	30	62	16	38.5	30.0	12,500	240	None	Steel
NUP206 ECP	30	62	16	42.0	34.0	12,000	250	None	Steel
NU207 ECP	35	72	17	50.0	38.5	11,000	300	None	Steel
NJ207 ECP	35	72	17	48.0	37.5	11,000	310	None	Steel
NUP207 ECP	35	72	17	52.0	42.0	10,500	340	None	Steel
NU208 ECP	40	80	18	62.0	52.5	10,000	370	None	Steel
NJ208 ECP	40	80	18	60.0	50.0	10,000	380	None	Steel
NUP208 ECP	40	80	18	65.0	55.0	9,500	400	None	Steel
NU209 ECP	45	85	19	65.0	55.0	9,000	410	None	Steel
NJ209 ECP	45	85	19	63.0	52.0	9,000	420	None	Steel
NUP209 ECP	45	85	19	68.0	58.0	8,500	440	None	Steel
NU210 ECP	50	90	20	75.0	60.0	8,500	480	None	Steel
NJ210 ECP	50	90	20	70.0	58.0	8,500	490	None	Steel
NUP210 ECP	50	90	20	78.0	65.0	8,000	520	None	Steel
NU211 ECP	55	100	21	88.0	70.0	7,500	600	None	Steel
NJ211 ECP	55	100	21	85.0	68.0	7,500	620	None	Steel
NUP211 ECP	55	100	21	92.0	75.0	7,000	650	None	Steel
NU212 ECP	60	110	22	105.0	82.5	6,500	730	None	Steel
NJ212 ECP	60	110	22	100.0	80.0	6,500	750	None	Steel
NUP212 ECP	60	110	22	108.0	85.0	6,000	780	None	Steel
NU213 ECP	65	120	23	120.0	95.0	6,000	820	None	Steel
NJ213 ECP	65	120	23	115.0	92.0	6,000	840	None	Steel
NUP213 ECP	65	120	23	125.0	100.0	5,500	880	None	Steel
NU214 ECP	70	125	24	135.0	110.0	5,500	930	None	Steel
NJ214 ECP	70	125	24	130.0	105.0	5,500	950	None	Steel
NUP214 ECP	70	125	24	140.0	115.0	5,000	980	None	Steel
NU215 ECP	75	130	25	150.0	120.0	5,000	1,000	None	Steel
NJ215 ECP	75	130	25	145.0	115.0	5,000	1,020	None	Steel
NUP215 ECP	75	130	25	155.0	125.0	4,800	1,050	None	Steel
NU216 ECP	80	140	26	165.0	135.0	4,800	1,200	None	Steel
NJ216 ECP	80	140	26	160.0	130.0	4,800	1,230	None	Steel
NUP216 ECP	80	140	26	170.0	140.0	4,500	1,260	None	Steel

10 Y Bearings

Y-bearings, also known as insert bearings or housed bearings, are designed to fit into a wide variety of housings and offer reliable performance in different operating conditions. They are based on deep groove ball bearings but have specific features that make them ideal for applications requiring easy installation, self-alignment, and good sealing capabilities. Y-bearings are particularly useful in applications involving moderate to high loads, misalignment, or harsh environments

where contamination or moisture could be a concern.

Y-bearings are characterized by a convex outer ring that fits into a corresponding housing, allowing for some degree of self-alignment to compensate for shaft misalignment. They are often pre-lubricated and equipped with effective seals, which makes them low-maintenance and durable.

10.1 Types of Y-Bearings: YAR, YEL, YAT

There are different types of Y-bearings available, and each is designed for specific applications and mounting requirements. The most common types are **YAR**, **YEL**, and **YAT** bearings. Here's a breakdown of their differences:

10.1.1 YAR Bearings:

YAR bearings are the most commonly used type of Y-bearings. They are equipped with a set screw that allows for easy mounting onto the shaft. These bearings feature a contact seal on both sides, ensuring protection against contaminants and retaining lubrication. YAR bearings are suitable for a wide range of applications, including agricultural machinery, conveyors, and industrial fans.



10.1.2 YEL Bearings:

YEL bearings are designed with an eccentric locking collar that enables quick and easy installation, particularly in applications with limited access. The eccentric collar provides secure and vibration-resistant shaft attachment. YEL bearings are commonly used in applications where set screws might not provide adequate security, such as high-vibration environments like textile machinery or packaging equipment.



10.1.3 YAT Bearings:

YAT bearings use a grub (or Allen) screw for locking onto the shaft, offering simple and effective mounting. These bearings are often used in lighter-duty applications that still require reliable performance and self-alignment, such as ventilation systems and conveyor systems.



