TIMKEN®

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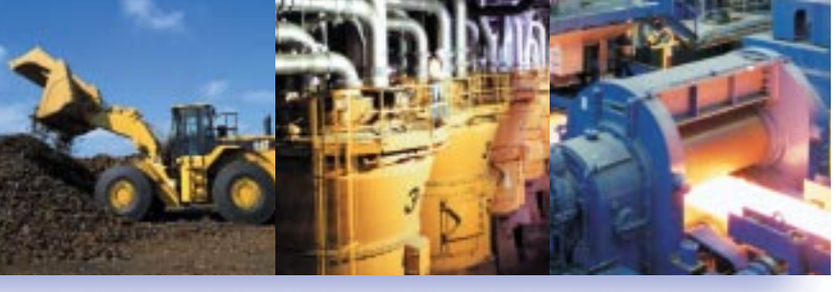
Timken® Spherical and Cylindrical Roller Bearings | Product and Technical Handbook

THE TIMKEN COMPANY



Timken Product and Technical Handbook

Timken realized long ago that there is more to producing a bearing than simply putting a design on paper and manufacturing it. We approach bearing manufacturing as a dynamic process where customer-focused needs and in-depth knowledge of mechanical properties and engineering unite. For years, Timken has employed this philosophy throughout its product and service offerings, including our line of large-bore Timken® spherical and cylindrical roller bearings. Timken spherical and cylindrical bearings provide competitive solutions by delivering the performance required to meet the rigors of today's demanding applications.

Timken Performance

Like our well-known tapered roller bearings, Timken spherical and cylindrical bearings provide exceptional performance in three essential ways:

- Performance that starts with having one of the highest standard published ratings in the industry, resulting in longer life for applications like power plants, oilfield and mining.
- Performance that provides the capability to manage high radial loads while withstanding marginal lubrication, contamination, extreme speeds and critical application stress factors, many of which are inherent in industrial processes.
- Performance that is engineered into the bearing design through tight critical dimensions, such as roller and raceway diameters and contact geometry.

Regardless of your application demands, Timken spherical and cylindrical bearings are manufactured to be durable, precise and dependable – attributes that ensure value along the entire supply chain.

Spherical and Cylindrical Applications

Oilfield
- Mud Pumps
- Draw Works
- Power Generation
- Coal Pulverizers

Mining
- Conveyor Drives
- Draglines
- Shovels
- Power Transmission
- Gear Drives
- Wind Energy
- Turbines

Metal Recycling
- Metal Shredders
- Briquetting Machines
- Rotary Dryers
- Rubber Mixing
- Banburys

Metal Processing
- Shears
- Rolling Mills
- Cement
- Conveyor Drives
- Vertical Mills
- Stacker Reclaimer
- Aggregate Crushing
- Hammer Mills
- Jaw Crushers
- Gyratory Cone

Pulp and Paper
- Wet End Applications

Competitive Solutions

Whether it's Timken customer engineering teams working with you on original equipment designs or our sales and service engineers providing on-site support at your facility, Timken consistently creates competitive solutions to keep your equipment running smoothly. Timken technological resources augment our products and provide ways to enhance performance and life:

- **Timken® Spexx™ bearings –** These industrial bearings feature surface finishes and tribological coatings that improve wear, lengthen fatigue life and boost frictional performance. Product lines include DuraSpexx™ power rating series, debris solutions, AquaSpexx™, Timken engineered surfaces and P900™ bearings.
- **Lubrication options –** Our solid lube is made from advanced polymers that retain viscosity. Timken G-Power and M-Power single-point lubricators consistently grease bearings while in operation. Similarly, our premium mill grease is created to enhance rolling mill performance.
- **Analytical tools –** State-of-the-art computer modeling and diagnostics identify design issues and provide proactive maintenance strategies. In addition to products and services that help identify up-front solutions, Timken offers follow-up services that trim maintenance budgets and reduce downtime.
- **Bearing training –** Our industrial training programs equip your employees to better install and handle bearings. During sessions at our facilities or yours, Timken engineers share valuable insights into bearing design, metallurgy and effective maintenance procedures, and then audit your team members' proficiency.
- **Timken Industrial Services –** Timken Industrial Services offers an array of repair and refurbishment options for customers, including:
  - **Bearing repair –** offering bearing repair of all sizes, types and brands, often for a fraction of the price of replacement bearings.
  - **Roll repair and overlays –** enhancing the life of rolls and reducing yearly roll costs.
  - **Chock rebuilds and manufacturing –** covering mini-rebuilds, full rebuilds and new chocks/housings within hot and cold mills.
  - **Z-Mill backing assembly options –** returning backing assemblies to their original specification for a fraction of the cost.

Timken also offers **four-row cylindrical bearings** for rolling mill applications. Page 31 lists four-row design information and fitting practices, and page 48 provides four-row part numbers. For more information on this design, contact your Timken sales representative or distributor.

For more than 100 years, delivering reliable Timken performance and competitive solutions to industrial customers has been the cornerstone of our business. It is the only way we know how to do business, and our line of Timken spherical and cylindrical bearings clearly supports that commitment.

For more information on our spherical and cylindrical product lines and accompanying services, contact your local Timken representative or visit timken.com.

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Preface

This product and technical handbook for Timken spherical and cylindrical roller bearings is a reference guide to the fundamentals of selecting and applying Timken spherical and cylindrical roller bearings. It provides an understanding of the bearing design and performance features. Major emphasis is placed on the bearing selection process to fill various application requirements. Bearing tolerances and suggested fitting practice are also included.

In addition to the traditional approach to bearing selection, this publication introduces a more in-depth analysis. This expanded version of the traditional approach is termed bearing system analysis (BSA) and in addition to load and speed, it includes the effects of lubrication, reliability, material properties, misalignment, load zones and useful life on bearing life. Using knowledge of all operational and environmental requirements of the application, together with past experience, BSA can help assure the proper bearing selection to achieve the desired bearing field performance.

WARNING

Failure to observe the following warnings could lead to a risk of serious bodily harm:

- Never spin a bearing with compressed air. The rollers may be forcefully expelled.
- If a hammer and bar are used for bearing removal, fragments from the hammer, bar or the bearing can be released with high velocity. *Note: A mild steel bar is preferred since it is less susceptible to fragmenting.*
- When installing or removing bearings, always wear safety glasses or goggles.
- Cleaning solvents may be toxic or flammable. Ensure adequate ventilation and wear protective clothing.
- Remove oil or rust inhibitor from parts before heating to avoid fire or fumes.

Roller Bearing Selection Process

Bearing selection is a process for evaluating the suitability of bearings for specific industrial applications. The quality of the information available to make these selections will play a major role in determining the success of the bearing selection.

The first step in bearing selection is identifying the proper bearing type, whether it is a cylindrical, spherical or tapered roller bearing. (See Timken's Tapered Roller Bearing Guide [Order No. 5667], for selections.) Each roller bearing type has advantages and disadvantages that are specific to each design and will affect such things as the loads and speeds that the bearing can sustain in the application.

We will begin with the assumption that a spherical or cylindrical roller bearing has been determined to be best suited for your application.

Next, assess the size constraints of the bearing envelope, or available space. This is done by considering the minimum shaft diameter, maximum housing bore, and available width within the application for the bearing. After the bearing envelope is defined, search the catalog for bearings with bores, outer diameters and widths that will fit within the bearing envelope. There may be several bearings with different load-carrying capacities available that fit within the envelope.

Determine which of these bearings will give the desired life in the application by performing a bearing life analysis for each bearing. The Bearing Load Ratings and Life Calculations section (page 10) in this handbook give a detailed explanation of how to perform bearing life analysis.

Once you have chosen the right bearing to handle the load requirements of the application, the bearing selection is completed with the selection of design options. These options include such features as cage type, cylindrical roller bearing flange arrangements, radial internal clearance, precision and lubrication. These options are selected based on the application's speed, temperature, mounting, and loading conditions, and will enable you to achieve optimal bearing performance and life.

For a closer look, your Timken sales representative can provide you with expert computer analysis to give you the most detailed information for your bearing application.

Characteristic	TRB Radial Double Row	TRB Thrust	CRB Caged Single Row	CRB Full Complement Single Row	CRB Thrust	SRB Radial Double Row	SRB Thrust
Pure Radial Load	Excellent	Unsuitable	Excellent	Excellent	Unsuitable	Excellent	Unsuitable
Pure Axial Load	Good	Excellent	Unsuitable	Unsuitable	Good	Fair	Excellent
Combined Load	Excellent	Fair	Fair	Poor	Unsuitable	Excellent	Fair
Moment Load	Fair	Poor	Unsuitable	Unsuitable	Unsuitable	Unsuitable	Unsuitable
High Stiffness	Excellent	Excellent	Good	Excellent	Excellent	Good	Good
Quiet Running	Fair	Fair	Good	Poor	Poor	Fair	Poor
Low Friction	Fair	Fair	Good	Poor	Poor	Fair	Fair
Misalignment	Poor	Poor	Poor	Poor	Unsuitable	Excellent	Excellent
Locating Position (Fixed)	Excellent	Good	*Fair	Fair	Fair	Good	Good
Non-Locating Position (Floating)	Good	Unsuitable	**Excellent	Fair	Unsuitable	Fair	Unsuitable

*Fair with flanges on inner and outer ring/unsuitable without
**Excellent without flanges on inner or outer ring/unsuitable with

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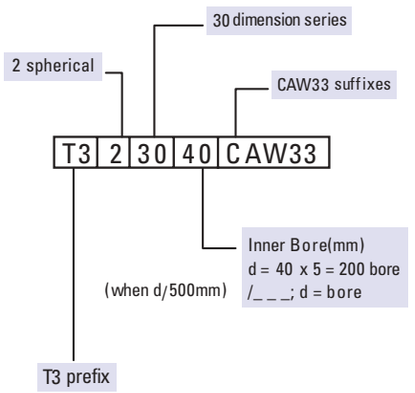
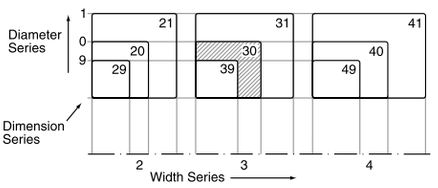
Spherical Roller Bearing Part Numbering

Timken uses a part numbering system based on the established world numbering system for spherical roller bearings. The system consists of a five-digit number, to which a variety of prefixes and suffixes are attached, indicating application-specific design customizations.



For example, consider part number T3-23040CAW33. The prefix (T3) designates carburized steel for rollers. The number (2) designates a spherical roller bearing. The next two digits (30) are referred to as the dimension series. They define the width and outer diameter of the bearing envelope. (See the shaded area in the figure at the top of the next column.) The first digit, which is the width series, ranges from 8,0,1,2,3,4,5,6 with 6 being the widest. The second digit is the outside diameter series, and ranges from 7,8,9,0,1,2,3,4 with 4 being the largest. The fourth and fifth



Series Designation

digits of the part number (40) represents the bore size in mm. Multiply this number by 5 to get the actual bore size. If there is a slash (/) between the third and fourth digits, the actual bore size would follow. This (/) rule only applies to bearings with a bore of 500 mm or larger. (Example: Spherical roller bearing 230/500CAW33 has a 500 mm bore.)

The following tables list the common Timken prefixes for spherical roller bearings.

Common Timken spherical roller bearing prefixes*:

T	Case carburized rings and rollers
T0	Case carburized rings
T1	Case carburized outer ring
T2	Case carburized inner ring
T3	Case carburized rollers
T4	Case carburized outer ring and rollers
T5	Case carburized inner ring and rollers

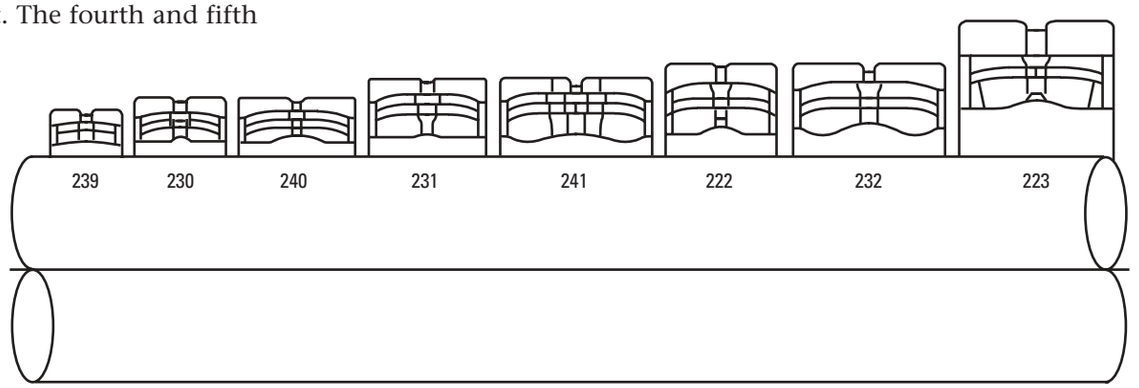
*Standard product without prefix is through hardened.

The following tables list the common Timken suffixes for spherical roller bearings.

Common Timken spherical roller bearing suffixes:

CA	One-piece, machined brass, inner ring guided cage
W33	Annular groove and three lubrication holes in outer ring
W77	W33 with holes plugged
W20	Three lubrication holes in outer ring
W26	Six lubrication holes in inner ring
W513	W33 and W26
W61	Lifting holes in outer ring
W517	W33 and W61
K (K30)	1:12 (1:30) tapered bore
C1 thru C5	(see section on radial internal clearance)
RIC designations	
R123...456	Special, non-standard RIC
C08	Special running accuracy (see page 17)
S1**	Normal dimensional stability to 200˚C
S2	Normal dimensional stability to 250˚C
S3	Normal dimensional stability to 300˚C

**This suffix is standard, so it is not included in the part number.



Typical Spherical Size Range

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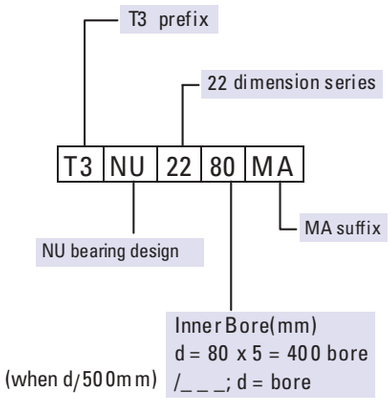
Cylindrical Roller Bearing Part Numbering

Timken uses a part numbering system based on the established world numbering system for cylindrical roller bearings. The system consists of cylindrical bearing design type prefixes, dimension series, bore size, and variety of suffixes that identify design and application specific customizations.



For example, consider part number T3-NU2280MA. The first prefix (T3) designates case carburized rollers. The next prefix (NU) designates the cylindrical bearing design having two machined flanges on the outer ring and no flanges on the inner ring. The cylindrical bearing types are described in the following section titled Cylindrical Roller Bearing Types, page 9. The next two digits (22) are the dimension series. (See the Spherical Roller Bearing Part Numbering section, page 6, for details.) The next two digits (80) represent the bore size in mm. Multiply this number by 5 to get the actual bore size. If there is a slash (/) between the third and fourth digits, the actual bore size would follow. This (/) rule only applies to bearings with a bore of 500 mm or larger. (Example: SRB 239/500CAW33 has a 500 mm bore.)

The following tables list the common Timken prefixes for cylindrical roller bearings.

Common Timken cylindrical roller bearing prefixes*:

T	Case carburized rings and rollers
T0	Case carburized rings
T1	Case carburized outer ring
T2	Case carburized inner ring
T3	Case carburized rollers
T4	Case carburized outer ring and rollers
T5	Case carburized inner ring and rollers

*Standard product without prefix is through hardened. See the Cylindrical Roller Bearing Designs section for additional prefixes.

The following tables list the common Timken suffixes for cylindrical roller bearings.

Common Timken cylindrical roller bearing suffixes:

M	Roller guided brass machined cage
MA	Outer ring guided brass machined cage
MB	Inner ring guided brass machined cage
E	Optimized internal design
F	Massive steel cage
V	No cage (used with NCF)
W33	Annular groove and three lubrication holes in outer ring
W20	Three lubrication holes in outer ring
W26	Six lubrication holes in inner ring
W513	W33 and W26
K (K30)	1:12 (1:30) tapered bore
C1 thru C5	RIC designations (see section on radial internal clearance)
R123...456	Special, non-standard RIC
S1**	Normal dimensional stability to 200°C
S2	Normal dimensional stability to 250°C
S3	Normal dimensional stability to 300°C

**This suffix is standard, so it is not included in the part number.

Spherical and Cylindrical Roller Bearing Cage Designs

Spherical Design

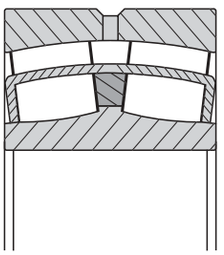
There are two basic variations of cage designs available:

- C Stamped steel
- CA Inner ring guided, brass

Contact your Timken sales representative for availability of different cage designs.

C Style

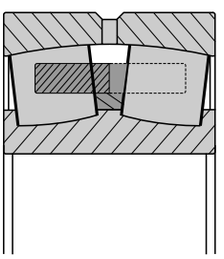
The C-style cage is a stamped steel, window or pocket-type cage. This design allows for a significantly reduced cage section because the bridge is supported on both sides. Also, the cage eliminates the need for the outboard retaining flanges and allows for longer rollers. The cage is made from two pieces, allowing the rows to move independently from each other, which may be beneficial in higher-speed applications or those with extreme thrust loading. This is the standard cage for smaller bore bearings, typically 180 mm and below.



C design with stamped cage

CA Style

The CA-style cage is a one-piece, double-pronged, machined-brass, inner-ring-guided cage. This is the standard cage for large bore bearings, typically 180 mm and above. The cage design provides adequate strength in guiding the heavy rollers through accelerations and decelerations experienced when entering and exiting the load zone. The brass cages have specially designed fingers to guide the rollers and limit skewing. Outboard flanges on the inner ring are used to retain the roller complement.



CA design with inner-ring-guided, machined-brass cage

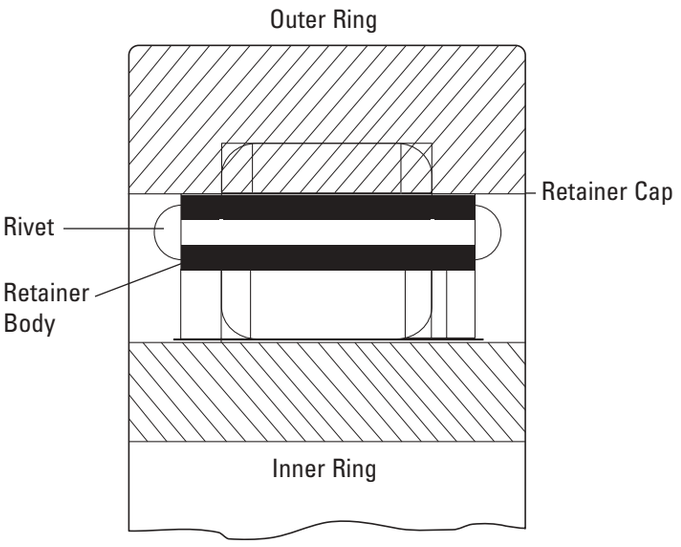
Cylindrical Design

There are many different configurations of cylindrical roller bearings, depending on application needs and mounting requirements. Some of the configurations can have flanges on the inner ring, outer ring or separable rings. There are single-row and also multiple-row bearings with these different configurations.

The selection of cylindrical roller bearing configuration depends on the application conditions, mounting, and assembly requirements. At right are some of the more common configurations for cylindrical roller bearings. Listed for each of the different bearing configurations are the basic design features, typical cage types, and basic mounting considerations.

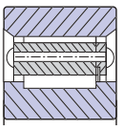
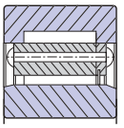
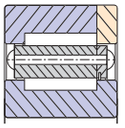
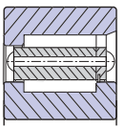
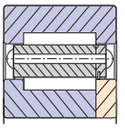
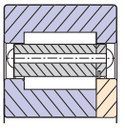
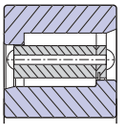
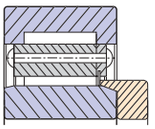
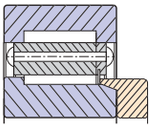
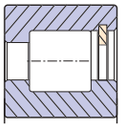
Machined Brass Cage

Machined brass cages are strong enough for high-speed applications and good for heavy-duty applications. The benefits of machined brass cages are low friction, quiet operation, high strength and cool operation. Machined brass cages have a two-piece design, held together with fasteners through the cage bridges. This is shown in the figure below:



One piece is a retainer cap ring and the other piece is a retainer body ring with integral separators (cage bridges). They are typically riveted together, although larger bearings may use cap screws.