10.2 Advantages of Y-Bearings

1. Easy Installation and Mounting:

Y-bearings are designed for quick and easy installation, whether by set screw (YAR), eccentric collar (YEL), or grub screw (YAT). This versatility makes them ideal for a variety of mounting situations, reducing downtime and simplifying maintenance.

2. Self-Alignment:

Thanks to their convex outer ring and the corresponding concave housing, Y-bearings are self-aligning. This feature compensates for shaft misalignment, reducing the risk of premature failure caused by misalignment in the assembly.

3. Effective Sealing:

Y-bearings are equipped with contact seals that provide superior protection against contaminants such as dust, dirt,

and moisture. The seals help retain lubrication, ensuring longer bearing life and reducing maintenance intervals.

4. Low Maintenance:

Most Y-bearings are pre-lubricated and feature sealed designs, which make them low-maintenance solutions for various applications. This is particularly useful in environments where access to the bearing for regular lubrication is difficult.

5. Versatility:

Y-bearings can be used in a wide range of applications across different industries. They are available in different configurations and can accommodate moderate loads, making them suitable for conveyors, fans, agricultural equipment, textile machines, and packaging machinery.

10.3 Typical Applications of Y-Bearings

Y-bearings are widely used across various industries due to their robust design, easy installation, and ability to handle misalignment and contamination. Common applications include:

Conveyors: Y-bearings are commonly used in conveyors to support rotating shafts in environments with dust, dirt, or other contaminants.



Agricultural Machinery: In farming equipment such as harvesters, tractors, and tillers, Y-bearings provide reliable performance and protect against contamination from dirt and moisture.



Textile Machinery: YEL bearings with eccentric collars are popular in high-vibration environments like textile machines, where secure mounting and reliable operation are critical.



Ventilation Systems: YAT bearings are often used in ventilation systems and fans, where smooth operation and low maintenance are essential.



Packaging Equipment: In packaging machinery, Y-bearings offer low maintenance and durable performance under varying loads and conditions.



10.4 Y-Bearings Dimensions and key features



Bearing Code	Bore Diameter (mm)	Outer Diameter (mm)	Width (mm)	Dynamic Load Rating (kN)	Static Load Rating (kN)	Speed Limit (RPM)	Mass (g)	Seal Type	Cage Material
YAR 204-2F	20	47	31	9.6	4.8	12,000	170	Contact Seal	Steel
YAR 205-2F	25	52	34.1	12.8	6.65	11,000	210	Contact Seal	Steel
YAR 206-2F	30	62	38.1	19.5	10.4	9,500	320	Contact Seal	Steel
YAR 207-2F	35	72	42.9	24.7	13.0	8,500	450	Contact Seal	Steel
YAR 208-2F	40	80	49.2	30.1	16.2	7,500	640	Contact Seal	Steel
YAR 209-2F	45	85	49.2	34.6	18.9	6,800	700	Contact Seal	Steel
YAR 210-2F	50	90	51.6	38.5	22.0	6,500	800	Contact Seal	Steel
YAR 211-2F	55	100	55.6	44.0	26.2	5,800	1,100	Contact Seal	Steel
YAR 212-2F	60	110	65.1	51.5	31.0	4,800	1,600	Contact Seal	Steel
YAR 213-2F	65	120	74.6	57.5	35.2	4,500	2,100	Contact Seal	Steel
YAR 214-2F	70	125	77.8	61.0	38.8	4,200	2,400	Contact Seal	Steel
YAR 215-2F	75	130	77.8	65.0	42.0	4,000	2,600	Contact Seal	Steel
YAR 216-2F	80	140	80.9	69.0	46.2	3,800	3,000	Contact Seal	Steel
YAR 217-2F	85	150	85.7	72.5	50.5	3,500	3,500	Contact Seal	Steel
YAR 218-2F	90	160	88.9	75.0	54.0	3,200	3,900	Contact Seal	Steel
YAR 220-2F	100	180	95.2	82.0	61.0	3,000	5,000	Contact Seal	Steel
YEL 204-2F	20	47	31	9.6	4.8	12,000	160	Contact Seal	Steel
YEL 205-2F	25	52	34.1	12.8	6.65	11,000	210	Contact Seal	Steel
YEL 206-2F	30	62	38.1	19.5	10.4	9,500	320	Contact Seal	Steel
YEL 207-2F	35	72	42.9	24.7	13.0	8,500	450	Contact Seal	Steel
YEL 208-2F	40	80	49.2	30.1	16.2	7,500	640	Contact Seal	Steel
YEL 209-2F	45	85	49.2	34.6	18.9	6,800	710	Contact Seal	Steel
YEL 210-2F	50	90	51.6	38.5	22.0	6,500	820	Contact Seal	Steel
YEL 211-2F	55	100	55.6	44.0	26.2	5,800	1,100	Contact Seal	Steel
YEL 212-2F	60	110	65.1	51.5	31.0	4,800	1,620	Contact Seal	Steel
YAT 204-2F	20	47	31	9.6	4.8	12,000	160	Contact Seal	Steel
YAT 205-2F	25	52	34.1	12.8	6.65	11,000	210	Contact Seal	Steel
YAT 206-2F	30	62	38.1	19.5	10.4	9,500	320	Contact Seal	Steel
YAT 207-2F	35	72	42.9	24.7	13.0	8,500	450	Contact Seal	Steel
YAT 208-2F	40	80	49.2	30.1	16.2	7,500	640	Contact Seal	Steel
YAT 209-2F	45	85	49.2	34.6	18.9	6,800	710	Contact Seal	Steel
YAT 210-2F	50	90	51.6	38.5	22.0	6,500	820	Contact Seal	Steel
YAT 211-2F	55	100	55.6	44.0	26.2	5,800	1,100	Contact Seal	Steel
YAT 212-2F	60	110	65.1	51.5	31.0	4,800	1,620	Contact Seal	Steel
YAT 213-2F	65	120	74.6	57.5	35.2	4,500	2,200	Contact Seal	Steel
YAT 214-2F	70	125	77.8	61.0	38.8	4,200	2,500	Contact Seal	Steel
YAT 215-2F	75	130	77.8	65.0	42.0	4,000	2,800	Contact Seal	Steel
YAT 216-2F	80	140	80.9	69.0	46.2	3,800	3,200	Contact Seal	Steel

11 Needle Roller bearings

Needle roller bearings are a type of rolling-element bearing that utilize long, thin cylindrical rollers resembling needles. These bearings are highly effective in applications where compact design and high load-carrying capacity are required. Despite their small cross-section, needle roller bearings can handle high radial loads due to the large surface area in contact with the raceway. Their design allows for efficient performance in applications with limited space, making them ideal for lightweight constructions.

Needle roller bearings are commonly used in automotive, industrial, and agricultural machinery due to their ability to support heavy loads while occupying minimal space.

11.1 Types of Needle Roller Bearings

Needle roller bearings come in various configurations to meet the needs of different applications. Some of the most common types include:

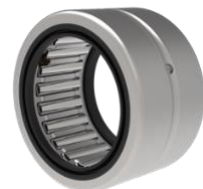
11.1.1 Drawn Cup Needle Roller Bearings:

These bearings consist of a thin, drawn outer ring (or cup) that encloses the needle rollers. They are designed to provide maximum load-carrying capacity with minimal radial space and are often used in applications where the housing bore is used as the raceway for the rollers. Drawn cup needle roller bearings are commonly used in gearboxes and automotive transmissions.



11.1.2 Solid Needle Roller Bearings:

Unlike drawn cup bearings, solid needle roller bearings have a machined outer ring, offering better rigidity and the ability to handle higher loads. These bearings are used in applications where higher strength is required, such as construction machinery or heavy-duty industrial equipment.



11.1.3 Needle Roller and Cage Assemblies:

In this type, needle rollers are held in place by a cage without an inner or outer raceway. This design allows for direct mounting onto the shaft and housing, making them suitable for applications where compactness is essential, and the shaft itself acts as the raceway. These bearings are used in applications like pumps and automotive engines.



11.1.4 Needle Roller Thrust Bearings:

These bearings consist of needle rollers arranged in a cage and are designed to handle axial loads. They are used in applications where axial space is limited but high axial load capacities are required, such as in automotive gearboxes or transmissions.

**11.1.5 Combination Needle Roller Bearings:**

Combination bearings combine a radial needle roller bearing and a thrust bearing in one unit, providing support for both radial and axial loads. These bearings are commonly used in applications where space constraints make it difficult to use separate radial and thrust bearings.

**11.2 Advantages of Needle Roller Bearings****1. High Load-Carrying Capacity:**

Due to the large surface area in contact with the raceway, needle roller bearings can support significantly higher loads compared to other types of bearings of similar size. This makes them highly efficient in load-bearing applications where space is limited.

2. Compact Design:

Needle roller bearings have a small radial cross-section, allowing them to fit into tight spaces. This makes them ideal for applications where minimizing the overall size of the assembly is important, such as automotive transmissions or hydraulic pumps.