(continued on page 10)

Bearing Designs	Design Features	Diagram
N	Two inner-ring flanges No outer-ring flanges Non-locating bearing (floating) Inner- or roller-guided cage	
NU	No inner-ring flanges Two outer-ring flanges Non-locating bearing (floating) Outer- or roller-guided cage	
NJ	One inner-ring flange Two outer-ring flanges Locates shaft axially in one direction Outer- or roller-guided cage	
NF	Two inner-ring flanges One outer-ring flange Locates shaft axially in one direction Inner- or roller-guided cage	
NP	Two inner-ring flanges One outer-ring flange One separable flange on outer ring Flange must be clamped against outer ring by means of the bearing mounting Locates shaft axially in both directions Inner- or roller-guided cage	
NUP	One inner-ring flange Two outer-ring flanges One separable flange on inner ring Flange must be clamped against outer ring by means of the bearing mounting Locates shaft axially in both directions Outer- or roller-guided cage	
NJF	One inner-ring flange One outer-ring flange Locates shaft axially in one direction Allows both shaft and housing to float Outer- or inner-guided cage	
NU + HJ	No inner-ring flanges Two outer-ring flanges One separable inner ring flange Locates shaft axially in one direction Outer- or roller-guided cage	
NJ + HJ	One inner-ring flange Two outer-ring flanges One separable inner ring flange Locates shaft axially in both directions Outer- or roller-guided cage	
NCF Full Complement	Two inner-ring flanges One outer-ring flange Retaining ring on outer ring to contain assembly Locates shaft axially in one direction Cageless design allows higher capacity bearing in a given envelope	

(continued from page 8)

There are three styles of machined brass cages: MA, MB and M. MA-type cages are outer-ring guided and are used in applications with pure outer-ring rotation. MB-type cages are inner-ring guided and are used in applications with pure inner-ring rotation. M-type machined brass cages are roller-guided and are used in applications with mixed rotation, where both the inner or outer ring could rotate. The standard Timken cage for most general applications is an MA-type brass cage. All three cage types are usually interchangeable between standard applications, but there are some exceptions. Many times, the flange design of the cylindrical roller bearing dictates the type of cage used. M-type cages are not recommended for thin cross-section bearings (thin, long rollers) due to possible skewing of the cage and rollers. The M-type cage is also not recommended for high-speed or oscillatory applications, where the cage can whirl due to higher G-forces on the cage.

Pin-Type Cage

Pin-type cages for cylindrical roller bearings have pins to support the rollers through their centers. The pins have one threaded end, which screws into one cage ring, and the other ends are welded to the other ring. There are some heavy-duty bearings where the pins are welded at both ends. The pin-type cage design allows for the largest number of rollers, and therefore the highest load capacity. This cage design is found on many larger cylindrical roller bearings.

Bearing Load Ratings and Life Calculations

The basic dynamic load rating and the static load rating are commonly used for bearing selection. The basic dynamic load rating is used to estimate life of a rotating bearing. Static load ratings are used to determine the maximum permissible load that can be applied to a non-rotating bearing. The basic philosophy of The Timken Company is to provide the most realistic bearing rating to assist our customers in the bearing selection process. Published ratings for Timken spherical and cylindrical bearings include the basic dynamic radial load rating C_{90}. This value is based on a basic rating life of ninety million revolutions. The basic static radial load rating is C_o.

Static Bearing Loads

The basic static load rating for a bearing is determined in accordance with ISO 76, and listed in the bearing tables. The equation for determining the equivalent static radial load is given below, and the static load factors X_0 and Y_0 are listed in the bearing tables.

$$P_{0r} = X_0F_r + Y_0F_a$$

Where,

P_{0r} = Static Equivalent Radial Load
F_r = Applied Radial Load
F_a = Applied Axial Load
X_0 = Static Radial Load Factor
Y_0 = Static Axial Load Factor

When selecting a bearing with an unknown static and/or pronounced shock loading, the equivalent radial load calculated for your application should be multiplied by a factor of safety between 2 and 4 (depending on the noise requirements). For more information on selecting a bearing for shock and static load conditions, contact your Timken representative.

Bearing Life

Many different performance criteria exist that dictate how a bearing should be selected. These include bearing fatigue life, rotational precision, power requirements, temperature limits, speed capabilities and sound. This handbook deals primarily with bearing life as related to material associated fatigue life.

Bearing life is defined here as the length of time, or number of revolutions, until a fatigue spall of 6 mm^2 (0.01 in^2) develops. Since metal fatigue is a statistical phenomenon, the life of an individual bearing is impossible to predetermine precisely. Bearings that may appear to be identical can exhibit considerable life scatter when tested under identical conditions. Thus it is necessary to base life predictions on a statistical evaluation of a large number of bearings operating under similar conditions. The Weibull distribution function is commonly used to predict life of a bearing at any given reliability level.

Rating Life

Rating life, L_{10}, is the life that 90 percent of a group of apparently identical bearings will complete or exceed before a fatigue spall develops. The L_{10} life is also associated with 90 percent reliability for a single bearing under a certain load.

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Bearing Life Equations

Traditionally, the L_{10} life has been calculated as follows for bearings under radial or combined loading where the dynamic equivalent radial load, P_r, has been determined:

$$L_{10} = \left(\frac{C_1}{P_r}\right)^{10/3} (1 \times 10^6) \text{ revolutions}$$

or

$$L_{10} = \left(\frac{C_1}{P_r}\right)^{10/3} \left(\frac{1 \times 10^6}{60_n}\right) \text{ hours}$$

Where n = RPM

With increased emphasis on the relationship between the reference conditions and the actual environment in which the bearing operates in the machine, the traditional life equations have been expanded to include certain additional variables that affect bearing performance. The approach whereby these factors, including a factor for useful life are considered in the bearing analysis and selection has been termed bearing systems analysis.

The ISO/ABMA expanded bearing life equation is:

$$L_{10a} = a_1 a_2 a_3 L_{10}$$

Where

- a_1 = reliability life factor
- a_2 = material life factor
- a_3 = operating condition life Factor (to be specified by the manufacturer)

The Timken expanded bearing life equation is:

$$L_{10a} = a_1 a_2 a_{3d} a_{3k} a_{3l} a_{3m} a_{3p} a_4$$

Where

- a_1 = reliability life factor
- a_2 = material life factor
- a_{3d} = debris life factor
- a_{3k} = load zone life factor
- a_{3l} = lubrication life factor
- a_{3m} = misalignment life factor
- a_{3p} = low load life factor
- a_4 = useful life adjustment factor

Reliability Life Factor (a_1)

The equation for the life adjustment factor for reliability is:

$$a_1 = 4.48 \left(ln \frac{100}{R}\right)^{2/3}$$

To adjust the calculated L_{10} life for reliability, multiply by the a1 factor. If 90 (90 percent reliability) is substituted for R in the above equation, $a_1 = 1$. For R = 99 (99 percent reliability), $a_1 = 0.21$.

Note that the equation for reliability adjustment assumes there is not a minimum life below which the probability of failure is minimal (i.e., zero probability of failure produces zero life). However, extensive bearing fatigue life testing has shown a minimum life exists below which the probability of failure is negligible. For a more accurate prediction of bearing lives for small probabilities of failure, contact your Timken representative.

Material Life Factor (a_2)

The life adjustment factor for bearing material, a_2, for standard Timken bearings manufactured from bearing-quality steel is 1.0. Bearings are also manufactured from premium steels, containing fewer and smaller inclusion impurities than standard steels and providing the benefit of extending bearing fatigue life (i.e., DuraSpexx bearings).

Application of the material life factor requires that fatigue life is limited by nonmetallic inclusions and that contact stresses are approximately less than 200 percent of the C rating, or less than 2400 MPa (350 KSI), and adequate lubrication is provided.

It is important to note that improvements in material can not offset poor lubrication in an operating bearing system. Please contact a Timken representative for applicability of the material factor.

Debris Life Factor (a_{3d})

Debris within a lubrication system reduces the life of a roller bearing by creating indentations on the contacting surfaces, leading to stress risers. The Timken life rating equations were developed based on test data obtained with 40µm oil filtration, and measured ISO cleanliness levels of approximately 15/12, which is typical of cleanliness levels found in normal industrial machinery. When more or less debris is present within the system, the fatigue life predictions can be adjusted according to the measured or expected ISO lubricant cleanliness level to more accurately reflect the expected bearing performance.

As opposed to determining the debris life factor based on ISO cleanliness levels, a Debris Signature Analysis™ can be performed for more accurate bearing performance predictions.

The Debris Signature Analysis is a process for determining the effects of the actual debris present in your system on the bearing performance. The typical way in which this occurs is through measurements of dented/bruised surfaces on actual bearings run in a given application. This type of analysis can be beneficial because different types of debris cause differing levels of performance, even when they are of the same size and amount in the lubricant.

Soft, ductile particles can cause less performance degradation than hard, brittle particles. Hard, ductile particles are typically most detrimental to bearing life. Brittle particles can break down, which

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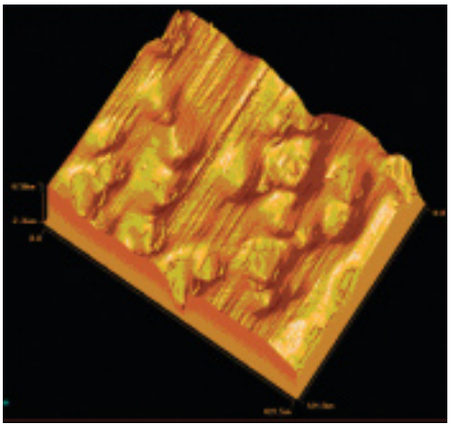
will not affect performance to as large of a degree as hard ductile particles. For more information on Debris Signature Analysis or the availability of debris resistant bearings for your application, contact your Timken representative.

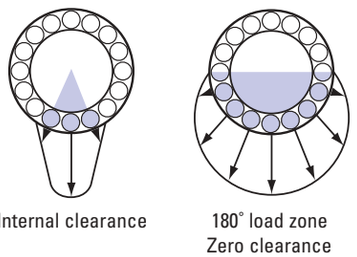


Surface Map of a Bearing Raceway with Debris Denting

Load Zone Life Factor (a_{3k})

The fatigue life of a bearing is a function of the stresses in rollers and raceways and the number of stress cycles that the loaded bearing surfaces experience in one bearing revolution. The stresses depend on applied load and on how many rollers support that load; the number of stress cycles depends on bearing geometry and, again, on how many rollers support the load.

Therefore, life for a given external load is related to the loaded arc, or load zone, of the bearing. The load zone in a spherical or cylindrical bearing is dominated by the internal clearance. Neglecting preload, less clearance in a bearing results in a larger load zone and subsequently longer bearing life.



Bearing Load Zones and Roller-Raceway Contact Loading

Using the dynamic equivalent load (Pr) instead of the applied radial load (Fr) in the equation for L10a roughly approximates the load zone factor for combined loading only. If a more accurate assessment of the load zone adjusted life is necessary (i.e., including the effects of internal clearance or fitting practice), contact your Timken representative to quantify this value using sophisticated computer programs.

Lubrication Life Factor (a_{3l})

The influence of lubrication film due to elastohydrodynamic (EHL) lubrication on bearing performance is related to the reduction or prevention of asperity (metal-to-metal) contact between the bearing surfaces.

During the last decade, extensive testing has been done at Timken's research facilities to quantify the effects of the lubrication-related parameters on bearing life. It has been found that the roller and raceway surface finish relative to lubricant film thickness have the most notable effect on improving bearing performance, while other factors include bearing geometry, material, loads and load zone also play an important role.

The following equation provides a simple method to calculate the lubrication factor for a more accurate prediction of the influence of lubrication on bearing life (L_{10a}).

$$a_{3l} = C_g \cdot C_l \cdot C_s \cdot C_v \cdot C_{gr}$$

Where
C_g = geometry factor
C_l = load factor
C_j = load zone factor
C_s = speed factor
C_v = viscosity factor
C_{gr} = grease lubrication factor

A lubricant contamination factor is not included in the lubrication factor because our endurance tests are run with a 40µm filter, corresponding to an ISO 15/12 cleanliness level, to provide a realistic approximation of typical lubricant cleanliness.

Geometry factor - *Cg*

Cg is given for each part number in the bearing tables that follow. The geometry factor also includes the material and load zone effects, as these are also inherent to the bearing design. However, the primary effect of the load zone is on roller load distributions and contact stresses within the bearing [refer to the previous section – Load Zone Life Factor (a_{3k})], which are not quantified within the lubrication factor.

Note that the geometry factor (C_g) factor is not applicable to our DuraSpexx product. For more information on DuraSpexx, consult your Timken representative.

Load factor - C_l

The C_l factor is obtained from the following figure. Note that the factor is different for spherical and cylindrical roller bearings. P_r is the equivalent load applied to the bearing in Newtons, and is determined in the Equivalent Bearing Loads (P_r) section.

Speed factor - C_s

C_s is determined from the following figure, where rev/min (RPM) is the rotational speed of the inner ring relative to the outer ring.

Viscosity factor - C_v

The lubricant kinematic viscosity [Centistokes (cSt)] is taken at the operating temperature of the bearing. The operating viscosity can be estimated by using the figure in the Lubrication section, and the viscosity factor (C_v) can then be determined from the following figure.

Grease lubrication factor – C_{gr}

For grease lubrication, the EHL lubrication film becomes depleted of oil over time and is reduced in thickness. Consequently, a reduction factor (C_{gr}) should be used to adjust for this effect.

$C_{gr} = 0.79$

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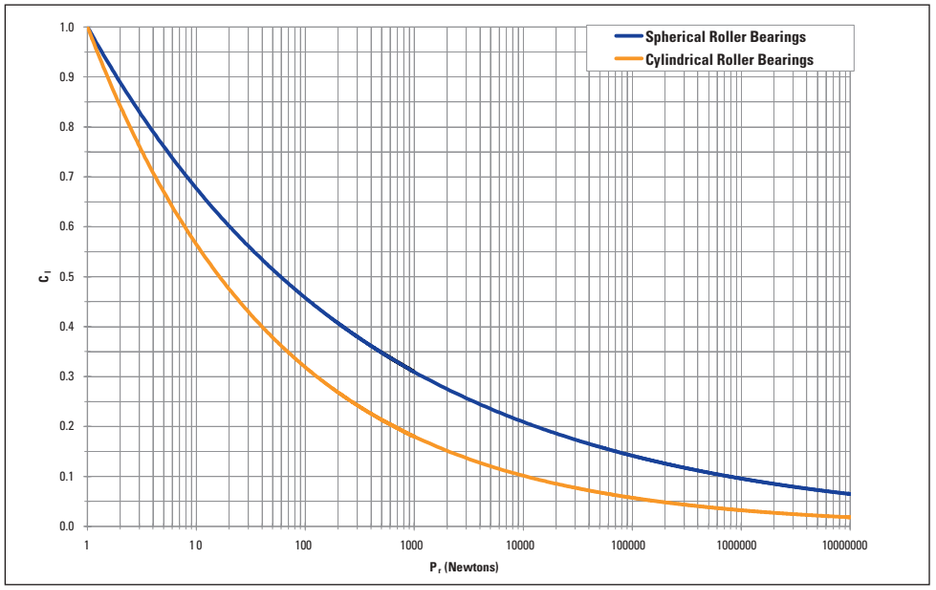
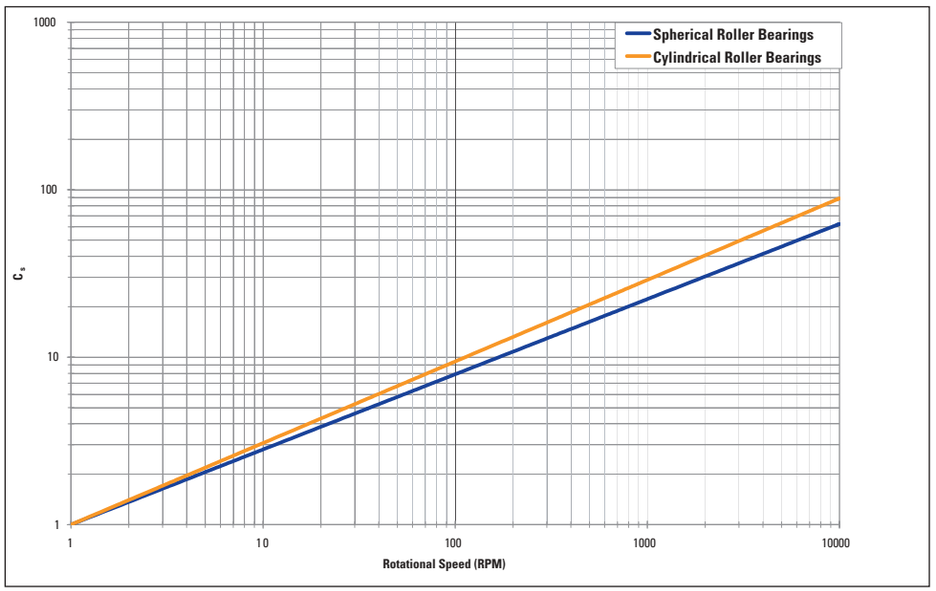
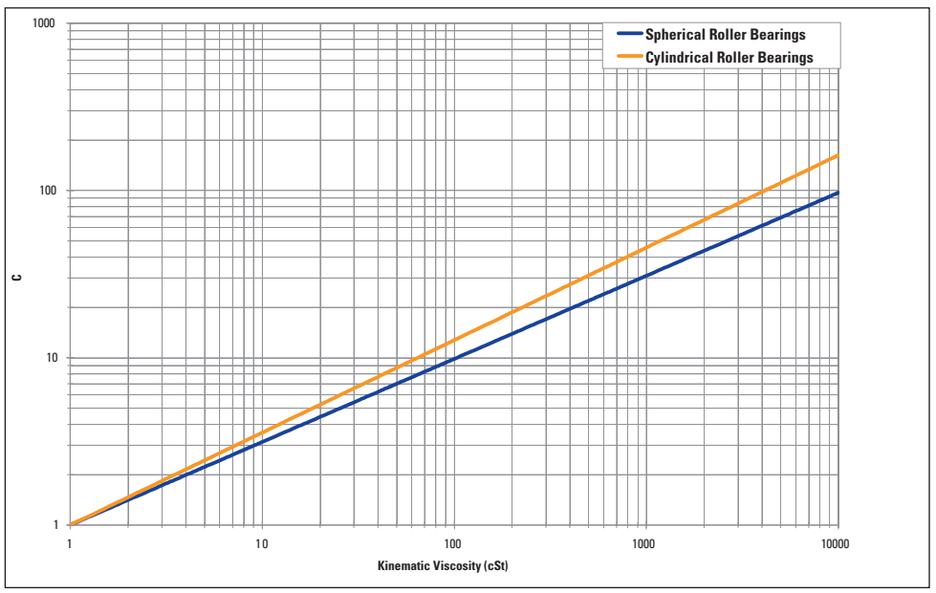
Load Factor (C_l) vs. Equivalent Bearing Load (P_r)



Speed Factor (Cs) vs. Rotational Speed



Viscosity Factor (C_v) vs. Kinematic Viscosity



Misalignment Life Factor (a_{3m})

The effect of bearing life depends on the magnitude of the angle of misalignment, on the internal bearing geometry, and on the applied loads.

The misalignment life factor for spherical bearings is equal to one, $a_{3m} = 1$, due to the self-aligning capabilities of a spherical roller bearing, when the allowable misalignment in a SRB bearing is between 1˚ and 2.5˚, depending upon the series of the bearing (see the Misalignment section, page 29). Life will be reduced if these limits are exceeded, when significant misalignment is introduced, due to roller-raceway contact truncation.

For cylindrical roller bearings, accurate alignment of the shaft relative to the housing is essential for proper performance.

For cylindrical roller bearings, accurate alignment of the shaft relative to the housing is essential for proper performance. The base condition for which the load rating of cylindrical roller bearings are defined is zero axial load and 0.0005 radians misalignment.

For cylindrical roller bearings, the misalignment factor is also a measure of the effect of bearing axial load on life.

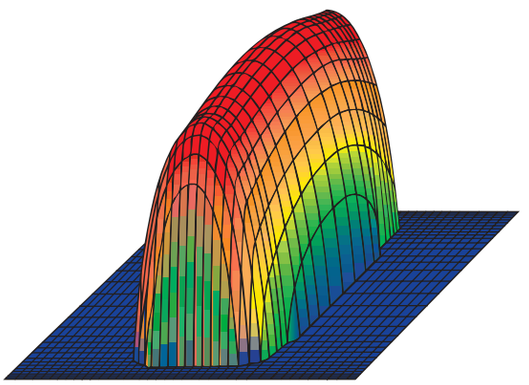
Axial loading of a cylindrical roller bearing causes a moment to be generated about the roller center, thus shifting the roller-raceway contact stresses similar to bearing misalignment.

Performance of the cylindrical roller bearings under various levels of misalignment and axial load can be predicted using sophisticated computer programs. Using these programs, Timken engineers can design special bearing contact profiles to accommodate the conditions of axial load and/or bearing misalignment in your application. Contact your Timken representative for more information.

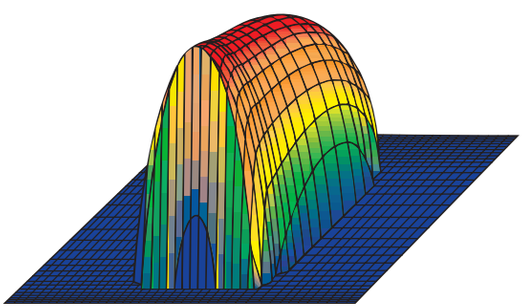
Low Load Life Factor (a_{3p})

Bearing life tests at Timken research facilities have shown greatly extended bearing fatigue life performance is achievable when the bearing contact stresses are low and the lubricant film is sufficient to fully separate the micro-scale textures of the contacting surfaces. Mating the test data with sophisticated computer programs for predicting bearing performance, Timken engineers have developed a low load factor for use in the catalog to predict the life increases expected when operating under low bearing loads. The following figures show the low-load factor (a3p) as a function of the lubricant life factor (a3l) and the ratio of bearing dynamic rating to the bearing equivalent load.