3. Lightweight:

The compact design of needle roller bearings also contributes to their lightweight nature. This makes them suitable for applications where reducing the weight of the overall

system is a priority, such as aerospace or lightweight machinery.

4. Versatility:

With various types and configurations available, needle roller bearings can be used in a wide range of applications, from

high-speed gearboxes to heavy-duty construction equipment.

5. Cost-Effective:

Needle roller bearings are generally more cost-effective compared to other types of bearings that provide similar load capacities. Their efficient design helps reduce material costs, making them an economical choice for many industries.

10.3 Typical Applications of Needle Roller Bearings

Needle roller bearings are widely used across different industries due to their compact design, high load-carrying capacity, and ability

to operate in tight spaces. Typical applications include:

- **Automotive Transmissions:** Needle roller bearings are commonly used in automotive transmissions, gearboxes, and universal joints due to their ability to handle high radial loads while taking up minimal space.
- **Construction Equipment:** Heavy-duty construction machinery such as cranes, bulldozers, and excavators often use needle roller bearings in their gearboxes and engines for durability and high-load performance.
- **Aerospace:** Needle roller bearings are used in aerospace applications where minimizing weight and size is essential while maintaining the ability to handle heavy loads.
- **Industrial Gearboxes:** In industrial machinery, needle roller bearings are used in gearboxes and pumps for their ability to handle high speeds and loads in a compact design.
- **Agricultural Machinery:** Needle roller bearings are employed in agricultural equipment like harvesters and tractors, where reliability and load-handling capability are critical in rough operating conditions.

11.4 Needle Roller Bearings Dimensions and key features

11.4.1. Drawn Cup Needle Roller Bearings



Bearing Code	Bore Diameter (mm)	Outer Diameter (mm)	Width (mm)	Dynamic Load Rating (kN)	Static Load Rating (kN)	Speed Limit (RPM)	Mass (g)	Cage Material
HK 0608	6	10	8	1.65	1.9	47,000	3	Steel
HK 1010	10	14	10	2.7	3.3	42,000	5	Steel
HK 1516	15	21	16	5.1	5.9	35,000	12	Steel
HK 2020	20	26	20	6.5	8.2	30,000	20	Steel
HK 2538	25	32	38	10.2	12.8	25,000	40	Steel
BK 1012	10	14	12	2.6	3.2	40,000	6	Steel
BK 1512	15	21	12	4.7	5.6	33,000	15	Steel
BK 2020	20	26	20	6.5	8.1	30,000	22	Steel
BK 3038	30	38	38	12.5	16.5	20,000	55	Steel
HK 4030	40	47	30	18.0	24.5	15,000	70	Steel
HK 5038	50	60	38	24.5	31.0	12,500	120	Steel
HK 6038	60	70	38	28.0	36.0	10,500	140	Steel
HK 7038	70	80	38	31.5	40.5	9,500	165	Steel
HK 8038	80	90	38	35.0	45.0	8,500	190	Steel
HK 10038	100	115	38	41.0	52.5	7,500	270	Steel

11.4.2 Solid Needle roller bearing



Bearing Code	Bore Diameter (mm)	Outer Diameter (mm)	Width (mm)	Dynamic Load Rating (kN)	Static Load Rating (kN)	Speed Limit (RPM)	Mass (g)	Cage Material
NK 5/10 TN	5	10	10	1.2	1.5	57,000	2	Polyamide
NK 12/16	12	19	16	6.1	7.8	30,000	9	Steel
NK 17/16	17	25	16	8.0	10.0	25,000	15	Steel
NK 22/20	22	32	20	11.0	14.0	21,000	25	Steel
NK 30/30	30	45	30	17.5	22.0	15,000	55	Steel
NK 40/30	40	55	30	21.5	28.0	12,000	85	Steel
NK 50/35	50	65	35	26.5	34.0	10,000	120	Steel
NK 60/35	60	80	35	31.0	41.0	8,500	160	Steel
NK 70/35	70	90	35	36.0	48.0	7,500	190	Steel
NK 80/35	80	100	35	41.0	54.0	6,500	220	Steel
NK 90/35	90	115	35	47.0	60.5	5,500	270	Steel
NK 100/36	100	125	36	51.0	68.0	4,800	310	Steel
NK 110/36	110	135	36	56.0	75.0	4,500	350	Steel
NK 120/36	120	145	36	61.0	82.0	4,000	400	Steel
NK 130/36	130	160	36	66.5	90.0	3,800	460	Steel

11.4.3 Needle Roller and Cage Assemblies



Bearing Code	Bore Diameter (mm)	Outer Diameter (mm)	Width (mm)	Dynamic Load Rating (kN)	Static Load Rating (kN)	Speed Limit (RPM)	Mass (g)	Cage Material
K 8x12x10 TN	8	12	10	1.2	1.5	52,000	3	Polyamide
K 12x16x10 TN	12	16	10	2.2	3.0	42,000	4	Polyamide
K 17x21x10	17	21	10	3.6	4.8	35,000	7	Steel
K 20x26x20	20	26	20	6.8	8.5	27,000	12	Steel

Bearing Code	Bore Diameter (mm)	Outer Diameter (mm)	Width (mm)	Dynamic Load Rating (kN)	Static Load Rating (kN)	Speed Limit (RPM)	Mass (g)	Cage Material
K 35x42x20	35	42	20	12.5	16.0	19,000	35	Steel
K 50x55x30	50	55	30	16.5	21.0	15,000	45	Steel
K 60x68x30	60	68	30	19.5	24.0	12,500	65	Steel
K 70x80x30	70	80	30	22.0	27.5	11,500	75	Steel
K 80x90x30	80	90	30	24.0	30.0	10,500	85	Steel
K 90x100x30	90	100	30	26.0	33.5	9,500	95	Steel
K 100x110x30	100	110	30	28.0	36.5	8,500	105	Steel
K 120x130x30	120	130	30	33.0	42.5	7,500	125	Steel
K 130x140x30	130	140	30	35.0	45.5	7,000	140	Steel

11.4.4 Needle roller trust bearing



Bearing Code	Bore Diameter (mm)	Outer Diameter (mm)	Width (mm)	Dynamic Load Rating (kN)	Static Load Rating (kN)	Speed Limit (RPM)	Mass (g)	Cage Material
AXK 0821 TN	8	21	2	6.2	8.0	12,000	3	Polyamide
AXK 1226	12	26	2	7.5	9.5	11,000	4	Steel
AXK 1730	17	30	2	9.0	11.0	9,000	6	Steel
AXK 2035	20	35	2	12.2	14.5	8,000	8	Steel
AXK 2542	25	42	2	16.0	19.0	7,000	12	Steel
AXK 3047	30	47	2	20.5	24.5	6,000	16	Steel
AXK 3552	35	52	2	23.0	27.0	5,500	18	Steel
AXK 4060	40	60	2	28.5	34.0	5,000	24	Steel
AXK 5070	50	70	3	32.0	38.0	4,500	32	Steel
AXK 6085	60	85	3	37.0	44.5	4,000	50	Steel
AXK 7090	70	90	3	42.5	50.0	3,800	60	Steel
AXK 80100	80	100	3	48.0	56.0	3,500	70	Steel
AXK 90120	90	120	3	52.5	64.0	3,200	95	Steel
AXK 100140	100	140	4	61.0	72.0	3,000	120	Steel

11.4.5 Combination Needle roller bearing



Bearing Code	Bore Diameter (mm)	Outer Diameter (mm)	Width (mm)	Dynamic Load Rating (kN)	Static Load Rating (kN)	Speed Limit (RPM)	Mass (g)	Cage Material
NKX 10	10	24	30	7.5 (Radial)	5.5 (Thrust)	20,000	20	Steel
NKX 15	15	30	40	11.5 (Radial)	7.5 (Thrust)	18,000	35	Steel
NKX 25	25	42	50	20.0 (Radial)	12.0 (Thrust)	15,000	65	Steel
NKX 30	30	47	55	25.0 (Radial)	15.0 (Thrust)	12,500	75	Steel
NKX 40	40	62	60	35.0 (Radial)	20.5 (Thrust)	10,500	125	Steel
NKX 50	50	72	70	40.5 (Radial)	25.0 (Thrust)	9,500	150	Steel
NKX 60	60	85	80	50.0 (Radial)	30.5 (Thrust)	8,500	210	Steel
NKX 70	70	95	90	56.0 (Radial)	35.0 (Thrust)	7,800	260	Steel
NKX 80	80	105	100	61.5 (Radial)	40.0 (Thrust)	7,000	320	Steel
NKX 90	90	120	110	68.0 (Radial)	46.0 (Thrust)	6,500	380	Steel
NKX 100	100	130	115	72.0 (Radial)	50.0 (Thrust)	6,000	420	Steel
NKX 110	110	140	120	80.0 (Radial)	56.0 (Thrust)	5,500	460	Steel

12. References

Our Expertise has been experienced by clients with the highest quality standards



13. Contact Information

For more information or to place an order, please contact us at:

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This comprehensive Bearings General Catalogue provides detailed information about various types of ball bearings, including technical specifications, features, benefits, applications, a bearing selection guide, and guidelines for fatigue life and lubrication calculations.



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