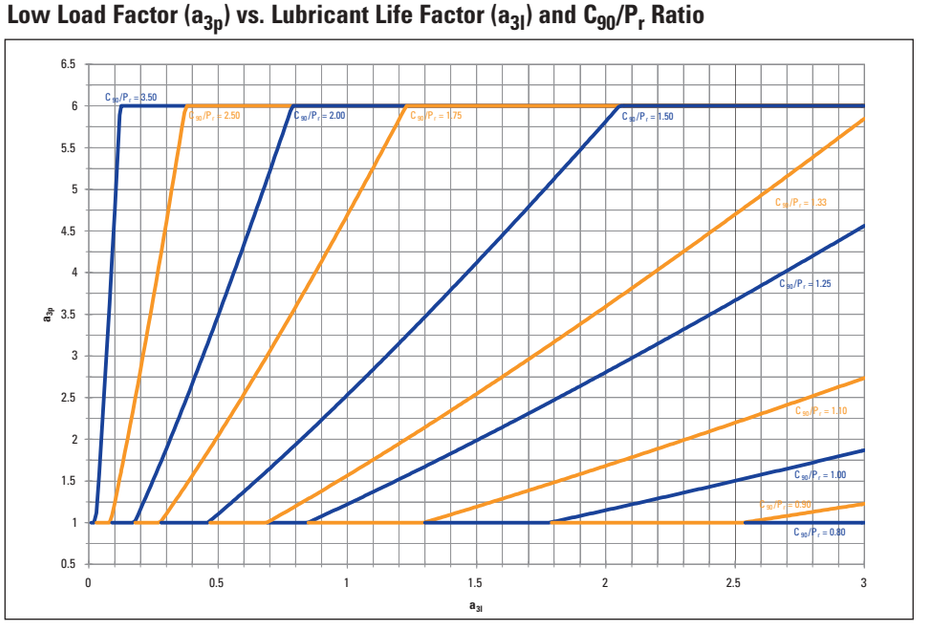
Roller Inner-Raceway Contact Stress without Misalignment



Roller Inner-Raceway Contact Stress with High Misalignment and Special Profiles



Low Load Factor (a_{3p}) vs. Lubricant Life Factor (a_{3l}) and C_{90}/P_r Ratio



Equivalent Bearing Loads (Pr)

To calculate the L_{10} life previously introduced, it is necessary to calculate a dynamic equivalent radial load, designated by P_r. The dynamic equivalent radial load is defined as a single radial load, that if applied to the bearing will result in the same life as the actual combined loading the bearing operates under.

$$P_r - XF_r + YF_a$$

Where

P_r = dynamic equivalent radial load
F_r = applied radial load
F_a = applied axial load
X = radial load factor
Y = axial load factor

For spherical roller bearings, the values for X and Y can be determined using the equations below. Calculate the ratio of the axial load to the radial load. Compare this ratio to the e value for the bearing.

In equation form,

$P_r = F_r + Y_1F_a$ for $F_a/F_r \le e$, and

$P_r = 0.67\ F_r + Y_2F_a$ for $F_a/F_r > e$.

Note that values for e, Y_1, and Y_2 are available in the data tables.

For cylindrical roller bearings, the equations for equivalent radial load can be determined using the tables below.

Bearing Series 2, 3 and 10

Load Range Ratio	Equivalent Radial Load
$0 \le F_a / F_r \le 0.11$	$P_r = F_r$
$0.11 < F_a / F_r \le 0.30$	$P_r = 0.925\ F_r + 0.682\ F_a$

Bearing Series 18, 19, 22, 23, 28, 29, 30 and 51

Load Range Ratio	Equivalent Radial Load
$0 \le F_a / F_r \le 0.17$	$P_r = F_r$
$0.17 < F_a / F_r \le 0.30$	$P_r = 0.925\ F_r + 0.441\ F_a$

Equivalent Radial Load for Cylindrical Roller Bearings

Spherical and cylindrical roller bearings are ordered with a specified standard or nonstandard radial internal clearance value. The standard radial internal clearances are designated as C1, C2, normal, C3, C4, or C5 and are in accordance with ISO 5753. C1 represents the minimum clearance and C5 represents the maximum clearance. Non-standardized values are also available by special request. Consult your Timken representative for more details on obtaining bearings with non-standard radial internal clearance values.

Standard radial internal clearance values are listed in the following tables based on bore size and type (tapered or cylindrical). The clearance required for a given application depends on the desired operating precision, the rotational speed of the bearing, and the fitting practice used. Most applications use a normal or C3 clearance. Typically, larger clearance reduces the operating load zone of the bearing, increases the maximum roller load and reduces the bearing's expected life (see the Bearing Life section, page 10). However, a spherical or cylindrical roller bearing that has been put into a preload condition can experience premature bearing damage caused by excessive heat generation and/or material fatigue.

Therefore, as a general guideline spherical and cylindrical roller bearings should NOT operate in a preloaded condition. For more information on the effect of bearing fitting practice on radial internal clearance, see the Bearing Mounting section (page 26).

To achieve an appropriate operating clearance, attention must be paid to the effects the fitting practice and thermal gradient within the bearing will have on the clearance. An interference fit between the inner ring and shaft or outer ring and housing will reduce the clearance within the bearing by typically 75 to 95 percent of the resultant fit.

Thus, a value of 85 percent can be used to approximate the amount of clearance loss due to the interference fit for most applications. For help selecting the necessary radial internal clearance for your application, consult your Timken representative.

Spherical Roller Bearing Radial Internal Clearance for Cylindrical Bore

Bore Diameter (mm)		Radial Internal Clearance (mm)											
		Group 1		Group 2		Group N		Group 3		Group 4		Group 5	
Over	Incl.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
14	18	--	--	.010	.020	.020	.035	.035	.045	.045	.060	.060	.075
18	24	--	--	.010	.020	.020	.035	.035	.045	.045	.060	.060	.075
24	30	--	--	.015	.025	.025	.040	.040	.055	.055	.075	.075	.095
30	40	--	--	.015	.030	.030	.045	.045	.060	.060	.080	.080	.100
40	50	--	--	.020	.035	.035	.055	.055	.075	.075	.100	.100	.125
50	65	--	--	.020	.040	.040	.065	.065	.090	.090	.120	.120	.150
65	80	--	--	.030	.050	.050	.080	.080	.110	.110	.145	.145	.180
80	100	.015	.035	.035	.060	.060	.100	.100	.135	.135	.180	.180	.225
100	120	.015	.040	.040	.075	.075	.120	.120	.160	.160	.210	.210	.260
120	140	.025	.050	.050	.095	.095	.145	.145	.190	.190	.240	.240	.300
140	160	.025	.060	.060	.110	.110	.170	.170	.220	.220	.280	.280	.350
160	180	.025	.065	.065	.120	.120	.180	.180	.240	.240	.310	.310	.390
180	200	.030	.070	.070	.130	.130	.200	.200	.260	.260	.340	.340	.430
200	225	.030	.080	.080	.140	.140	.220	.220	.290	.290	.380	.380	.470
225	250	.040	.090	.090	.150	.150	.240	.240	.320	.320	.420	.420	.520
250	280	.040	.100	.100	.170	.170	.260	.260	.350	.350	.460	.460	.570
280	315	.040	.110	.110	.190	.190	.280	.280	.370	.370	.500	.500	.630
315	355	.040	.120	.120	.200	.200	.310	.310	.410	.410	.550	.550	.690
355	400	.040	.130	.130	.220	.220	.340	.340	.450	.450	.600	.600	.750
400	450	.050	.140	.140	.240	.240	.370	.370	.500	.500	.660	.660	.820
450	500	.050	.140	.140	.260	.260	.410	.410	.550	.550	.720	.720	.900
500	560	.050	.150	.150	.280	.280	.440	.440	.600	.600	.780	.780	1.000
560	630	.060	.170	.170	.310	.310	.480	.480	.650	.650	.850	.850	1.100
630	710	.060	.190	.190	.350	.350	.530	.530	.700	.700	.920	.925	1.190
710	800	.060	.210	.210	.390	.390	.580	.580	.770	.770	1.010	1.010	1.300
800	900	.060	.230	.230	.430	.430	.650	.650	.860	.860	1.120	1.120	1.440
900	1000	.070	.260	.260	.480	.480	.710	.710	.930	.930	1.220	1.220	1.570
1000	1120	.080	.290	.290	.530	.530	.780	.780	1.020	1.020	1.330	1.330	1.720
1120	1250	.090	.320	.320	.580	.580	.860	.860	1.120	1.120	1.460	1.460	1.870
1250	1400	.090	.350	.350	.640	.640	.950	.950	1.240	1.240	1.620	1.620	2.060
1400	1600	.100	.400	.400	.720	.720	1.060	1.060	1.380	1.380	1.800	1.800	2.300
1600	1800	.110	.450	.450	.810	.810	1.180	1.180	1.550	1.550	2.000	2.000	2.550

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Spherical Roller Bearing Radial Internal Clearance for Tapered Bore

Bore Diameter (mm)		Radial Internal Clearance (mm)											
		Group 1		Group 2		Group N		Group 3		Group 4		Group 5	
Over	Incl.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
--	--	--	--	--	--	--	--	--	--	--	--	--	--
18	24	--	--	.015	.025	.025	.035	.035	.045	.045	.060	.060	.075
24	30	--	--	.020	.030	.030	.040	.040	.055	.055	.075	.075	.095
30	40	--	--	.025	.035	.035	.050	.050	.065	.065	.085	.085	.105
40	50	--	--	.030	.045	.045	.060	.060	.080	.080	.100	.100	.130
50	65	--	--	.040	.055	.055	.075	.075	.095	.095	.120	.120	.160
65	80	--	--	.050	.070	.070	.095	.095	.120	.120	.150	.150	.200
80	100	.035	.055	.055	.080	.080	.110	.110	.140	.140	.180	.180	.230
100	120	.040	.065	.065	.100	.100	.135	.135	.170	.170	.220	.220	.280
120	140	.050	.080	.080	.120	.120	.160	.160	.200	.200	.260	.260	.330
140	160	.055	.090	.090	.130	.130	.180	.180	.230	.230	.300	.300	.380
160	180	.060	.100	.100	.140	.140	.200	.200	.260	.260	.340	.340	.430
180	200	.070	.110	.110	.160	.160	.220	.220	.290	.290	.370	.370	.470
200	225	.070	.120	.120	.180	.180	.250	.250	.320	.320	.410	.410	.520
225	250	.080	.140	.140	.200	.200	.270	.270	.350	.350	.450	.450	.570
250	280	.080	.150	.150	.220	.220	.300	.300	.390	.390	.490	.490	.620
280	315	.100	.170	.170	.240	.240	.330	.330	.430	.430	.540	.540	.680
315	355	.110	.190	.190	.270	.270	.360	.360	.470	.470	.590	.590	.740
355	400	.120	.210	.210	.300	.300	.400	.400	.520	.520	.650	.650	.820
400	450	.130	.230	.230	.330	.330	.440	.440	.570	.570	.720	.720	.910
450	500	.150	.260	.260	.370	.370	.490	.490	.630	.630	.790	.790	1.000
500	560	.170	.290	.290	.410	.410	.540	.540	.680	.680	.870	.870	1.100
560	630	.180	.320	.320	.460	.460	.600	.600	.760	.760	.980	.980	1.230
630	710	.190	.350	.350	.510	.510	.670	.670	.850	.850	1.090	1.090	1.360
710	800	.210	.390	.390	.570	.570	.750	.750	.960	.960	1.220	1.220	1.500
800	900	.240	.440	.440	.640	.640	.840	.840	1.070	1.070	1.370	1.370	1.690
900	1000	.270	.490	.490	.710	.710	.930	.930	1.190	1.190	1.520	1.520	1.860
1000	1120	.290	.530	.530	.770	.770	1.030	1.030	1.300	1.300	1.670	1.670	2.050
1120	1250	.310	.570	.570	.830	.830	1.120	1.120	1.420	1.420	1.830	1.830	2.250
1250	1400	.330	.620	.620	.910	.910	1.230	1.230	1.560	1.560	2.000	2.000	2.450
1400	1600	.360	.680	.680	1.000	1.000	1.350	1.350	1.720	1.720	2.200	2.200	2.700
1600	1800	.390	.750	.750	1.110	1.110	1.500	1.500	1.920	1.920	2.400	2.400	2.950

Cylindrical Roller Bearing Radial Internal Clearance for Cylindrical Bore

Bore Diameter (mm)		Radial Internal Clearance (μm)											
		C1		C2		Normal		C3		C4		C5	
Over	Including	min	max	min	max	min	max	min	max	min	max	min	max
0	10	5	15	0	25	20	45	35	60	50	75		
10	24	5	15	0	25	20	45	35	60	50	75	65	90
24	30	5	15	0	25	20	45	35	60	50	75	70	95
30	40	5	15	5	30	25	50	45	70	60	85	80	105
40	50	5	18	5	35	30	60	50	80	70	100	95	125
50	65	5	20	10	40	40	70	60	90	80	110	110	140
65	80	10	25	10	45	40	75	65	100	90	125	130	165
80	100	10	30	15	50	50	85	75	110	105	140	155	190
100	120	10	30	15	55	50	90	85	125	125	165	180	220
120	140	10	35	15	60	60	105	100	145	145	190	200	245
140	160	10	35	20	70	70	120	115	165	165	215	225	275
160	180	10	40	25	75	75	125	120	170	170	220	250	300
180	200	15	45	35	90	90	145	140	195	195	250	275	330
200	225	15	50	45	105	105	165	160	220	220	280	305	365
225	250	15	50	45	110	110	175	170	235	235	300	330	395
250	280	20	55	55	125	125	195	190	260	260	330	370	440
280	315	20	60	55	130	130	205	200	275	275	350	410	485
315	355	20	65	65	145	145	225	225	305	305	385	455	535
355	400	25	75	100	190	190	280	280	370	370	460	510	600
400	450	25	85	110	210	210	310	310	410	410	510	565	665
450	500	25	95	110	220	220	330	330	440	440	550	625	735
500	560	25	100	120	240	240	360	360	480	480	600	690	810
560	630	30	110	140	260	260	380	380	500	500	620	780	900
630	710	30	130	145	285	285	425	425	565	565	705	865	1005
710	800	35	140	150	310	310	470	470	630	630	790	975	1135
800	900	35	160	180	350	350	520	520	690	690	860	1095	1265
900	1000	35	180	200	390	390	580	580	770	770	960	1215	1405
1000	1120			220	430	430	640	640	850	850	1060	1355	1565
1120	1250			230	470	470	710	710	950	950	1190	1510	1750
1250	1400			270	530	530	790	790	1050	1050	1310	1680	1940
1400	1600			330	610	610	890	890	1170	1170	1450	1920	2200
1600	1800			380	700	700	1020	1020	1340	1340	1660	2160	2480
1800	2000			400	760	760	1120	1120	1480	1480	1840	2390	2760

Standard Timken spherical and cylindrical roller bearings maintain normal tolerances according to ISO 492. For applications where the running tolerances are critical, P6 or P5 tolerances are recommended. The following table lists the critical tolerances for Timken spherical and cylindrical roller bearings with normal, P6 and P5 precision.

The C08 suffix denotes increased running accuracy on the inner and outer rings. The inner and outer ring runouts for C08 bearings are held to P5 tolerances.

For more information about the availability of P6, P5, C08 or other non-standard tolerances, contact your Timken representative.

Inner Ring Tolerances for Both Bearing Types

Bearing Bore Diameter (mm)		Tolerance on Bearing Bore Diameter (μm)			Assembled Inner Ring Runout (μm)			Tolerance on Inner Ring Width (μm)		
Over	Including	Normal	P6	P5	Normal	P6	P5	Normal	P6	P5
0.6	2.5	+ 0 - 8	+ 0 - 7	+ 0 - 5	10	5	4	+ 0 -40	+ 0 -40	+ 0 -40
2.5	10	+ 0 - 8	+ 0 - 7	+ 0 - 5	10	6	4	+ 0 -120	+ 0 -120	+ 0 -40
10	18	+ 0 - 8	+ 0 - 7	+ 0 - 5	10	7	4	+ 0 -120	+ 0 -120	+ 0 -80
18	30	+ 0 -10	+ 0 - 8	+ 0 - 6	13	8	4	+ 0 -120	+ 0 -120	+ 0 -120
30	50	+ 0 -12	+ 0 -10	+ 0 - 8	15	10	5	+ 0 -120	+ 0 -120	+ 0 -120
50	80	+ 0 -15	+ 0 -12	+ 0 - 9	20	10	5	+ 0 -150	+ 0 -150	+ 0 -150
80	120	+ 0 -20	+ 0 -15	+ 0 -10	25	13	6	+ 0 -200	+ 0 -200	+ 0 -200
120	180	+ 0 -25	+ 0 -18	+ 0 -13	30	18	8	+ 0 -250	+ 0 -250	+ 0 -250
180	250	+ 0 -30	+ 0 -22	+ 0 -15	40	20	10	+ 0 -300	+ 0 -300	+ 0 -300
250	315	+ 0 -35	+ 0 -25	+ 0 -18	50	25	13	+ 0 -350	+ 0 -350	+ 0 -350
315	400	+ 0 -40	+ 0 -30	+ 0 -23	60	30	15	+ 0 -400	+ 0 -400	+ 0 -400
400	500	+ 0 -45	+ 0 -35	+ 0 -27	65	35	17	+ 0 -450	+ 0 -450	+ 0 -450
500	630	+ 0 -50	+ 0 -40	+ 0 -33	70	40	19	+ 0 -500	+ 0 -500	+ 0 -500
630	800	+ 0 -75	+ 0 -50	+ 0 -40	80	45	22	+ 0 -750	+ 0 -750	+ 0 -750
800	1000	+ 0 -100	+ 0 -65	+ 0 -50	90	50	26	+ 0 -1000	+ 0 -1000	+ 0 -1000
1000	1250	+ 0 -125	+ 0 -80	+ 0 -65	100	60	30	+ 0 -1250	+ 0 -1250	+ 0 -1250
1250	1600	+ 0 -160	+ 0 -100	+ 0 -80	120	70	35	+ 0 -1600	+ 0 -1600	+ 0 -1600
1600	2000	+ 0 -200	+ 0 -130	+ 0 -100	140	80	40	+ 0 -2000	+ 0 -2000	+ 0 -2000

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Outer Ring Tolerances for Both Bearing Types

Bearing Outside Diameter (mm)		Tolerance on Bearing Outside Diameter (μm)			Assembled Outer Ring Runout (μm)			Tolerance on Outer Ring Width (μm)		
Over	Including	Normal	P6	P5	Normal	P6	P5	Normal	P6	P5
2.5	6	+ 0 - 8	+ 0 - 7	+ 0 - 5	15	8	5	Equal to Bearing Assembly's Inner Ring Width Tolerance		
6	18	+ 0 - 8	+ 0 -7	+ 0 - 5	15	8	5			
18	30	+ 0 - 9	+ 0 - 8	+ 0 - 6	15	9	6			
30	50	+ 0 -11	+ 0 - 9	+ 0 - 7	20	10	7			
50	80	+ 0 -13	+ 0 -11	+ 0 - 9	25	13	8			
80	120	+ 0 -15	+ 0 -13	+ 0 -10	35	18	10			
120	150	+ 0 -18	+ 0 -15	+ 0 -11	40	20	11			
150	180	+ 0 -25	+ 0 -18	+ 0 -13	45	23	13			
180	250	+ 0 -30	+ 0 -20	+ 0 -15	50	25	15			
250	315	+ 0 -35	+ 0 -25	+ 0 -18	60	30	18			
315	400	+ 0 -40	+ 0 -28	+ 0 -20	70	35	20			
400	500	+ 0 -45	+ 0 -33	+ 0 -23	80	40	23			
500	630	+ 0 -50	+ 0 -38	+ 0 -28	100	50	25			
630	800	+ 0 -75	+ 0 -45	+ 0 -35	120	60	30			
800	1000	+ 0 -100	+ 0 -60	+ 0 -40	140	75	35			
1000	1250	+ 0 -125	+ 0 -80	+ 0 -50	160	85	40			
1250	1600	+ 0 -160	+ 0 -100	+ 0 -65	190	100	45			
1600	2000	+ 0 -200	+ 0 -130	+ 0 -85	220	100	55			
2000	2500	+ 0 -250	+ 0 -160	+ 0 -110	250	120	65			

Recommended Fitting Practice

The following tables list the recommended fitting practice for Timken spherical and cylindrical roller bearings. The tables assume:

- The bearing is of normal precision.
- The housing is thick and made from steel or cast iron.
- The shaft is solid and made from steel.
- The bearing seats are ground or accurately turned to less than approximately 1.6μm arithmetic average surface roughness.

The suggested fit symbols are in accordance with ISO 286 and are defined in the tables.

For help with a recommended fitting practice, especially those not conforming to the above listing, contact your Timken representative.

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The proper fitting practice of a roller bearing is critical to achieving the expected performance of the bearing.

Typically, the reduction in radial internal clearance of Timken spherical and cylindrical bearings are 75 to 95 percent of the resultant fit of the bearing housing or shaft. Thus, for estimation of the loss in radial clearance due to fit, an average value of 85 percent can be used.

As a general guideline, rotating inner rings should be applied with an interference fit. Loose fits may permit the inner rings to creep or turn and wear the shaft and the backing shoulder. This wear will result in excessive bearing looseness and possible bearing and shaft damage. Additionally, abrasive metal particles resulting from creep or turning may enter into the bearing and cause excessive damage and vibration.

Stationary inner-ring fitting practice depends on the loading of the application. The load conditions and bearing envelope dimensions should be used to select the suggested shaft fit from the tables.

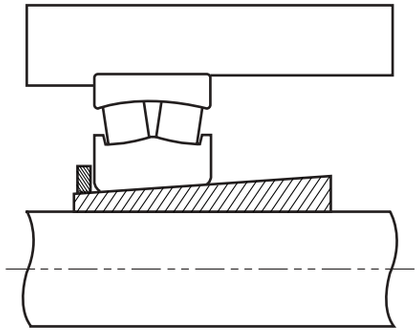
Similarly, rotating outer-ring applications should use an interference fit between the outer ring and housing.

Stationary outer rings are generally mounted with loose fits to permit assembly and disassembly. The loose fit also permits axial movement when a spherical bearing is mounted in the float position.

Thin-walled housings, light-alloy housings, or hollow shafts must use press fits tighter than required for thick-walled housings, steel or cast iron housings or solid shafts. Tighter fits are also required when mounting the bearing on relatively rough, or unground, surfaces.

Tapered Bore Axial Drive-Up

Typically, the tapered bore bearings are selected to simplify shaft mounting and dismounting. Since the spherical roller bearing is not separable, mounting can be simplified by use of an adapter sleeve with a cylindrical bore and tapered OD. A tapered bore roller bearing can also be used mounted directly onto a tapered shaft.



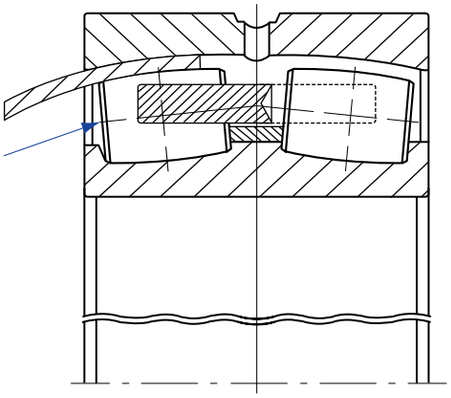
Spherical Roller Bearing Mounted with an Adapter Sleeve

Bearings with a tapered bore typically require a tighter fit on the shaft than bearings with a cylindrical bore. The inner ring of the bearing is secured by driving it up a tapered shaft or sleeve. Also assembly procedures may require special fits. In these cases, experience should be used as a guideline. For approximating the clearance loss for axial drive-up, again the 85 percent radial loss approximation can be used. That is, the radial clearance loss per axial drive-up can roughly be approximated as 71µm/mm for a 1:12 tapered bore and 28µm/mm for a 1:30 tapered bore.

Measuring Radial Clearance

Typically, the radial internal clearance of a spherical or cylindrical roller bearing is measured using feeler gages. The roller bearing will be positioned vertically such that all of the clearance is to one side. One ring is moved relative to the other a few complete rotations so that the rollers are properly seated in the raceway. For spherical roller bearings, the roller is slightly pressed (see arrow in the following figure) so that its end is contacting the floating ring. Now the radial clearance can be measured by inserting the feeler gage between the roller and the outer raceway, starting with the smallest gage sizes and increasing until the gage will no longer pass through the gap.

Below is an example of how to measure radial internal clearance for a spherical bearing. The process for a cylindrical roller bearing is much the same.



Measuring Radial Internal Clearance

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Spherical Roller Bearing Inner-Ring Fitting Practice

Load Condition		Shaft Diameter (mm) Over	Including	Shaft Fits [a]
Rotating Inner Ring or Direction of Radial Load Indeterminate	Light or Fluctuating Variable Load	04	0	j6
		40	100	k6
		100	200	m6
	Normal to Heavy Load	04	0	k5
		40	65	m5
		65	100	m6
		100	140	n6
		140	280	p6
		280	500	r6
		500	---	r7
	Very Heavy or Shock Load	02	0	m 5
		20	50	m6
		50	100	n6
		100	140	p6
		140	200	r6
		200	---	r7
	High Running Accuracy and Light Loads	18	100	k5
		100	200	m5
Static Inner Ring Radial Load	Floating Position with All Load Conditions	All Shaft Diameters		g6
	Fixed Position with All Load Conditions	All Shaft Diameters		h6
Axial Load	All Load Conditions	0	250	j6
		250	---	js6

[a] For solid steel shafts with normal precision bearings. For hollow or nonferrous alloy shafts or other precision class bearings, contact your Timken representative.

Spherical Roller Bearing Outer-Ring Fitting Practice

Housing Type	Load Conditions Bearing Rotation & Load	Operating Conditions	Axial Displacement Requirements (Fixed or Floating Position)	Housing Diameter Over	Including	Housing Fits[a]
Solid or Split Housing	Static Outer Ring Load	All Operating Conditions Not Covered	Floating Position	All Sizes		H7
		Light to Normal Loads	Floating Position	All Sizes		H8
		Heat Conducted Through Shaft	Floating Position	All Sizes		G7
		Shock Loads & Temporary Unloading	Floating Position	All Sizes		J7
	Direction of Load Indeterminate	Light to Normal	Floating Position	All Sizes		J7
Solid Housing	Rotating Outer Ring Load	Light or Variable Load	Fixed Position	All Sizes		M7
		Normal to Heavy Load	Fixed Position	All Sizes		N7
		Heavy Load (Thin Wall Housing)	Fixed Position	All Sizes		P7
		Heavy Shock Load	Fixed Position	All Sizes		P7
	Direction of Load Indeterminate	Light to Normal	Floating Position	All Sizes		J7
		Normal to Heavy	Fixed Position	All Sizes		K7
		Heavy Shock Load	Fixed Position	All Sizes		M7
Split Housing	High Accuracy Rotation and Quit Running	High Stiffness at Variable Loads	Fixed Position	0	125	M6
				125	200	N6
				200	---	P6
		Light Loads, Indeterminate Load Direction	Fixed Position	All Sizes		K6
		Axial Displacement of Outer Ring Desired	Floating Position	All Sizes		J6
		Quiet Running	Floating Position	All Sizes		H6

[a] For solid steel shafts with normal precision bearings. For hollow or nonferrous alloy shafts or other precision class bearings, contact your Timken representative.

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Cylindrical Roller Bearing Inner-Ring Fitting Practice

Load Conditions		Shaft Diameter (mm)		Shaft Fits [a]
		Over	Including	
Rotating Inner Ring or Direction of Load Indeterminate	Light or Fluctuating Variable Load	0	40	j6
		40	140	k6
		140	320	m6
		320	500	n6
		500	---	p6
	Normal to Heavy Load	0	40	k 5
		40	100	m5
		100	140	m6
		140	360	n6
		360	500	p6
		500	---	r6
	Very Heavy or Shock Load	0	40	m 5
		40	65	m6
		65	140	n6
		140	320	p6
		320	500	r6
		500	---	r7
	High Running Accuracy with Light Loads	0	40	j5
		40	140	k5
		140	200	m5
Static Inner Ring Radial Load	Floating Position with All Load Conditions	All Sizes		g6
	Fixed Position with All Load Conditions	All Sizes		h6
Axial Load	All Load Conditions	0	250	j6
		250	---	js6

[a] For solid steel shafts with normal precision bearings. For hollow or nonferrous alloy shafts, tolerances are generally selected which give a slightly tighter fit than those in the table.

Cylindrical Roller Bearing Outer-Ring Fitting Practice

Housing Type	Load Conditions		Axial Displacement Requirements (Fixed or Floating Positions)	Housing Diameter (mm)		Housing Fits [a]
	Bearing Rotation & Load	Operating Conditions		Over	Including	
Solid or Split Housing	Static Outer Ring Load	All Operating Conditions Not Covered Below	Floating Position	All Sizes		H7
		Light to Normal Loads	Floating Position	All Sizes		H8
		Heat Conducted Through Shaft	Floating Position	All Sizes		G7
		Shock loads & Temporary Unloading	Floating Position	All Sizes		J6
	Direction of Load Indeterminate	Light to Normal Loads	Floating Position	All Sizes		J7
Solid Housing	Rotating Outer Ring Load	Light or Variable Loads	Fixed Position	All Sizes		M7
		Normal to Heavy Loads	Fixed Position	All Sizes		N7
		Heavy Load (Thin Wall Housing)	Fixed Position	All Sizes		P7
	Direction of Load Indeterminate	Light to Normal Loads	Floating Position	All Sizes		J7
		Normal to Heavy Loads	Fixed Position	All Sizes		K7
		Heavy Shock Loads	Fixed Position	All Sizes		M7
Split Housing	High Accuracy Rotation and Quiet Running	High stiffness at Variable Loads	Fixed Position	0	125	M6
				125	---	N6
		Light Loads with Indeterminate Direction	Fixed Position	All Sizes		K6
		Axial displacement of Outer Ring Desired	Floating Position	All Sizes		J6
		Quiet running	Floating Position	All Sizes		H6

[a] For cast iron or steel housings. For housing of nonferrous alloys, tolerances are generally selected which give a slightly tighter fit than those in the table.

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Shaft Tolerances and Resulting Fits

Bore Diameter (mm) Over	Including	Normal Precision Bore Tolerance	g6 Tolerance	g6 Fit	h6 Tolerance	h6 Fit	js6 Tolerance	js6 Fit	j6 Tolerance	j6 Fit
0	3	0 -8	-2 -8	8L 6T	0 -6	6L 8T	3 -3	3L 11T	4 -2	2L 12T
3	6	0 -8	-4 -12	12L 4T	0 -8	8L 8T	4 -4	4L 12T	6 -2	2L 14T
6	10	0 -8	-5 -14	14L 3T	0 -9	9L 8T	4.5 -4.5	5L 13T	7 -2	2L 15T
10	18	0 -8	-6 -17	17L 2T	0 -11	11L 8T	5.5 -5.5	6L 14T	8 -3	3L 16T
18	30	0 -10	-7 -20	20L 3T	0 -13	13L 10T	6.5 -6.5	7L 17T	9 -4	4L 19T
30	50	0 -12	-9 -25	25L 3T	0 -16	16L 12T	8 -8	8L 20T	11 -5	5L 23T
50	65	0 -15	-10 -29	29L 5T	0 -19	19L 15T	9.5 -9.5	10L 25T	12 -7	7L 27T
65	80	0 -15	-10 -29	29L 5T	0 -19	19L 15T	9.5 -9.5	10L 25T	12 -7	7L 27T
80	100	0 -20	-12 -34	34L 8T	0 -22	22L 20T	11 -11	11L 31T	13 -9	9L 33T
100	120	0 -20	-12 -34	34L 8T	0 -22	22L 20T	11 -11	11L 31T	13 -9	9L 33T
120	140	0 -25	-14 -39	39L 11T	0 -25	25L 25T	12.5 -12.5	13L 38T	14 -11	11L 39T
140	160	0 -25	-14 -39	39L 11T	0 -25	25L 25T	12.5 -12.5	13L 38T	14 -11	11L 39T
160	180	0 -25	-14 -39	39L 11T	0 -25	25L 25T	12.5 -12.5	13L 38T	14 -11	11L 39T
180	200	0 -30	-15 -44	44L 15T	0 -29	29L 30T	14.5 -14.5	15L 45T	16 -13	13L 46T
200	225	0 -30	-15 -44	44L 15T	0 -29	29L 30T	14.5 -14.5	15L 45T	16 -13	13L 46T
225	250	0 -30	-15 -44	44L 15T	0 -29	29L 30T	14.5 -14.5	15L 45T	16 -13	13L 46T
250	280	0 -35	-17 -49	49L 18T	0 -32	32L 35T	16 -16	16L 51T	16 -16	16L 51T
280	315	0 -35	-17 -49	49L 18T	0 -32	32L 35T	16 -16	16L 51T	16 -16	16L 51T
315	355	0 -40	-18 -54	54L 22T	0 -36	36L 40T	18 -18	18L 58T	18 -18	18L 58T
355	400	0 -40	-18 -54	54L 22T	0 -36	36L 40T	18 -18	18L 58T	18 -18	18L 58T
400	450	0 -45	-20 -60	60L 25T	0 -40	40L 45T	20 -20	20L 65T	20 -20	20L 65T
450	500	0 -45	-20 -60	60L 25T	0 -40	40L 45T	20 -20	20L 65T	20 -20	20L 65T
500	560	0 -50	-22 -66	66L 28T	0 -44	44L 50T	22 -22	22L 72T	22 -22	22L 72T
560	630	0 -50	-22 -66	66L 28T	0 -44	44L 50T	22 -22	22L 72T	22 -22	22L 72T
630	710	0 -75	-24 -74	74L 51T	0 -50	50L 75T	25 -25	25L 100T	25 -25	25L 100T
710	800	0 -75	-24 -74	74L 51T	0 -50	50L 75T	25 -25	25L 100T	25 -25	25L 100T
800	900	0 -100	-26 -82	82L 74T	0 -56	56L 100T	28 -28	28L 128T	28 -28	28L 128T
900	1000	0 -100	-26 -82	82L 74T	0 -56	56L 100T	28 -28	28L 128T	28 -28	28L 128T
1000	1120	0 -125	-28 -94	94L 97T	0 -66	66L 125T	33 -33	33L 158T	33 -33	33L 158T
1120	1250	0 -125	-28 -94	94L 97T	0 -66	66L 125T	33 -33	33L 158T	33 -33	33L 158T
1250	1400	0 -160	-30 -108	108L 130T	0 -78	78L 160T	39 -39	39L 199T	39 -39	39L 199T
1400	1600	0 -160	-30 -108	108L 130T	0 -78	78L 160T	39 -39	39L 199T	39 -39	39L 199T
1600	1800	0 -200	-32 -124	124L 168T	0 -92	92L 200T	46 -46	46L 246T	46 -46	46L 246T
1800	2000	0 -200	-32 -124	124L 168T	0 -92	92L 200T	46 -46	46L 246T	46 -46	46L 246T

All values in micrometers unless otherwise specified.

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k5		m5		m6		n6		p6		r6		r7	
Tolerance	Fit	Tolerance	Fit	Tolerance	Fit	Tolerance	Fit	Tolerance	Fit	Tolerance	Fit	Tolerance	Fit
4	0T	6	2T	8	2T	10	4T	12	6T	16	10T	20	10T
0	12T	2	14T	2	16T	4	18T	6	20T	10	24T	10	28T
6	1T	9	4T	12	4T	16	8T	20	12T	23	15T	27	15T
1	14T	4	17T	4	20T	8	24T	12	28T	15	31T	15	35T
7	1T	12	6T	15	6T	19	10T	24	15T	28	19T	34	19T
1	15T	6	20T	6	23T	10	27T	15	32T	19	36T	19	42T
9	1T	15	7T	18	7T	23	12T	29	18T	34	23T	41	23T
1	17T	7	23T	7	26T	12	31T	18	37T	23	42T	23	49T
11	2T	17	8T	21	8T	28	15T	35	22T	41	28T	49	28T
2	21T	8	27T	8	31T	15	38T	22	45T	28	51T	28	59T
13	2T	20	9T	25	9T	33	17T	42	26T	50	34T	59	34T
2	25T	9	32T	9	37T	17	45T	26	54T	34	62T	34	71T
15	2T	24	11T	30	11T	39	20T	51	32T	60	41T	71	41T
2	30T	11	39T	11	45T	20	54T	32	66T	41	75T	41	86T
15	2T	24	11T	30	11T	39	20T	51	32T	62	43T	73	43T
2	30T	11	39T	11	45T	20	54T	32	66T	43	77T	43	88T
18	3T	28	13T	35	13T	45	23T	59	37T	73	51T	86	51T
3	38T	13	48T	13	55T	23	65T	37	79T	51	93T	51	106T
18	3T	28	13T	35	13T	45	23T	59	37T	76	54T	89	54T
3	38T	13	48T	13	55T	23	65T	37	79T	54	96T	54	109T
21	3T	33	15T	40	15T	52	27T	68	43T	88	63T	103	63T
3	46T	15	58T	15	65T	27	77T	43	93T	63	113T	63	128T
21	3T	33	15T	40	15T	52	27T	68	43T	90	65T	105	65T
3	46T	15	58T	15	65T	27	77T	43	93T	65	115T	65	130T
21	3T	33	15T	40	15T	52	27T	68	43T	93	68T	108	68T
3	46T	15	58T	15	65T	27	77T	43	93T	68	118T	68	133T
24	4T	37	17T	46	17T	60	31T	79	50T	106	77T	123	77T
4	54T	17	67T	17	76T	31	90T	50	109T	77	136T	77	153T
24	4T	37	17T	46	17T	60	31T	79	50T	109	80T	126	80T
4	54T	17	67T	17	76T	31	90T	50	109T	80	139T	80	156T
24	4T	37	17T	46	17T	60	31T	79	50T	113	84T	130	84T
4	54T	17	67T	17	76T	31	90T	50	109T	84	143T	84	160T
27	4T	43	20T	52	20T	66	34T	88	56T	126	94T	146	94T
4	62T	20	78T	20	87T	34	101T	56	123T	94	161T	94	181T
27	4T	43	20T	52	20T	66	34T	88	56T	130	98T	150	98T
4	62T	20	78T	20	87T	34	101T	56	123T	98	165T	98	185T
29	4T	46	21T	57	21T	73	37T	98	62T	144	108T	165	108T
4	69T	21	86T	21	97T	37	113T	62	138T	108	184T	108	205T
29	4T	46	21T	57	21T	73	37T	98	62T	150	114T	171	114T
4	69T	21	86T	21	97T	37	113T	62	138T	114	190T	114	211T
32	5T	50	23T	63	23T	80	40T	108	68T	166	126T	189	126T
5	77T	23	95T	23	108T	40	125T	68	153T	126	211T	126	234T
32	5T	50	23T	63	23T	80	40T	108	68T	172	132T	195	132T
5	77T	23	95T	23	108T	40	125T	68	153T	132	217T	132	240T
30	0T	56	26T	70	26T	88	44T	122	78T	194	150T	220	150T
0	80T	26	106T	26	120T	44	138T	78	172T	150	244T	150	270T
30	0T	56	26T	70	26T	88	44T	122	78T	199	155T	225	155T
0	80T	26	106T	26	120T	44	138T	78	172T	155	249T	155	275T
35	0T	65	30T	80	30T	100	50T	138	88T	225	175T	255	175T
0	110T	30	140T	30	155T	50	175T	88	213T	175	300T	175	330T
35	0T	65	30T	80	30T	100	50T	138	88T	235	185T	265	185T
0	110T	30	140T	30	155T	50	175T	88	213T	185	310T	185	340T
40	0T	74	34T	90	34T	112	56T	156	100T	266	210T	300	210T
0	140T	34	174T	34	190T	56	212T	100	256T	210	366T	210	400T
40	0T	74	34T	90	34T	112	56T	156	100T	276	220T	310	220T
0	140T	34	174T	34	190T	56	212T	100	256T	220	376T	220	410T
46	0T	86	40T	106	40T	132	66T	186	120T	316	250T	355	250T
0	171T	40	211T	40	231T	66	257T	120	311T	250	441T	250	480T
46	0T	86	40T	106	40T	132	66T	186	120T	326	260T	365	260T
0	171T	40	211T	40	231T	66	257T	120	311T	260	451T	260	490T
54	0T	102	48T	126	48T	156	78T	218	140T	378	300T	425	300T
0	214T	48	262T	48	286T	78	316T	140	378T	300	538T	300	585T
54	0T	102	48T	126	48T	156	78T	218	140T	408	330T	455	330T
0	214T	48	262T	48	286T	78	316T	140	378T	330	568T	330	615T
65	0T	123	58T	150	58T	184	92T	262	170T	462	370T	520	370T
0	265T	58	323T	58	350T	92	384T	170	462T	370	662T	370	720T
65	0T	123	58T	150	58T	184	92T	262	170T	492	400T	550	400T
0	265T	58	323T	58	350T	92	384T	170	462T	400	692T	400	750T

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Housing Tolerances and Resulting Fits

Outside Diameter (mm)		Normal Precision Outside	G7		H6		H7		H8		J6		J7	
Over	Including	Diameter Tolerance	Tolerance	Fit	Tolerance	Fit	Tolerance	Fit	Tolerance	Fit	Tolerance	Fit	Tolerance	Fit
6	01	0	20	5L	9	0T	15	0T	22	0T	5	4T	8	7T
		-8	5	28L	0	17L	0	23L	0	30L	-4	13L	-7	16L
10	18	0	24	6L	11	0T	18	0T	27	0T	6	5T	10	8T
		-8	6	32L	0	19L	0	26L	0	35L	-5	14L	-8	18L
18	30	0	28	7L	13	0T	21	0T	33	0T	8	5T	12	9T
		-9	7	37L	0	22L	0	30L	0	42L	-5	17L	-9	21L
30	50	0	34	9L	16	0T	25	0T	39	0T	10	6T	14	11T
		-11	9	45L	0	27L	0	36L	0	50L	-6	21L	-11	25L
50	80	0	40	10L	19	0T	30	0T	46	0T	13	6T	18	12T
		-13	10	53L	0	32L	0	43L	0	59L	-6	26L	-12	31L
80	120	0	47	12L	22	0T	35	0T	54	0T	16	6T	22	13T
		-15	12	62L	0	37L	0	50L	0	69L	-6	31L	-13	37L
120	150	0	54	14L	25	0T	40	0T	63	0T	18	7T	26	14T
		-18	14	72L	0	43L	0	58L	0	81L	-7	36L	-14	44L
150	180	0	54	14L	25	0T	40	0T	63	0T	18	7T	26	14T
		-25	14	79L	0	50L	0	65L	0	88L	-7	43L	-14	51L
180	250	0	61	15L	29	0T	46	0T	72	0T	22	7T	30	16T
		-30	15	91L	0	59L	0	76L	0	102L	-7	52L	-16	60L
250	315	0	69	17L	32	0T	52	0T	81	0T	25	7T	36	16T
		-35	17	104L	0	67L	0	87L	0	116L	-7	60L	-16	71L
315	400	0	75	18L	36	0T	57	0T	89	0T	29	7T	39	18T
		-40	18	115L	0	76L	0	97L	0	129L	-7	69L	-18	79L
400	500	0	83	20L	40	0T	63	0T	97	0T	33	7T	43	20T
		-45	20	128L	0	85L	0	108L	0	142L	-7	78L	-20	88L
500	630	0	92	22L	44	0T	70	0T	110	0T	37	7T	48	22T
		-50	22	142L	0	94L	0	120L	0	160L	-7	87L	-22	98L
630	800	0	104	24L	50	0T	80	0T	125	0T	40	10T	56	24T
		-75	24	179L	0	125L	0	155L	0	200L	-10	115L	-24	131L
800	1000	0	116	26L	56	0T	90	0T	140	0T	46	10T	64	26T
		-100	26	216L	0	156L	0	190L	0	240L	-10	146L	-26	164L
1000	1250	0	133	28L	66	0T	105	0T	165	0T	56	10T	77	28T
		-125	28	258L	0	191L	0	230L	0	290L	-10	181L	-28	202L
1250	1600	0	155	30L	78	0T	125	0T	195	0T	68	10T	95	30T
		-160	30	315L	0	238L	0	285L	0	355L	-10	228L	-30	255L
1600	2000	0	182	32L	92	0T	150	0T	230	0T	82	10T	118	32T
		-200	32	382L	0	292L	0	350L	0	430L	-10	282L	-32	318L
2000	2500	0	209	34L	110	0T	175	0T	280	0T	100	10T	141	34T
		-250	34	459L	0	360L	0	425L	0	530L	-10	350L	-34	391L

All values in micrometers unless otherwise specified.

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	K6		K7		M6		M7		N6		N7		P6		P7	
	Tolerance	Fit	Tolerance	Fit	Tolerance	Fit	Tolerance	Fit	Tolerance	Fit	Tolerance	Fit	Tolerance	Fit	Tolerance	Fit
	2	7T	5	10T	-3	12T	0	15T	-7	16T	-4	19T	-12	21T	-9	24T
	-7	10L	-10	13L	-12	5L	-15	8L	-16	1L	-19	4L	-21	4T	-24	1T
	2	9T	6	12T	-4	15T	0	18T	-9	20T	-5	23T	-15	26T	-11	29T
	-9	10L	-12	14L	-15	4L	-18	8L	-20	1T	-23	3L	-26	7T	-29	3T
	2	11T	6	15T	-4	17T	0	21T	-11	24T	-7	28T	-18	31T	-14	35T
	-11	11L	-15	15L	-17	5L	-21	9L	-24	2T	-28	2L	-31	9T	-35	5T
	3	13T	7	18T	-4	20T	0	25T	-12	28T	-8	33T	-21	37T	-17	42T
	-13	14L	-18	18L	-20	7L	-25	11L	-28	1T	-33	3L	-37	10T	-42	6T
	4	15T	9	21T	-5	24T	0	30T	-14	33T	-9	39T	-26	45T	-21	51T
	-15	17L	-21	22L	-24	8L	-30	13L	-33	1T	-39	4L	-45	13T	-51	8T
	4	18T	10	25T	-6	28T	0	35T	-16	38T	-10	45T	-30	52T	-24	59T
	-18	19L	-25	25L	-28	9L	-35	15L	-38	1T	-45	5L	-52	15T	-59	9T
	4	21T	12	28T	-8	33T	0	40T	-20	45T	-12	52T	-36	61T	-28	68T
	-21	22L	-28	30L	-33	10L	-40	18L	-45	2T	-52	6L	-61	18T	-68	10T
	4	21T	12	28T	-8	33T	0	40T	-20	45T	-12	52T	-36	61T	-28	68T
	-21	29L	-28	37L	-33	17L	-40	25L	-45	5L	-52	13L	-61	11T	-68	3T
	5	24T	13	33T	-8	37T	0	46T	-22	51T	-14	60T	-41	70T	-33	79T
	-24	35L	-33	43L	-37	22L	-46	30L	-51	8L	-60	16L	-70	11T	-79	3T
	5	27T	16	36T	-9	41T	0	52T	-25	57T	-14	66T	-47	79T	-36	88T
	-27	40L	-36	51L	-41	26L	-52	35L	-57	10L	-66	21L	-79	12T	-88	1T
	7	29T	17	40T	-10	46T	0	57T	-26	62T	-16	73T	-51	87T	-41	98T
	-29	47L	-40	57L	-46	30L	-57	40L	-62	14L	-73	24L	-87	11T	-98	1T
	8	32T	18	45T	-10	50T	0	63T	-27	67T	-17	80T	-55	95T	-45	108T
	-32	53L	-45	63L	-50	35L	-63	45L	-67	18L	-80	28L	-95	10T	-108	0L
	0	44T	0	70T	-26	70T	-26	96T	-44	88T	-44	114T	-78	122T	-78	148T
	-44	50L	-70	50L	-70	24L	-96	24L	-88	6L	-114	6L	-122	28T	-148	28T
	0	50T	0	80T	-30	80T	-30	110T	-50	100T	-50	130T	-88	138T	-88	168T
	-50	75L	-80	75L	-80	45L	-110	45L	-100	25L	-130	25L	-138	13T	-168	13T
	0	56T	0	90T	-34	90T	-34	124T	-56	112T	-56	146T	-100	156T	-100	190T
	-56	100L	-90	100L	-90	66L	-124	66L	-112	44L	-146	44L	-156	0L	-190	0L
	0	66T	0	105T	-40	106T	-40	145T	-66	132T	-66	171T	-120	186T	-120	225T
	-66	125L	-105	125L	-106	85L	-145	85L	-132	59L	-171	59L	-186	5L	-225	5L
	0	78T	0	125T	-48	126T	-48	173T	-78	156T	-78	203T	-140	218T	-140	265T
	-78	160L	-125	160L	-126	112L	-173	112L	-156	82L	-203	82L	-218	20L	-265	20L
	0	92T	0	150T	-58	150T	-58	208T	-92	184T	-92	242T	-170	262T	-170	320T
	-92	200L	-150	200L	-150	142L	-208	142L	-184	108L	-242	108L	-262	30L	-320	30L
	0	110T	0	175T	-68	178T	-68	243T	-110	220T	-110	285T	-195	305T	-195	370T
	-110	250L	-175	250L	-178	182L	-243	182L	-220	140L	-285	140L	-305	55L	-370	55L

Mounting Guidelines

When using a tight fit inner ring, the method of assembly will depend on whether the bearing has a cylindrical or tapered bore. When mounting a cylindrical bore with a tight fit, mounting is simplified by heating the inner ring, traditionally done via submersion in hot oil or by induction heating (see photo below).

When heating in oil, it takes approximately 30 minutes to raise the temperature of the bearing to the appropriate level and the oil temperature should not exceed 120˚C (250˚F). Induction heating, on the other hand, is very rapid and care should be taken not to heat the bearing above 93˚C (200˚F).

As a general rule, the temperature difference between the inner ring and the shaft needs to be approximately 80˚C (175˚F) to slip on the ring. The ring should be moved onto the shaft while still at temperature and then allowed to cool and securely seat itself on the shaft. The inner ring retaining device should only be tightened after the bearing has cooled. A mechanical or hydraulic press can also be used to press on cylindrical bore bearings, but this is typically only used for small-diameter product.

Tapered bore bearings are always mounted with a tight fit and must be mounted onto a mating tapered surface.

Tapered adapter sleeves can be used to provide a tapered bearing seat; however, the bearing is often pressed directly on to tapered journals machined into the shaft. When the shafts are manufactured with tapered journals, the journals and inboard abutment face (e.g., fillet ring) should be gauged for proper size. Two tools, the sine bar and ring gage, are available to aid in these measurements.

The ring gage is a tapered bore master that is placed on the bearing journal and then used as a reference surface for measuring between the gage face and the shaft shoulder. This measurement, along with the dimensional constants of the gage, can then be used to determine the required length of the fillet ring. If the fillet is sized properly, the bearing will then simply have to be pressed up firmly against the face of the fillet ring to achieve the proper fit and radial internal clearance.

In the case where the bearing is not being pressed up against a backing shoulder, alternate methods must be used to determine that the bearing has been pressed up properly. One method is to measure the axial distance the bearing moves up the tapered seat, but the preferred method is to measure the reduction in radial internal clearance. A comparison must be made, so the radial internal clearance must be measured before the bearing is mounted and then compared to the mounted value. The radial internal clearance can be measured by placing a feeler gage between the unloaded roller and the outer raceway. The best location is at top dead center when the bearing is resting on its outer ring.

To remove tight fit inner rings, similar principals to mounting are again used. Heating, hydraulic nuts and mechanical removal tools can be used, or hydraulic pressure is applied to the shaft. This requires that an annular groove be machined in the bearing seat, which is fed to an axial hole breaking out on the end of the shaft. After the axial retaining devices have been removed, hydraulic pressure is applied to the axial cavity until sufficient fluid flows into the groove beneath the bearing and builds up pressure. The pressure is then used to expand the inner ring and relieve the interference between the ring and shaft. Once expanded, the inner ring will slide from the shaft.

Induction Heating of a Large Bore Spherical Roller Bearing

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Speed Ratings

For Timken spherical roller bearings, the thermal speed ratings are listed in the bearing tables. The thermal speed ratings for Timken cylindrical roller bearings are located in the part number listings at the back of this catalog. These values have been generated by balancing the heat generated within the bearing to the heat dissipated from the bearing. In calculating these numbers, the following assumptions have been made:

- The radial load is 5 percent of the static load rating.
- For oil, it is assumed to be in a bath with the fill to the middle of the lowest rolling element, and for grease it is assumed a 30 percent bearing cavity fill.
- The oil viscosity is assumed to be 12 cSt (ISO VG32) operated at 70˚C, and the grease base oil viscosity is assumed to be 22 cSt operated at 70˚C.
  The bearing and its components are at 70˚C and the bearing environment is at 20˚C.
- The housing and shaft are steel or cast iron.
- The bearing rotational axis is horizontal.
- The outer ring is stationary and the inner ring is rotating.
- The bearing radial internal clearance complies with class normal, and standard fits are used.
- The bearing does not contain seals.
- The bearing does not experience misalignment or axial load.

Thus, the thermal speed ratings are for reference only, and can be considerably lower or higher depending on your application. Consult your Timken representative for more accurate information regarding a bearing's speed limitations in your application.

Temperature Limitations

Standard Timken spherical roller bearings are dimensionally stabilized up to 200˚C. Upon special request, the bearings can be ordered with dimensional stabilization up to 250˚C (S2 suffix) or 300˚C (S3 suffix). Consult your Timken representative for availability in specific part numbers.

Standard Timken cylindrical roller bearings are dimensionally stabilized up to 150˚C. Upon special request, the bearings can be ordered with dimensional stabilization up to 200˚C (S1 suffix), 250˚C (S2 suffix) or 300˚C (S3 suffix).

Above this, typical high temperature steels used by Timken for tapered roller bearings are also an option for both spherical and cylindrical roller bearings. Consult your Timken representative for availability of S1, S2, S3 suffixes or high temperature steels in specific part numbers and applications.

A bearing lubricant must perform three fundamental functions:

1) reduce friction and wear by separating adjacent surfaces and limiting metal-to-metal contact;

2) transfer heat from the bearing surfaces;

3) protect the bearing surfaces from corrosion and dirt. Many different lubrication systems – including grease, oil level, force-fed oil and oil-mist systems – can be used to successfully lubricate the bearing surfaces.

The simplest lubrication system for any bearing application is grease. Grease life is dependent upon such factors as speed, environmental conditions and operating temperature. Past experience is the best guide to relubrication frequency.

When grease lubrication is used, the grease should be packed into the bearing, making sure that it gets between the rollers and the cage, not just on the outside of these parts. Over greasing in certain applications also can be a problem. In high-speed applications, over greasing will generate excessive heat, which can lead to lubricant degradation and bearing damage.

Based on these considerations, the bearing and housing should be filled 100 percent and 30 to 50 percent respectively for normal applications. Cylindrical roller bearings generally use NLGI No. 1 or No. 2 greases.

Oils are selected primarily on the basis of application requirements, regardless of the type of lubricant system. The recommended volume of oil in any system must always be maintained to prevent premature bearing damage. The simplest type of oil lubrication system is the oil-level system, where the bearings are partially submerged in a static oil reservoir. The oil level must be to the center of the lowest rolling element. This type of system is generally only used for low and moderate speed applications because of the limited ability to transfer heat.

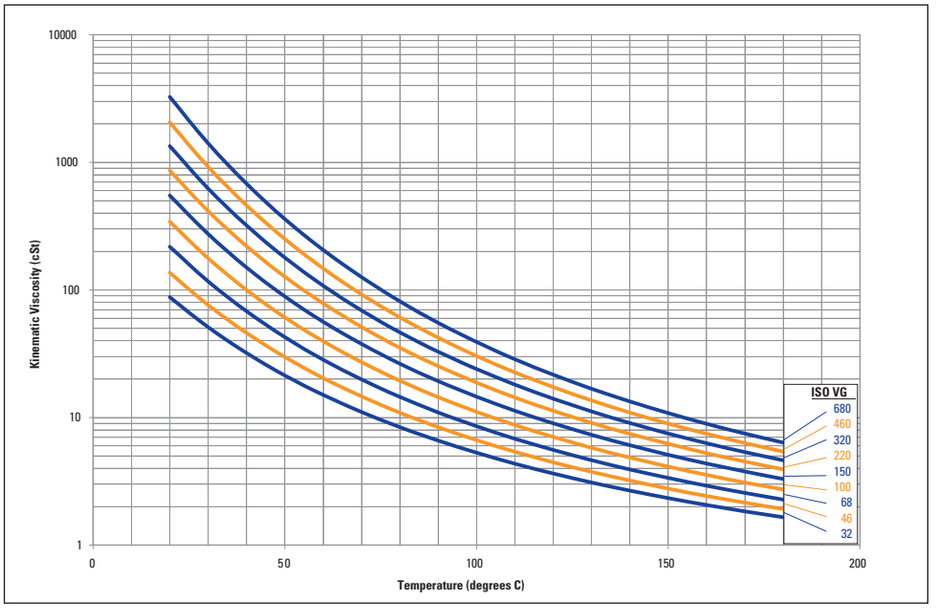
Force-fed oil systems are more elaborate than static oil systems. In a typical system, oil is pumped from a central reservoir to each bearing. Circulating oil provides a continuous, regulated oil flow providing the advantage of maximum heat removal and washing action to remove contamination or debris, which could cause premature bearing wear.

Oil-mist systems deliver very fine particles of oil suspended in a low-velocity, low-pressure air stream. Oil mist provides minimum cooling capacity because the slow airflow rates and the low specific heat of air.

Regardless of the lubrication system selected for a particular application, the lubricant itself should be selected so that the viscosity is sufficient to yield proper bearing life, predicted by the a3l life factor. The figure below is used to predict the oil's kinematic viscosity versus temperature (use base oil for grease).

Higher viscosity lubricants will increase the likelihood of adequate film thickness but will also increase bearing torque and operating temperature and lower bearing speed limit. The lubricant must be selected to balance these tradeoffs between bearing torque and life adjustment to obtain proper bearing lubrication.

Kinematic Viscosity



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Misalignment

Timken spherical roller bearings have the ability to accept a certain degree of misalignment between the shaft and the housing and are thus said to be self-aligning. This is accomplished because the shaft, inner ring and roller assemblies can pivot about the center of the bearing, with the rollers maintaining adequate contact in the spherical raceway of the outer ring. The maximum misalignment for the most common series is listed at right.

Maximum Misalignment for a Bearing Series

Bearing Series	Maximum Misalignment
238	± 1.0°
222, 230, 231, 239, 249	± 1.5°
223, 240	± 2.0°
232, 241	± 2.5°

For cylindrical roller bearings, the misalignment factor is also a measure of the axial load effect on life. Axial loading of a cylindrical roller bearing causes a moment to be generated about the roller center, and shifts the roller-raceway contact stresses similar to bearing misalignment. The base condition for cylindrical roller bearings is defined at zero axial load and 0.0005 radians misalignment. Performance of the bearing under other operating conditions can be predicted using SYSx or GST, and special profiles can be designed to accommodate the conditions of axial load and/or bearing misalignment.

Required Minimum Load

To prevent gross sliding of the spherical rollers or cylindrical rollers, a minimum load must be applied upon the bearing.

Usually the weight of the components supported by the bearing combined with the external loading of the application exceeds the minimum required load of a spherical roller bearing. Confirming that a particular bearing is loaded to this minimum amount is particularly important for high-speed applications. If the minimum load requirement is not met, additional radial load should be applied. A general guideline to use for the required minimum load is:

$$F_{rm} \approx 0.02 \bullet C$$

Where
F_{rm} = minimum radial load (kN)
C = basic dynamic radial load rating (kN)

For more information on the minimum load required for your application, consult your Timken representative.

Axial Internal Clearance

Timken cylindrical roller bearings are designed with the optimal amount of axial internal clearance between the flange face and the roller ends. Two competing characteristics are present when designing the axial internal clearance of a cylindrical roller bearing.

First, to prevent thermal effects from seizing the bearing, enough clearance must be designed into the bearing to allow the roller to effectively change size as necessary for an application. Second, the amount of skewing allowed by the roller is maintained by this clearance. Thus, smaller axial internal clearance allows less roller skew. By using sophisticated design software, the bearings are designed to allow the maximum amount of axial clearance without compromising bearing performance due to roller skew. For ISO normal class bearings, this value is usually negligible at about 1.5 ten thousandths of the total bearing's radial section.

Allowable Axial Float from Center

A cylindrical roller bearing's main advantage is the ability to internally float. This ability is designed into the bearing by eliminating flanges and extending the raceway in that direction (i.e., the difference between NUP & NJ). The bearing data tables list the value "S," which is the axial float from center for a given bearing design. Starting when the bearing components are all axially aligned, this is the value it can float in one direction before the roller-raceway contact is truncated.

For N and NU bearing designs without flange rings, the total allowable bearing float from one side to the other is two times the S value listed in the tables.

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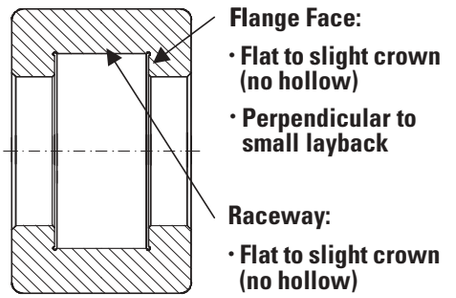
Product Enhancements

Bearing Profiles

The industry standard cylindrical roller bearing profile has flat inner and outer raceways, and a single, non-tangent radius dub on the roller body. The flanges (ribs) are flat and perpendicular to the raceways, and the roller ends are flat. Standard Timken catalog parts follow the same profiling nominal dimensions (see figure below).

Timken can supply a multiple radius dub (MRD) profile on the roller body similar to what is typically manufactured on tapered roller bearing cones. With the MRD profile on the roller, edge stresses associated with roller-inner as well as roller-outer raceway contacts are reduced if not eliminated.



Standard Timken Outer Raceway and Flange Profile

Roller and Raceway Scuffing

In cylindrical roller bearings, there are primarily three contact locations where scuffing occurs:

- Between roller body contacts in full complement cylindrical roller bearings.
- Between the roller end-flange face contacts in any CRB.
- Roller body-inner raceway contacts in caged spherical or cylindrical roller bearings.

The information in this section should be used along with the Required Minimum Load or Lubrication discussion, pages 28 and 29.

There are two primary methods for reducing the risk of roller body scuffing in roller bearings that will be discussed within. The first method is to decrease the radial play in the bearing. By decreasing the radial internal clearance in the bearing, the roller load zone increases and the rollers are guided through a larger portion of their operation.

There are limits to how far the radial internal clearance can be reduced however. There are methods of surface modifications to the roller bodies and raceways that can make the lubricant film more effective and reduce the risk of scuffing.

Scuffing between the roller end-flange face contacts typically occurs in a cylindrical roller bearing when large axial loads are applied to the bearing. In this situation, a different bearing type is usually the best solution (i.e., spherical roller bearing, tapered roller bearing). However, some applications or customers require the use of a cylindrical roller bearing with large axial loads. In this situation, a non-standard cylindrical roller bearing can be designed with spherical roller ends and laid back flange faces, or modified surface finishes to increase the lubricant film generation at this interface.

Engineered Surfaces

Timken engineered surfaces provide improved wear, fatigue, frictional, and marginal lubrication performance of spherical and cylindrical bearings. The engineered surfaces team selects and confirms the optimum tribology surface or coating to meet your needs. Contact your Timken representative for more information.

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Four-row Cylindrical Bearings

Timken four-row cylindrical bearings are designed with well-balanced cross-sections to provide the highest radial capacity possible within the bearing envelope. The four-row cylindrical assembly is an ideal bearing for rolling mills at the back-up roll position where radial loads can be extremely high. The cylindrical bearing design can tolerate moderate to high mill speeds. The rollers and outer race sections are matched to ensure equal load distribution from row to row. The roller and raceway profiles are custom designed and manufactured to allow optimized stress distribution while minimizing the effect of roller-edge loading based on your specific load cycle.

Inner rings are interchangeable with the outer assemblies. Timken typically provides the inner rings with additional grind stock. This allows the mill operator to optimize the roll's precision by finish grinding the inner ring after mounting on the roll neck. Inner rings also can be provided in a finished state with no additional grinding required after mounting on the roll neck or furnished with a tapered bore for your application.

Precision runout characteristics are another reason to select the Timken four-row cylindrical assembly. Our standard for holding bearing runout is P5, which is two classes higher than the normal precision class P0. In addition, our envelope tolerances (bore, OD and width) for the assembly also are typically held to one class higher than normal, P0.

The bearings listed in this catalog range in size from 230 mm bore to 1,040 mm bore. However, when requested, Timken can design and manufacture larger sizes. Our team of engineers is ready to work with you, whether retrofitting an existing mill or creating bearings for a new mill in the earliest design stages.

Design

Figure 1: This four-row assembly includes two double outer rings with triple flanges in each ring. The outer ring assembly includes the two double outer rings, rollers and two cages, which create a unitized construction. Handling is made simpler with this design, and a loading slot is used for roller insertion. Lubrication is accomplished via slots in the faces of the outer ring. The cage is roller guided and produced as a single piece, machined-brass design. The rollers are staggered between the races. This construction is ideal for smaller mills, such as bar mills, and is well suited for grease lubrication.

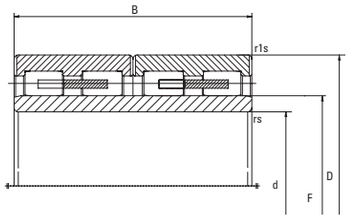

Fig. 1

Figure 2: This four-row assembly is similar to the Figure 1 design with the exception that the double outer rings include radial oil holes at the center of each double outer ring for oil lubricated applications. The cage and roller sets are again integrated with the double outer ring for ease of installation into the chock.

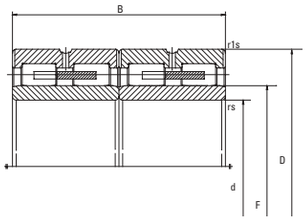

Fig. 2

Figure 3: This four-row assembly includes two double outer rings with an integral center rib, two separable flange rings at each end of the assembly, and a central separable flange ring mounted between the two outer rings. This assembly style allows for complete disassembly for inspection of all internal components and raceways. The inner ring assembly is typically a two-piece design, but can also be supplied as either one-piece or four-piece designs. The cage is roller guided and is a single piece, machined-brass design.

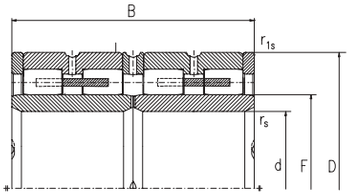

Fig. 3

Figure 4: This four-row assembly is similar to the Figure 3 design but with a pin-type cage. The inner ring assembly is typically a two-piece design, but can also be supplied as either a one-piece or four-piece. It is also important to note that special processes have been established in cage design, manufacturing and welding to assure high and consistent quality of the final product.

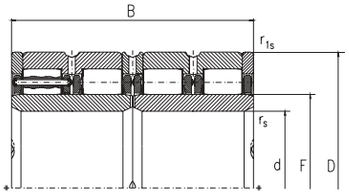

Fig. 4

The bearing shown in Figure 4 includes a groove, and oil holes through the central rib for a circulating oil system. Timken also offers this bearing design with special modifications for oil-mist and air-oil lubricating systems. Contact your Timken representative for more information.

Four-row part numbers are listed on pages 48 and 49.

Cylindrical Roller Bearing Four-Row Fitting Practice (Inner Ring)

Bearing Bore Diameter (mm)		Inner Ring Bore Tolerance (μm)		Seat Deviation (μm)		Resultant Fit for Inner Ring (μm)	
Over	Including	min	max	min	max	min	max
3	6	-7	0	+ 19	+ 27	19 T	34 T
6	10	-7	0	+ 23	+ 32	23 T	39 T
10	18	-7	0	+ 28	+ 39	28 T	46 T
18	30	-8	0	+ 35	+ 48	35 T	56 T
30	50	-10	0	+ 43	+ 59	43 T	69 T
50	65	-12	0	+ 53	+ 72	53 T	84 T
65	80	-12	0	+ 59	+ 78	59 T	90 T
80	100	-15	0	+ 71	+ 93	71 T	108 T
100	120	-15	0	+ 79	+ 101	79 T	116 T
120	140	-18	0	+ 92	+ 117	92 T	135 T
140	160	-18	0	+ 100	+ 125	100 T	143 T
160	180	-18	0	+ 108	+ 133	108 T	151 T
180	200	-22	0	+ 122	+ 151	122 T	173 T
200	225	-22	0	+ 130	+ 159	130 T	181 T
225	250	-22	0	+ 140	+ 169	140 T	191 T
250	280	-25	0	+ 158	+ 190	158 T	215 T
280	315	-25	0	+ 170	+ 202	170 T	227 T
315	355	-30	0	+ 190	+ 226	190 T	256 T
355	400	-30	0	+ 208	+ 244	208 T	274 T
400	450	-35	0	+ 232	+ 272	232 T	307 T
450	500	-35	0	+ 252	+ 292	252 T	327 T
500	560	-40	0	+ 280	+ 324	280 T	364 T
560	630	-40	0	+ 310	+ 354	310 T	394 T
630	710	-50	0	+ 340	+ 390	340 T	440 T
710	800	-50	0	+ 380	+ 430	380 T	480 T
800	900	-65	0	+ 430	+ 486	430 T	551 T
900	1000	-65	0	+ 470	+ 526	470 T	591 T
1000	1120	-80	0	+ 520	+ 586	520 T	666 T
1120	1250	-80	0	+ 580	+ 646	580 T	726 T
1250	1400	-100	0	+ 640	+ 718	640 T	818 T

Roll Neck Tolerance and Inner Ring Fit (using P6 bore tolerance)

Cylindrical Roller Bearing Four-Row Fitting Practice (Outer Ring)

Bearing O.D. (mm)		Outer Ring O.D. Tolerance (μm)		Seat Deviation (μm)		Resultant Fit for Outer Ring (μm)	
Over	Including	min	max	min	max	min	max
3	6	-7	0	+ 10	+ 22	10 L	29 L
6	10	-7	0	+ 13	+ 28	13 L	35 L
10	18	-7	0	+ 16	+ 34	16 L	41 L
18	30	-8	0	+ 20	+ 41	20 L	49 L
30	50	-9	0	+ 25	+ 50	25 L	59 L
50	80	-11	0	+ 30	+ 60	30 L	71 L
80	120	-13	0	+ 36	+ 71	36 L	84 L
120	150	-15	0	+ 43	+ 83	43 L	98 L
150	180	-18	0	+ 43	+ 83	43 L	101 L
180	250	-20	0	+ 50	+ 96	50 L	116 L
250	315	-25	0	+ 56	+ 108	56 L	133 L
315	400	-28	0	+ 62	+ 119	62 L	147 L
400	500	-33	0	+ 68	+ 131	68 L	164 L
500	630	-38	0	+ 76	+ 146	76 L	184 L
630	800	-45	0	+ 80	+ 160	80 L	205 L
800	1000	-60	0	+ 86	+ 176	86 L	236 L
1000	1250	-80	0	+ 98	+ 203	98 L	283 L
1250	1600	-100	0	+ 110	+ 235	110 L	335 L

Chock Bore Tolerance and Outer Ring Fit (using P6 outer ring OD tolerance)

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Spherical and Cylindrical Bearing Part Numbers

Principal Dimensions (mm)			Fig.	Basic Load Ratings (kN)		Dimensions (mm) (mm)					Backing and Fillet Dimensions (mm)			Calculation Factors					
d	D	B		C	Co	rsmin	D1	b	k	d2	d_a	D_a	**$r_{s(max)}$	e	Y1	Y2	Y0	Cg	
180	250	52	1	429	740	2	231	5.5	3	204	188.8	241.2	2.0	0.18	3.8	5.6	3.7	0.066	
190	260	52	1	435	766	2	242	5.5	3	214	198.8	251.2	2.0	0.18	3.8	5.7	3.8	0.068	
	290	75	1	824	1340	2.1	260	14	7.5	224	200.2	279.8	2.1	0.24	2.8	4.2	2.8	0.072	
200	280	60	1	565	1010	2.1	258	8.5	4.5	228	210.2	269.8	2.0	0.19	3.5	5.3	3.5	0.071	
	310	82	1	964	1540	2.1	278	14	7.5	237	210.2	299.8	2.1	0.24	2.8	4.1	2.7	0.073	
	310	109	1	1250	2080	2.1	269	11	6	229	210.2	299.8	2.1	0.33	2	3	2	0.073	
	340	112	1	1460	2240	3	293	16.5	9	243	214.0	326.0	2.5	0.31	2.2	3.2	2.1	0.075	
	340	140	1	1710	2660	3	284	11	6	237	214.0	326.0	2.5	0.4	1.7	2.5	1.7	0.076	
	360	98	1	1400	1960	4	313	16.5	9	251	217.0	343.0	3.0	0.27	2.5	3.8	2.5	0.077	
	360	128	1	1760	2600	4	304	16.5	9	247	217.0	343.0	3.0	0.35	1.9	2.9	1.9	0.077	
	420	138	1	2240	2980	5	352	22.5	12	271	220.0	400.0	4.0	0.34	2	3	2	0.083	
220	300	60	1	583	1080	2.1	278	8.5	4.5	248	230.2	289.8	2.1	0.18	3.8	5.7	3.8	0.075	
	340	90	1	1150	1880	3	306	14	7.5	260	232.4	327.6	2.5	0.24	2.8	4.1	2.7	0.078	
	340	118	1	1450	2490	3	295	11	6	254	232.4	327.6	2.5	0.32	2.1	3.1	2	0.079	
	370	120	1	1690	2600	4	321	16.5	9	265	237.0	353.0	3.0	0.31	2.2	3.2	2.1	0.080	
	370	150	1	1990	3200	4	310	11	6	260	237.0	353.0	3.0	0.39	1.7	2.6	1.7	0.081	
	400	108	1	1670	2360	4	345	16.5	9	277	237.0	383.0	3.0	0.27	2.5	3.8	2.5	0.082	
	400	144	1	2170	3250	4	339	16.5	9	274	237.0	383.0	3.0	0.35	1.9	2.8	1.9	0.082	
	460	145	1	2570	3450	5	387	22.5	12	297	240.0	440.0	4.0	0.32	2.1	3.1	2	0.088	
240	320	60	1	6110	1180	2.1	298	8.5	4.5	267	250.2	309.8	2.1	0.16	4.1	6.1	4	0.078	
	360	118	1	1400	2730	3	316	11	6	274	252.4	347.6	2.5	0.3	2.2	3.3	2.2	0.081	
	360	92	1	1210	2050	3	326	14	7.5	280.0	252.4	347.6	2.5	0.23	2.9	4.4	2.9	0.081	
	400	128	1	1940	3110	4	347	16.5	9	290	257.0	383.0	3.0	0.31	2.2	3.3	2.2	0.084	
	400	160	1	2250	3640	4	338	11	6	283	257.0	383.0	3.0	0.38	1.8	2.6	1.7	0.086	
	440	120	1	2060	2950	4	382	22.5	12	306	257.0	423.0	3.0	0.27	2.5	3.8	2.5	0.086	
	440	160	1	2620	3970	4	373	22.5	12	303	248.5	431.5	4.0	0.36	1.9	2.8	1.8	0.088	
	500	155	1	2980	4040	5	423	22.5	12	324	260.0	480.0	4.0	0.31	2.2	3.3	2.1	0.092	
260	360	75	1	916	1740	2.1	331	8.5	4.5	294	270.2	349.8	2.1	0.18	3.7	5.5	3.6	0.085	
	400	104	1	1550	2580	4	360	16.5	9	307	274.6	385.4	3.0	0.24	2.8	4.2	2.8	0.086	
	400	140	1	1960	3460	4	348	11	6	299	267.3	392.7	4.0	0.33	2.1	3.1	2	0.086	
	440	144	1	2390	3770	4	381	16.5	9	314	268.5	431.5	4.0	0.31	2.1	3.2	2.1	0.089	
	440	180	1	2810	4480	4	371	14	7.5	307	277.0	423.0	3.0	0.39	1.7	2.6	1.7	0.090	
	480	130	1	2450	3430	5	416	22.5	12	328	280.0	460.0	4.0	0.27	2.5	3.7	2.5	0.091	
	480	174	1	3100	4760	5	406	22.5	12	329	277.0	463.0	3.0	0.35	1.9	2.8	1.9	0.092	
	540	165	1	3380	4610	6	456	22.5	12	350	286.0	514.0	5.0	0.31	2.1	3.2	2.1	0.096	
280	380	75	1	889	1720	2.1	352	11	6	314	290.2	369.8	2.1	0.18	3.8	5.6	3.7	0.086	
	420	106	1	1630	2820	4	379	16.5	9	326	294.6	405.4	3.0	0.23	2.9	4.4	2.9	0.090	
	420	140	1	2060	3790	4	369	11	6	320	287.3	412.7	4.0	0.31	2.2	3.3	2.1	0.090	
	460	146	1	2510	4060	5	401	16.5	9	333	300.0	440.0	4.0	0.3	2.2	3.3	2.2	0.092	
	460	180	1	2870	4880	5	390	14	7.5	330	300.0	440.0	4.0	0.37	1.8	2.7	1.8	0.094	
	500	130	1	2550	3670	5	438	22.5	12	350	300.0	480.0	4.0	0.26	2.6	3.9	2.6	0.094	
	500	176	1	3220	4960	5	429	22.5	12	348	290.0	490.0	5.0	0.34	2	2.9	1.9	0.095	
	580	175	1	3830	5270	6	491	22.5	12	377	306.0	554.0	5.0	0.31	2.2	3.2	2.1	0.100	
300	420	90	1	1260	2420	3	385	11	6	342	312.4	407.6	2.5	0.19	3.5	5.3	3.5	0.092	
	460	118	1	1970	3330	4	414	16.5	9	352	314.6	445.4	3.0	0.23	2.9	4.3	2.8	0.094	
	460	160	1	2600	4740	4	401	14	7.5	346	314.6	445.4	3.0	0.32	2.1	3.1	2	0.095	
	500	160	1	2930	4810	5	434	16.5	9	361	320.0	480.0	4.0	0.31	2.2	3.3	2.1	0.097	
	500	200	1	3510	6020	5	422	14	7.5	356	320.0	480.0	4.0	0.38	1.8	2.6	1.7	0.098	
	540	140	1	2900	4230	5	472	22.5	12	378	320.0	520.0	4.0	0.26	2.6	3.9	2.6	0.099	
	540	192	1	3750	5870	5	461	22.5	12	375	320.0	520.0	4.0	0.35	1.9	2.9	1.9	0.100	
320	440	90	1	1270	2500	3	405	11	6	361	332.4	427.6	2.5	0.18	3.7	5.5	3.6	0.095	
	480	121	1	2140	3790	4	434	16.5	9	372	334.6	465.4	3.0	0.23	2.9	4.4	2.9	0.098	

**These maximum fillet radii will be cleared by bearing corners.

Notes:
- Contact customer engineering for missing data.
- Geometry factor given for through hardened inner raceways, contact customer engineering for the value with case carburized inner raceways.
- Lifting holes and other bearing modifications are avaialable per customer request.

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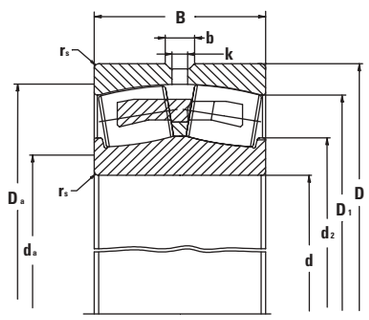
Weight (kg)		Reference Thermal Speed Ratings (rpm)		Part Number			
				Straight Bore		Tapered Bore	
Straight	Tapered	Oil	Grease	World	Timken	World	Timken
8.07	7.77	1900	1500	**23936CAW33**	SP310942	**23936CAKW33**	SP601872
8.38	8.08	1800	1400	**23938CAW33**	SP604293	**23938CAKW33**	SP608419
18.1	17.6	1700	1400	**23038CAW33**	SP166459	**23038CAKW33**	SP181718
11.9	11.6	1600	1300	**23940CAW33**	SP613604	**23940CAKW33**	SP618819
23.4	22.7	1600	1300	**23040CAW33**	SP311846	**23040CAKW33**	SP316428
30.9	30.4	1200	1000	**24040CAW33**	SP342334	**24040CAK30W33**	SP728440
42.5	41.2	1200	1000	**23140CAW33**	SP392762	**23140CAKW33**	SP395860
52.4	51.7	880	790	**24140CAW33**	SP196753	**24140CAK30W33**	SP210773
44	43	1500	1200	**22240CAW33**	SP206494	**22240CAKW33**	SP207938
59.4	57.6	1000	900	**23240CAW33**	SP221638	**23240CAKW33**	SP244204
94.5	92.5	1000	960	**22340CAW33**	SP243638	**22340CAKW33**	SP247411
12.8	12.4	1500	1200	**23944CAW33**	SP622364	**23944CAKW33**	SP626079
30.3	29.4	1400	1200	**23044CAW33**	SP319004	**23044CAKW33**	SP321948
40.8	40.2	1100	960	**24044CAW33**	SP258597	**24044CAK30W33**	SP270977
53.5	51.8	1100	960	**23144CAW33**	SP970654	**23144CAKW33**	SP770762
67.6	66.6	760	690	**24144CAW33**	SP182052	**24144CAK30W33**	SP293197
60.9	59.7	1300	1100	**22244CAW33**	SP970568	**22244CAKW33**	SP448815
82.3	79.9	890	790	**23244CAW33**	SP458440	**23244CAKW33**	SP460128
120	117	960	840	**22344CAW33**	SP250255	**22344CAKW33**	SP255193
14	13.4	1300	1100	**23948CAW33**	SP632015	**23948CAKW33**	SP635954
43.7	43	1000	870	**24048CAW33**	SP347046	**24048CAK30W33**	SP729188
33	32	1300	1100.0	**23048CAW33**	SP780054	**23048CAKW33**	SP440567
66.7	64.6	990	860	**23148CAW33**	SP400943	**23148CAKW33**	SP404497
83.2	82	680	620	**24148CAW33**	SP307920	**24148CAK30W33**	SP313028
82.7	80.9	1200	1000	**22248CAW33**	SP211467	**22248CAKW33**	SP212800
111	108	780	690	**23248CAW33**	SP319491	**23248CAKW33**	SP324018
154	151	850	750	**22348CAW33**	SP259640	**22348CAKW33**	SP262996
24	23.2	1200	1000	**23952CAW33**	SP334862	**23952CAKW33**	SP341163
48	46.5	1100	1000	**23052CAW33**	SP325165	**23052CAKW33**	SP329008
66.7	65.6	910	780	**24052CAW33**	SP359246	**24052CAK30W33**	SP366205
92.1	89.3	880	770	**23152CAW33**	SP377186	**23152CAKW33**	SP386398
112	111	600	550	**24152CAW33**	SP519858	**24152CAK30W33**	SP772858
107	105	1100	940	**22252CAW33**	SP215080	**22252CAKW33**	SP219069
146	142	690	620	**23252CAW33**	SP461527	**23252CAKW33**	SP466498
187	183	780	690	**22352CAW33**	SP264706	**22352CAKW33**	SP266858
25.4	24.6	1100	940	**23956CAW33**	SP397748	**23956CAKW33**	SP398801
52.3	50.7	1100	920	**23056CAW33**	SP331805	**23056CAKW33**	SP552734
71.5	70.4	820	710	**24056CAW33**	SP431211	**24056CAK30W33**	SP448298
97.3	94.2	810	710	**23156CAW33**	SP411992	**23156CAKW33**	SP417013
122	120	540	500	**24156CAW33**	SP464279	**24156CAK30W33**	SP487440
113	110	1000	870	**22256CAW33**	SP224834	**22256CAKW33**	SP226923
154	150	640	580	**23256CAW33**	SP492033	**23256CAKW33**	SP501595
226	222	710	630	**22356CAW33**	SP268294	**22356CAKW33**	SP272798
40.1	38.8	1000	860	**23960CAW33**	SP636620	**23960CAKW33**	SP640359
72.1	69.9	1000	850	**23060CAW33**	SP337327	**23060CAKW33**	SP343111
102	100	740	640	**24060CAW33**	SP434550	**24060CAK30W33**	SP729818
129	125	730	640	**23160CAW33**	SP860883	**23160CAKW33**	SP421408
166	163	470	440	**24160CAW33**	SP193318	**24160CAK30W33**	SP773341
143	140	920	790	**22260CAW33**	SP232650	**22260CAKW33**	SP233199
191	185	590	530	**23260CAW33**	SP467004	**23260CAKW33**	SP469353
42.4	41	960	800	**23964CAW33**	SP644918	**23964CAKW33**	SP645871
78	75.7	920	780	**23064CAW33**	SP862000	**23064CAKW33**	SP343618



Equivalent Dynamic Bearing Load

$P = F_r + Y_1 F_a$ $\quad F_a / F_r \leq e$

$P = 0.67 F_r + Y_2 F_a$ $\quad F_a / F_r > e$

Equivalent Static Load

$P_0 = F_r + Y_0 F_a$

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Principal Dimensions (mm)			Fig.	Basic Load Ratings (kN)		Dimensions (mm)					Backing and Fillet Dimensions (mm)			Calculation Factors					
d	D	B		C	Co	rsmin	D1	b	k	d2	d_a	D_a	**$r_{s(max)}$	e	Y1	Y2	Y0	Cg	
	480	160	1	2660	4970	4	423	14	7.5	367	334.6	465.4	3.0	0.31	2.2	3.3	2.2	0.098	
	540	176	1	3500	5680	5	467	22.5	12	385	340.0	520.0	4.0	0.31	2.1	3.2	2.1	0.101	
	540	218	1	4070	6890	5	456	16.5	9	382	340.0	520.0	4.0	0.39	1.7	2.6	1.7	0.102	
	580	208	1	4350	6870	5	495	22.5	12	401	340.0	560.0	4.0	0.35	1.9	2.8	1.9	0.105	
340	420	60	1	734	1740	2.1	398	-	4.5	367	350.2	409.8	2.1	0.12	5.6	8.4	5.5	0.095	
	460	90	1	1340	2740	3	426	11	6	381	350.2	449.8	2.1	0.17	3.9	5.9	3.9	0.101	
	520	133	1	2530	4330	5	467	22.5	12	395	358.0	502.0	4.0	0.24	2.8	4.2	2.8	0.102	
	520	180	1	3210	5940	5	454	16.5	9	391	358.0	502.0	4.0	0.33	2.1	3.1	2	0.104	
	580	190	1	3990	6540	5	499	22.5	12	411	360.0	560.0	4.0	0.31	2.1	3.2	2.1	0.106	
	580	243	1	4910	8220	5	489	16.5	9	406	360.0	560.0	4.0	0.4	1.7	2.5	1.6	0.106	
	620	224	1	5040	8030	6	527	22.5	12	427	366.0	594.0	5.0	0.35	1.9	2.8	1.9	0.109	
360	480	90	1	1380	2900	3	445	11	6	400	372.4	467.6	2.5	0.16	4.1	6.1	4	0.104	
	540	134	1	2590	4540	5	485	22.5	12	414	378.0	522.0	4.0	0.23	2.9	4.4	2.9	0.104	
	540	180	1	3320	6320	5	475	16.5	9	412	378.0	522.0	4.0	0.31	2.2	3.2	2.1	0.105	
	600	192	1	4160	7010	5	523	22.5	12	435	380.0	580.0	4.0	0.3	2.2	3.3	2.2	0.110	
	600	243	1	4950	8430	5	509	16.5	9	422	380.0	580.0	4.0	0.4	1.7	2.5	1.7	0.110	
	650	232	1	4790	8530	6	551	22.5	12	448	386.0	624.0	5.0	0.35	1.9	2.9	1.9	0.112	
380	520	106	1	1810	3800	4	481	14	7.5	431	394.6	505.4	3.0	0.18	3.8	5.6	3.7	0.107	
	560	135	1	2650	4840	5	508	22.5	12	439	398.0	542.0	4.0	0.22	3.1	4.6	3	0.108	
	560	180	1	3430	6810	5	497	16.5	9	434	398.0	542.0	4.0	0.3	2.2	3.3	2.2	0.109	
	620	194	1	4230	7150	5	542	22.5	12	452	400.0	600.0	4.0	0.3	2.3	3.4	2.2	0.112	
	680	240	1	5720	9250	6	581	22.5	12	472	406.0	654.0	5.0	0.35	1.9	2.9	1.9	0.118	
400	540	106	1	1840	3910	4	498	14	7.5	447	414.6	525.4	3.0	0.17	3.9	5.9	3.9	0.109	
	600	148	1	2890	5710	5	541	22.5	12	464	418.0	582.0	4.0	0.23	3	4.4	2.9	0.112	
	600	200	1	4020	7730	5	527	22.5	12	457	418.0	582.0	4.0	0.31	2.2	3.2	2.1	0.113	
	650	200	1	4520	7710	6	567	22.5	12	474	426.0	624.0	5.0	0.29	2.3	3.4	2.3	0.115	
	720	185	1	4850	7320	6	631	22.5	12	504	426.0	694.0	5.0	0.25	2.7	4	2.6	0.121	
	720	256	1	6450	1050	6	615	22.5	12	500	426.0	694.0	5.0	0.35	1.9	2.9	1.9	0.121	
	820	243	1	7260	1040	7.5	696	22.5	12	534	432.0	788.0	6.0	0.3	2.2	3.3	2.2	0.126	
420	560	106	1	1860	4030	4	519	16.5	9	468	434.6	545.4	3.0	0.16	4.1	6.1	4	0.112	
	620	150	1	3250	6010	5	562	22.5	12	485	438.0	602.0	4.0	0.22	3	4.5	3	0.115	
	620	200	1	4110	8070	5	547	22.5	12	477	438.0	602.0	4.0	0.3	2.3	3.4	2.2	0.117	
	700	224	1	5590	9620	6	607	22.5	12	504	446.0	674.0	5.0	0.31	2.2	3.3	2.1	0.122	
	700	280	1	6700	11500	6	593	22.5	12	494	446.0	674.0	5.0	0.38	1.8	2.6	1.7	0.123	
440	600	118	1	2300	4930	4	550	16.5	9	493	454.6	585.4	3.0	0.17	3.9	5.8	3.8	0.114	
	650	157	1	3570	6640	6	589	22.5	12	509	463.0	627.0	5.0	0.22	3.1	4.6	3	0.119	
	650	212	1	4500	8940	6	572	22.5	12	500	463.0	627.0	5.0	0.3	2.3	3.4	2.2	0.120	
	720	226	1	5320	10200	6	633	22.5	12	527	466.0	694.0	5.0	0.3	2.3	3.4	2.2	0.123	
	720	280	1	6840	12000	6	613	22.5	12	515	466.0	694.0	5.0	0.37	1.8	2.7	1.8	0.124	
	790	280	1	7640	12600	7.5	675	22.5	12	549	472.0	758.0	6.0	0.35	1.9	2.9	1.9	0.130	
460	680	163	1	3500	7040	6	617	22.5	12	530	483.0	657.0	5.0	0.22	3.1	4.6	3	0.122	
	680	218	1	4950	9850	6	601	22.5	12	523	483.0	657.0	5.0	0.29	2.3	3.4	2.2	0.122	
	760	240	1	6440	11200	7.5	666	22.5	12	554	492.0	728.0	6.0	0.3	2.3	3.4	2.2	0.128	
	830	296	1	8530	14200	7.5	707	22.5	12	574	492.0	798.0	6.0	0.35	1.9	2.9	1.9	0.131	
	650	128	1	2730	5890	5	601	16.5	9	538	492.0	632.0	4.0	0.17	3.9	5.8	3.8	0.126	
	700	165	1	3980	7460	6	633	22.5	12	547	503.0	677.0	5.0	0.21	3.2	4.8	3.1	0.126	
	700	218	1	4970	1010	6	622	22.5	12	542	503.0	677.0	5.0	0.28	2.4	3.5	2.3	0.126	
	790	248	1	6820	12000	7.5	691	22.5	12	577	512.0	758.0	6.0	0.3	2.3	3.4	2.3	0.132	
	790	308	1	8190	15100	7.5	674	22.5	12	569	512.0	758.0	6.0	0.37	1.8	2.7	1.8	0.132	
	870	310	1	9170	15300	7.5	739	22.5	12	601	512.0	838.0	6.0	0.35	1.9	2.9	1.9	0.136	
	870	310	1	9170	15300	7.5	739	22.5	12	601	512.0	838.0	6.0	0.35	1.9	2.9	1.9	0.136	
500	620	90	1	1490	3760	3	586	-	7.5	542	512.4	607.6	2.5	0.12	5.5	8.1	5.4	0.122	

**These maximum fillet radii will be cleared by bearing corners.

Notes:
- Contact customer engineering for missing data.
- Geometry factor given for through hardened inner raceways, contact customer engineering for the value with case carburized inner raceways.
- Lifting holes and other bearing modifications are avaialable per customer request.

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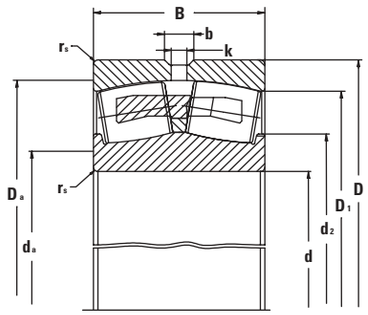
Weight (kg)		Reference Thermal Speed Ratings (rpm)		Part Number			
				Straight Bore		Tapered Bore	
Straight	Tapered	Oil	Grease	World	Timken	World	Timken
105	103	690	600	**24064CAW33**	SP932718	**24064CAK30W33**	SP731052
167	162	670	590	**23164CAW33**	SP803877	**23164CAKW33**	SP422970
208	205	430	400	**24164CAW33**	SP653050	**24164CAK30W33**	SP774226
240	233	520	470	**23264CAW33**	SP471017	**23264CAKW33**	SP200925
18.9	18.3	580	490	**23868CAW20**	SP524348	**23868CAKW20**	SP530205
44.3	42.8	880	740	**23968CAW33**	SP527511	**23968CAKW33**	SP540000
105	102	850	720	**23068CAW33**	SP313872	**23068CAKW33**	SP343848
142	140	630	550	**24068CAW33**	SP732209	**24068CAK30W33**	SP735084
211	204	610	540	**23168CAW33**	SP672527	**23168CAKW33**	SP424359
273	269	390	360	**24168CAW33**	SP782444	**24168CAK30W33**	SP782290
306	297	470	420	**23268CAW33**	SP471918	**23268CAKW33**	SP473963
46.3	44.8	850	710	**23972CAW33**	SP564729	**23972CAKW33**	SP601556
110	106	810	680	**23072CAW33**	SP261646	**23072CAKW33**	SP344481
151	149	580	510	**24072CAW33**	SP738813	**24072CAK30W33**	SP742611
222	215	570	500	**23172CAW33**	SP426033	**23172CAKW33**	SP429657
280	276	370	350	**24172CAW33**	SP774577	**24172CAK30W33**	SP780135
340	330	450	410	**23272CAW33**	SP479168	**23272CAKW33**	SP483241
69.5	67.4	760	640	**23976CAW33**	SP646640	**23976CAKW33**	SP650133
116	112	760	640	**23076CAW33**	SP344959	**23076CAKW33**	SP346541
153	151	540	470	**24076CAW33**	SP811658	**24076CAK30W33**	SP743930
230	223	560	500	**23176CAW33**	SP639591	**23176CAKW33**	SP646493
377	366	420	390	**T3-23276CAW33**	SP671270	**T3-23276CAKW33**	SP675256
71.7	69.4	720	610	**23980CAW33**	SP652511	**23980CAKW33**	SP656200
150	146	700	590	**23080CAW33**	SP351132	**23080CAKW33**	SP352527
206	203	510	450	**24080CAW33**	SP744268	**24080CAK30W33**	SP748096
262	253	510	450	**23180CAW33**	SP682447	**23180CAKW33**	SP686248
344	337	630	550	**T3-22280CAW33**	SP238672	**T3-22280CAKW33**	SP241786
455	441	380	350	**T3-23280CAW33**	SP485639	**T3-23280CAKW33**	SP492512
631	619	410	370	**T5-22380CAW33**	SP937521	**T5-22380CAKW33**	SP793732
74.5	72.1	680	570	**23984CAW33**	SP658335	**23984CAKW33**	SP669178
157	152	660	560	**23084CAW33**	SP360962	**23084CAKW33**	SP363220
214	210	480	420	**24084CAW33**	SP750952	**24084CAK30W33**	SP754760
353	342	450	410	**23184CAW33**	SP431465	**23184CAKW33**	SP432430
441	434	260	250	**24184CAW33**	SP790493	**24184CAK30W33**	SP794675
102	98.5	630	540	**23988CAW33**	SP671367	**23988CAKW33**	SP676653
181	175	620	530	**23088CAW33**	SP390726	**23088CAKW33**	SP364450
251	247	450	400	**24088CAW33**	SP758321	**24088CAK30W33**	SP761981
362	351	430	390	**23188CAW33**	SP434520	**23188CAKW33**	SP436527
456	450	270	260	**24188CAW33**	SP800873	**24188CAK30W33**	SP802302
595	577	330	300	**T3-23288CAW33**	SP730597	**T3-23288CAKW33**	SP744283
205	199	590	500	**23092CAW33**	SP366431	**23092CAKW33**	SP367439
279	274	420	370	**24092CAW33**	SP700010	**24092CAK30W33**	SP764171
441	427	410	370	**23192CAW33**	SP715684	**23192CAKW33**	SP440394
701	676	300	280	**T3-23292CAW33**	SP369103	**T3-23292CAKW33**	SP508682
127	123	560	480	**23996CAW33**	SP132409	**23996CAKW33**	SP747095
215	208	560	480	**23096CAW33**	SP372232	**23096CAKW33**	SP375069
292	288	400	360	**24096CAW33**	SP750194	**24096CAK30W33**	SP768088
490	474	380	350	**T3-23196CAW33**	SP440628	**T3-23196CAKW33**	SP450576
618	609	230	220	**T3-24196CAW33**	SP803999	**T3-24196CAK30W33**	SP805986
816	792	290	260	**T-23296CAW33**	SP692594	**T-23296CAKW33**	SP241486
816	792	290	260	**T5-23296CAW33**	SP692594	**T5-23296CAKW33**	SP241486
62.7	60.6	310	270	**238/500CAW20**	SP518434	**238/500CAKW20**	SP521071



Equivalent Dynamic Bearing Load

$P = F_r + Y_1 F_a$ $F_a / F_r \leq e$

$P = 0.67 F_r + Y_2 F_a$ $F_a / F_r > e$

Equivalent Static Load

$P_0 = F_r + Y_0 F_a$

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Principal Dimensions (mm)			Fig.	Basic Load Ratings (kN)		Dimensions (mm)					Backing and Fillet Dimensions (mm)			Calculation Factors					
d	D	B		C	Co	rsmin	D1	b	k	d2	d_a	D_a	**$r_{s(max)}$	e	Y1	Y2	Y0	Cg	
	670	128	1	2720	6160	5	622	22.5	12	561	518.0	652.0	4.0	0.17	4	6	3.9	0.127	
	720	167	1	4110	7890	6	657	22.5	12	571	523.0	697.0	5.0	0.21	3.2	4.8	3.2	0.131	
	720	218	1	5070	10500	6	652	25.4	8.5	569	523.0	697.0	5.0	0.27	2.5	3.7	2.4	0.128	
	830	264	1	7490	13200	7.5	723	22.5	12	603	532.0	798.0	6.0	0.3	2.2	3.3	2.2	0.136	
	920	336	1	10700	18000	7.5	778	22.5	12	630	532.0	888.0	6.0	0.36	1.9	2.8	1.8	0.141	
530	710	136	1	3080	6770	5	659	22.5	12	591	548.0	692.0	4.0	0.17	4	6	4	0.131	
	780	185	1	4870	9320	6	708	22.5	12	612	553.0	757.0	5.0	0.22	3.1	4.7	3.1	0.134	
	780	250	1	6230	12700	6	688	22.5	12	601	553.0	757.0	5.0	0.29	2.4	3.5	2.3	0.134	
	870	272	1	7530	14600	7.5	767	27.1	8.5	635	562.0	838.0	6.0	0.29	2.3	3.4	2.2	0.140	
560	750	140	1	3280	7240	5	696	22.5	12	624	578.0	732.0	4.0	0.16	4.2	6.2	4.1	0.135	
	820	195	1	5400	10400	6	745	22.5	12	644	583.0	797.0	5.0	0.22	3.1	4.6	3.1	0.138	
	820	258	1	6880	14000	6	729	22.5	12	636	583.0	797.0	5.0	0.28	2.4	3.5	2.3	0.140	
	920	280	1	8880	15800	7.5	806	22.5	12	671	592.0	888.0	6.0	0.29	2.3	3.5	2.3	0.144	
600	800	150	1	3760	8360	5	742	22.5	12	665	618.0	782.0	4.0	0.16	4.1	6.1	4	0.141	
	870	200	1	5770	11400	6	789	22.5	12	685	623.0	847.0	5.0	0.21	3.2	4.8	3.2	0.143	
	980	300	1	10000	18100	7.5	863	22.5	12	720	632.0	948.0	6.0	0.29	2.3	3.4	2.3	0.153	
	980	375	1	12100	22900	7.5	836	22.5	12	702	632.0	948.0	6.0	0.37	1.8	2.7	1.8	0.151	
630	850	165	1	4340	9850	6	786	22.5	12	707	653.0	827.0	5.0	0.17	3.9	5.9	3.9	0.147	
	920	212	1	6520	12700	7.5	838	22.5	12	724	658.0	892.0	6.0	0.21	3.2	4.8	3.2	0.149	
	920	290	1	8370	17400	7.5	815	22.5	12	712	658.0	892.0	6.0	0.28	2.4	3.5	2.3	0.149	
	1030	400	1	13500	25700	7.5	878	22.5	12	742	662.0	998.0	6.0	0.37	1.8	2.7	1.8	0.157	
670	900	170	1	4760	10700	6	834	22.5	12	747	693.0	877.0	5.0	0.17	4.1	6	4	0.150	
710	950	180	1	5180	11900	6	880	22.5	12	790	733.0	927.0	5.0	0.17	4.1	6	4	0.149	
	1030	236	1	8060	16300	7.5	939	22.5	12	815	738.0	1002.0	6.0	0.21	3.3	4.9	3.2	0.160	
	1150	438	1	16100	31100	9.5	983	22.5	12	832	750.0	1110.0	8.0	0.37	1.8	2.7	1.8	0.168	
	1150	438	1	16100	31100	9.5	983	22.5	12	832	750.0	1110.0	8.0	0.37	1.8	2.7	1.8	0.168	
750	1000	185	1	5590	13000	6	927	22.5	12	834	773.0	977.0	5.0	0.16	4.2	6.2	4.1	0.163	
	1090	335	1	11300	24300	7.5	970	22.5	12	852	778.0	1062.0	6.0	0.28	2.5	3.7	2.4	0.168	
850	1120	200	1	6470	15600	6	1041	22.5	12	941	873.0	1097.0	5.0	0.16	4.3	6.5	4.2	0.175	
900	1180	206	1	7100	17100	6	1100	22.5	12	992	923.0	1157.0	5.0	0.15	4.4	6.6	4.3	0.187	
	1180	280	1	9180	23900	6	1085	22.5	12	990	923.0	1157.0	5.0	0.21	3.3	4.9	3.2	0.182	
	1180	280	1	9180	23900	6	1085	22.5	12	990	923.0	1157.0	5.0	0.21	3.3	4.9	3.2	0.182	
950	1250	224	1	7950	19700	7.5	1161	22.5	12	1051	964	1236	7.5	0.16	4.3	6.4	4.2	0.186	

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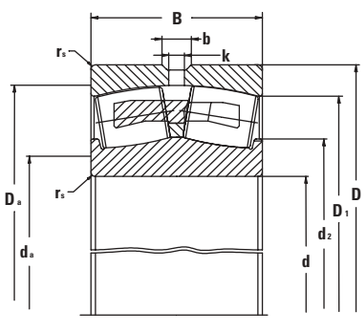
Weight (kg)		Reference Thermal Speed Ratings (rpm)		Part Number			
				Straight Bore		Tapered Bore	
Straight	Tapered	Oil	Grease	World	Timken	World	Timken
131	127	540	460	**239/500CAW33**	SP537610	**239/500CAKW33**	SP540110
225	218	520	450	**230/500CAW33**	SP770713	**230/500CAKW33**	SP780405
2.9	281	370	330	**240/500CAW33**	SP709700	**240/500CAK30W33**	SP692056
582	564	360	330	**T3-231/500CAW33**	SP377500	**T3-231/500CAKW33**	SP379171
988	959	260	240	**T5-232/500CAW33**	SP900250	**T5-232/500CAKW33**	SP744993
155	150	500	430	**239/530CAW33**	SP542079	**239/530CAKW33**	SP544750
308	298	490	420	**230/530CAW33**	SP286272	**230/530CAKW33**	SP288174
419	413	350	310	**240/530CAW33**	SP693155	**240/530CAK30W33**	SP701215
640	613	330	300	**T3-231/530CAW33**	SP380696	**T3-231/530CAKW33**	SP382271
177	172	470	400	**239/560CAW33**	SP547766	**239/560CAKW33**	SP550592
355	344	440	390	**230/560CAW33**	SP290304	**230/560CAKW33**	SP293375
475	467	320	290	**240/560CAW33**	SP703556	**240/560CAK30W33**	SP708327
754	731	310	280	**T3-231/560CAW33**	SP384459	**T3-231/560CAKW33**	SP387228
217	210	440	370	**239/600CAW33**	SP552246	**239/600CAKW33**	SP554271
402	390	420	360	**230/600CAW33**	SP297558	**230/600CAKW33**	SP303257
905	877	280	250	**T5-231/600CAW33**	SP186778	**T5-231/600CAKW33**	SP953346
1150	1135	160	160	**T5-241/600CAW33**	SP596092	**T5-241/600CAK30W33**	SP859736
277	268	400	350	**239/630CAW33**	SP558376	**239/630CAKW33**	SP560883
477	462	390	340	**230/630CAW33**	SP304486	**230/630CAKW33**	SP306410
671	660	270	250	**240/630CAW33**	SP711109	**240/630CAK30W33**	SP717749
1370	1350	150	140	**T-241/630CAW33**	SP215922	**T-241/630CAK30W33**	SP253714
316	306	380	320	**239/670CAW33**	SP565414	**239/670CAKW33**	SP567184
364	353	350	300	**239/710CAW33**	SP570952	**239/710CAKW33**	SP575077
667	623	330	290	**T3-230/710CAW33**	SP308048	**T3-230/710CAKW33**	SP310307
1835	1805	130	120	**T-241/710CAW33**	SP134712	**T-241/710CAK30W33**	SP428574
1825	1800	130	120	**T-241/710CAFW33**	SP134712	**T-241/710CAFK30W33**	SP428574
417	404	320	280	**239/750CAW33**	SP580995	**239/750CAKW33**	SP584129
1065	1050	210	190	**T3-240/750CAW33**	SP718477	**T3-240/750CAK30W33**	SP721222
553	536	280	240	**239/850CAW33**	SP587492	**239/850CAKW33**	SP588453
612	592	260	220	**239/900CAW33**	SP596845	**239/900CAKW33**	SP600305
838	824	110	100	**249/900CAW33**	SP806999	**249/900CAK30W33**	SP809944
838	–	110	100	**T-249/900CAW33**	SP950790	–	–
769	745	240	210	**239/950CAW33**	SP697514	**239/950CAKW33**	SP699710



Equivalent Dynamic Bearing Load

$P = F_r + Y_1 F_a$ $F_a / F_r \neg Ë e$

$P = 0.67 F_r + Y_2 F_a$ $F_a / F_r > e$

Equivalent Static Load

$P_0 = F_r + Y_0 F_a$

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Principal Dimensions (mm)			Fig.	Basic Load Ratings (kN)		Dimensions (mm)					Calculation Factors	
d	D	B		C	Co	d1	D1	F,E	r/r1	S(2)	Cg	
180	280	46	1	391	505	-	244	205	2.1	6.6	0.113	
200	310	51	1	445	602	-	270	229	2.1	8.6	0.123	
	310	51	3	445	602	240	270	229	2.1	-	0.123	
	320	88.9	1	1130	1650	-	281	228	3	6.4	0.153	
	360	58	2	870	1080	258	312	243	4	4.7	0.139	
	360	58	1	870	1080	-	312	243	4	4.7	0.139	
	360	58	3	870	1080	258	312	243	4	-	0.139	
	360	98	1	1410	1900	-	312	241	4	9	0.159	
	360	98	3	1410	1900	256	312	241	4	-	0.159	
	360	98/143	10	1410	1900	-	312	241	4	33.5	0.159	
	420	80	2	1130	1310	280	337	260	5	8	0.147	
	420	80	1	1130	1310	-	337	260	5	8	0.147	
	420	138	1	2240	2720	-	347	247	5	12.8	0.169	
220	340	56	1	565	759	-	297	250	3	8.4	0.133	
	350	98.4	1	1400	2060	-	308	249	3	7.4	0.165	
	400	65	1	865	1100	-	332	270	4	5.2	0.147	
	400	65	3	865	1100	286	332	270	4	-	0.147	
	400	108	1	1820	2350	-	348	259	4	7.4	0.169	
	400	133.4	1	2210	3030	-	344	260	3	8.8	0.180	
	460	88	1	1390	1620	-	371	284	5	9.4	0.158	
	460	145	2	2560	3230	302	381	277	5	13.8	0.183	
	460	145	1	2560	3230	-	381	277	5	13.8	0.183	
	460	145	3	2560	3230	302	381	277	5	-	0.183	
228.6	342.9	44.45	6	593	842	268	304	314	4/3	-	0.137	
240	360	56	1	595	832	-	317	270	3	8.4	0.140	
	390	107.95	1	1750	2550	-	343	273	3	6.6	0.178	
	440	72	2	1080	1300	313	365	295	4	6.5	0.157	
	440	72	1	1080	1300	-	365	295	4	6.5	0.157	
	440	72	3	1080	1300	313	365	295	4	-	0.157	
	440	120	1	1660	2360	-	365	295	4	11.5	0.179	
	440	146	1	2630	3660	-	378	287	3	9.1	0.194	
	500	95	2	1900	2190	334	415	306	5	10.3	0.173	
	500	95	1	1900	2190	-	415	306	5	10.9	0.173	
	500	155	1	2430	3240	-	403	310	5	19.4	0.193	

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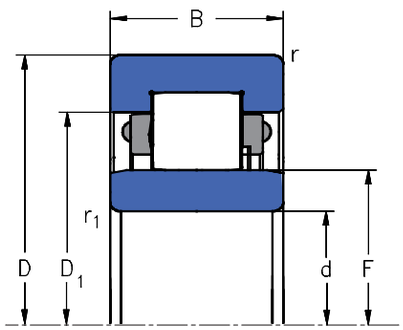

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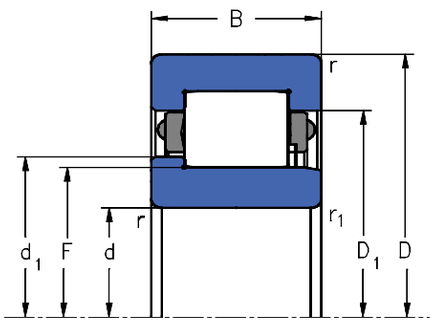

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Angle Ring (Figure 8 & 9)				Weight (Kg)	Reference Thermal Speed Ratings (rpm)		Part Numbers	
Part Number	Weight (kg)	B1	B2		Oil	Grease	World	Timken
				10.7	2500	2100	**NU1036MA**	CP277565
				14.6	2300	1900	**NU1040MA**	CP102045
				15.4	2300	1900	**NUP1040MA**	CP115633
				29.7	1200	1000	**NU5140MA**	CP325346
				27.8	1500	1300	**NJ240EMA**	CP123824
				27.4	1500	1300	**NU240EMA**	CP131492
				28.2	1500	1300	**NUP240EMA**	CP132336
				47	1100	1000	**NU2240EMA**	CP142406
				48.2	1100	1000	**NUP2240EMA**	CP148146
				51.5	1100	1000	**NU2240EMA**	CP958586
HJ340	5.6	18	33	58.8	1400	1200	**NJ340MA**	CP152030
HJ340	5.6	18	33	57.8	1400	1200	**NU340MA**	CP158956
				104	1000	900	**NU2340EMA**	CP163890
				18.5	2000	1600	**NU1044MA**	CP196323
				38.9	1000	930	**NU5144MA**	CP343925
				38.5	1500	1300	**NU244MA**	CP211178
				39.5	1500	1300	**NUP244MA**	CP214181
				62.6	1000	920	**NU2244EMA**	CP219609
				81.4	910	830	**T2-NU5244MAW61**	CP371986
				75.9	1200	1100	**NU344MA**	CP180435
				127	860	780	**NJ2344EMA**	CP227913
				125	860	780	**NU2344EMA**	CP243800
				129	860	780	**NUP2344EMA**	CP244101
				16.7	1000	890	**NP5145MB**	CP248826
				20.2	1800	1500	**NU1048MA**	CP256286
				54.7	890	810	**NU5148MA**	CP770255
				53.5	1300	1100	**NJ248MA**	CP264746
				52.6	1300	1100	**NU248MA**	CP267649
				54.4	1300	1100	**NUP248MA**	CP269588
				85.6	1000	900	**NU2248MA**	CP270853
				108	790	730	**NU5248MAW61**	CP740397
				97.5	1000	930	**NJ348EMA**	CP627081
				96.1	1000	930	**NU348EMA**	CP753352
				153	840	750	**NU2348MA**	CP295002

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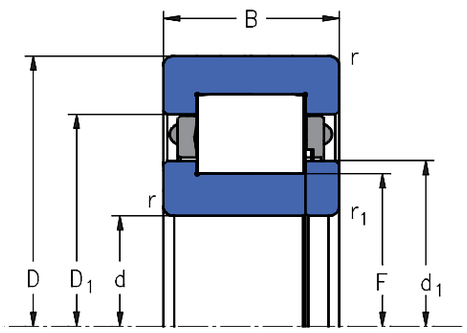

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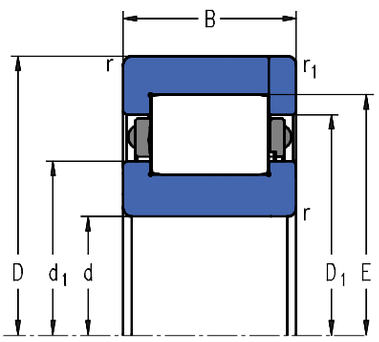

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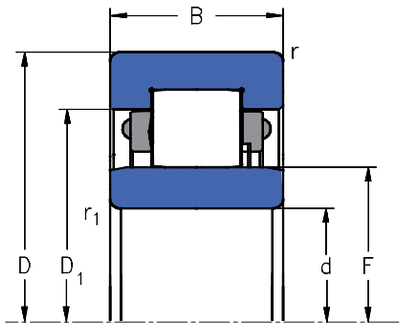
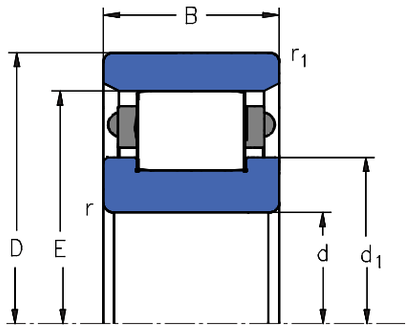
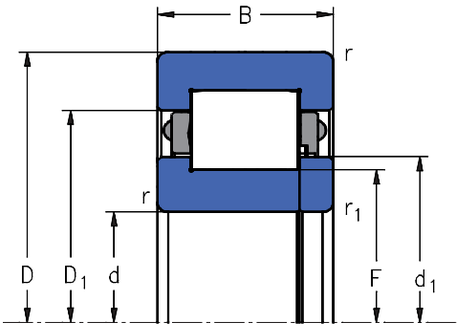
Principal Dimensions (mm)			Fig.	Basic Load Ratings (kN)		Dimensions (mm)					Calculation Factors	
d	D	B		C	Co	d1	D1	F,E	r/r1	S(2)	Cg	
260	360	46	1	468	710	-	325	285	2.1/1.5	2.6	0.139	
	400	65	1	737	1030	-	349	296	4	9.9	0.151	
	480	80	1	1320	1710	-	399	320	5	8	0.170	
	480	130	1	2060	2970	-	398	320	5	11.5	0.194	
	480	158.75	1	3120	4250	-	412	308	5	9.3	0.205	
280	420	65	2	754	1080	330	369	316	4	9.9	0.157	
	420	65	1	754	1080	-	369	316	4	9.9	0.157	
	460	123.8	1	2350	3560	-	402	321	3	10.9	0.204	
	500	165.1	1	3370	4760	-	431	327	4	10	0.216	
	580	175	1	3120	4270	-	467	362	6	20.3	0.217	
292.1	387.35	57.15	3	854	1420	322	357	311	3	-	0.169	
300	380	48	2	531	985	329	356	321	2.1/1.5	5.1	0.161	
	460	74	1	1000	1420	-	402	340	4	10.7	0.170	
	480	127	3	2380	3670	361	419	341	3	-	0.210	
	540	177.8	1	3930	5590	-	467	352	4	11.7	0.229	
305	460	65	4	1280	1950	359	-	422	5	4.7	0.184	
	460	65	3	1280	1950	359	406	342	5/2	-	0.184	
320	480	74	1	1020	1490	-	422	360	4	11.7	0.176	
	580	92	1	1850	2460	-	485	390	5	9.4	0.196	
	580	150	1	2720	3980	-	485	390	5	18.9	0.223	
	580	190.5	1	4480	6440	-	503	380	5	11.9	0.243	
340	520	82	1	1240	1800	-	455	385	5	10.5	0.187	
360	540	82	1	1270	1880	-	475	405	5	10.5	0.191	
	650	232	1	5320	7710	-	552	422	6	14.1	0.262	
	650	232	1	5320	7710	-	552	422	6	14.1	0.262	
380	560	82	1	1300	1960	-	495	425	5	9.5	0.199	
400	600	90	2	1560	2340	470	527	450	5	9	0.210	
	600	90	1	1560	2340	-	528	450	5	9	0.210	
	720	185	1	4890	7340	-	608	480	6	12.1	0.272	
420	620	90	1	1590	2440	-	548	470	5	13	0.216	
457.2	685.8	139.7	4	3540	5480	530	-	640	6.4	9.9	0.262	
460	680	100	1	1940	3020	-	601	516	6	8.5	0.233	
469.9	571.5	82.55	3	1450	3170	503	539	491	3	-	0.246	

NU **N** **NUP**







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Angle Ring (Figure 8 & 9)				Weight (Kg)	Reference Thermal Speed Ratings (rpm)		Part Numbers	
Part Number	Weight (kg)	B1	B2		Oil	Grease	World	Timken
				14.9	1000	860	**NU1952MA**	CP311624
				30	1600	1400	**NU1052MA**	CP318009
				69.7	1100	1000	**NU252MA**	CP337067
				113	850	780	**NU2252MA**	CP344617
				140	710	650	**NU5152MAW61**	CP662640
				32.1	1600	1300	**NJ1056MA**	CP351707
				31.8	1600	1300	**NU1056MA**	CP349609
				88.3	710	650	**NU5156MAW56**	CP502131
				152	660	610	**NU5256MAW61**	CP743549
				234	690	620	**NU2356MA**	CP370344
				18.9	810	700	**NUP5159MA**	CP429923
				13.7	860	730	**NJ2860EMA**	CP432298
				45.7	1300	1100	**NU1060MA**	CP445781
				96.5	660	600	**NUP5160MA**	CP764735
				196	570	530	**NU5260MAW61**	CP611256
				41.3	670	590	**N5161M**	CP469444
				42.7	670	590	**NUP5161M**	CP484506
HJ1064	5.64	19	36	48.1	1300	1000	**NU1064MA**	CP486648
				115	890	780	**NU264MA**	CP493365
				180	660	610	**NU2264MA**	CP503238
				241	520	480	**NU5164MAW61**	CP758000
HJ1068	7.38	21.3	39.5	64.2	1100	1000	**NU1068MA**	CP519139
				68	1100	940	**NU1072MA**	CP528174
				362	470	440	**T3-NU3272MA**	CP946735
				362	470	440	**T3-NU3272MAW61**	CP946735
				71.3	1000	890	**NU1076MA**	CP534785
HJ1080	10.5	23	43	94.2	970	820	**NJ1080MA**	CP560479
HJ1080	10.5	23	43	91.9	970	820	**NU1080MA**	CP561388
				364	420	390	**T3-NU2280MA**	CP561941
				96.1	920	780	**NU1084MA**	CP587351
				188	410	370	**N5191M**	CP605732
				130	810	690	**NU1092F2M**	CP614658
				46.5	450	400	**NUP5194MAR330...394**	CP625091

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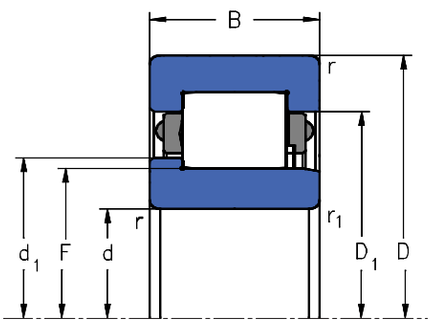

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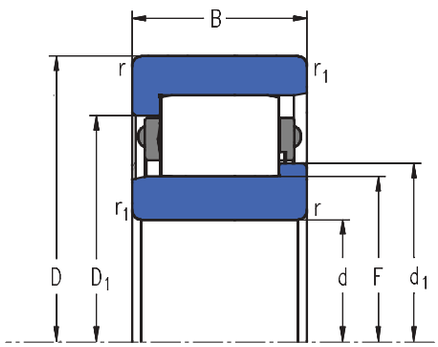

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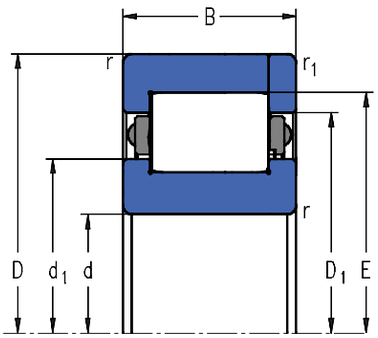

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Principal Dimensions (mm)			Fig.	Basic Load Ratings (kN)		Dimensions (mm)					Calculation Factors	
d	D	B		C	Co	d1	D1	F,E	r/r1	S(2)	Cg	
480	600	56	2	866	1680	523	560	511	3	7.4	0.216	
	650	78	7	1530	2580	538	593	523	5	7	0.230	
	700	100	2	2360	3920	560	622	536	6	9.8	0.253	
500	670	100	1	2130	4140	-	608	543	5	5	0.264	
560	680	56	2	816	1780	607	638	597	3	7.4	0.233	
	820	115	1	2650	4270	-	726	625	6	18.8	0.269	
600	800	90	3	2200	3870	669	739	649	5	-	0.272	
	800	90	7	2200	3870	669	739	649	5	7	0.262	
	800	118	3	3030	5800	670	736	649	5	-	0.296	
	870	118	1	3130	5210	-	779	667	6	16.8	0.262	
630	850	128	3	3470	6520	704	782	683	6	-	0.312	
647.7	774.54	101.6	6	2160	5340	692	732	746	5/1.5	-	0.314	
660.4	863.6	107.95	3	3230	6030	728	800	704	5	-	0.311	
	838.2	114.3	6	2990	6400	725	781	801	6/1.5	-	0.323	
673.1	838.2	117.475	3	3020	6800	728	782	710	5	-	0.331	
710	950	140	2	4020	8190	794	866	770	6	11.1	0.348	
723.8	908.05	120.65	6	3440	7440	788	848	870	5/1.5	-	0.343	
850	1050	125	2	3660	8170	918	982	896	5/6	8	0.373	
950	1250	132	1	4360	8520	-	1147	1025	7.5	12.8	0.381	
	1250	132	3	4360	8520	1055	1147	1025	7.5	-	0.381	

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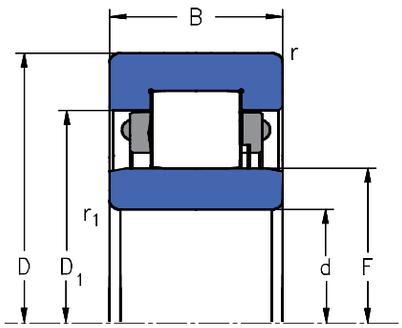

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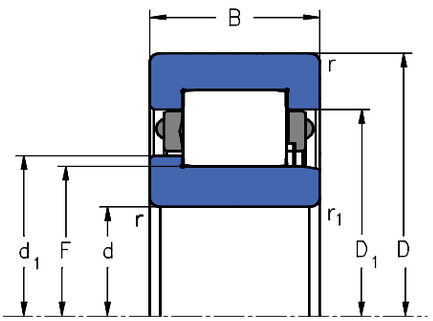

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	Angle Ring (Figure 8 & 9)				Weight (Kg)	Reference Thermal Speed Ratings (rpm)		Part Numbers	
	Part Number	Weight (kg)	B1	B2		Oil	Grease	World	Timken
					38.9	500	440	**NJ1896MA**	CP684465
					77.2	450	390	**NJF5196MA**	CP640672
					138	710	610	**NJ1096EMA**	CP481212
					104	400	350	**NU29/500M**	CP666941
					43.8	400	340	**NJ18/560EMA**	CP716354
					213	630	540	**NU10/560MA**	CP738425
					136	330	290	**NUP19/600EMA**	CP758111
					135	330	290	**NJF51/600EMA**	CP766240
					173	310	280	**NUP29/600MA**	CP774123
					249	550	480	**NU10/600MA**	CP778235
					229	290	260	**NUP29/630EMA**	CP802469
					99.8	290	260	**NP51/648M**	CP561692
					176	270	240	**NUP51/660MA**	CP117430
					160	270	240	**NP52/667M**	CP229691
					167	260	240	**NUP51/673MANS**	CP152541
					307	240	220	**NJ29/710MA**	CP771048
					197	240	210	**NP51/724M**	CP248834
					255	200	180	**T-NJ51/850MA**	CP431299
					482	180	160	**NU19/950MA**	CP724445
					502	180	160	**NUP19/950MA**	CP737874

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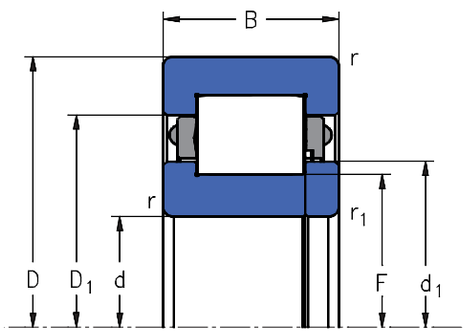

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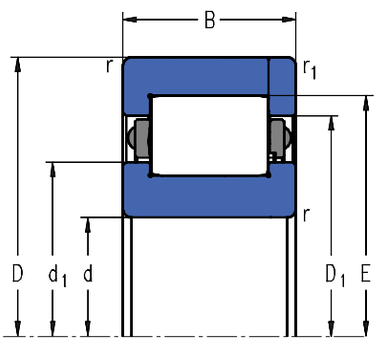

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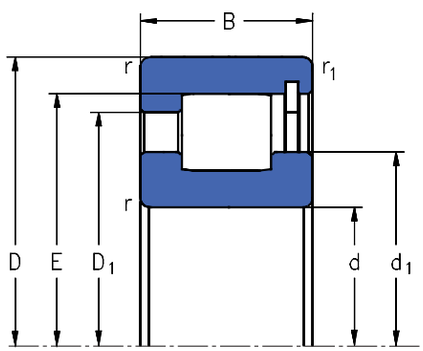
Principal Dimensions (mm)			Fig.	Basic Load Ratings (kN)		Dimensions (mm)					
d	D	B		C	Co	d1	D1	F,E	r/r1	S(2)	
200	250	24	1	193	343	218	231	238	1.5	1.1	
220	270	24	1	202	377	239	251	258	1.5	1.1	
	300	48	1	575	1010	251	272	283	2.1	1.5	
260	320	28	1	297	561	283	299	307	2	1.1	
	360	60	1	846	1490	294	320	333	2.1	1.5	
280	350	33	1	362	682	307	326	334	2	1.1	
300	380	38	1	464	858	330	354	363	2.1	1.5	
	420	72	1	1260	2240	342	374	390	3	3	
320	400	38	1	479	912	350	374	383	2.1	1.5	
	440	72	1	1300	2380	363	394	411	3	3	
340	420	38	1	492	966	370	394	403	2.1	1.5	
	520	133	1	2710	4200	397	463	486	5	5	
360	440	38	1	506	1020	390	414	423	2.1	1.5	
380	480	46	1	708	1360	417	446	457	2.1	1.5	
	520	82	1	1820	3410	430	469	487	4	4	
400	500	46	1	722	1420	434	464	474	2.1	1.5	
440	540	46	1	756	1560	475	506	516	2.1	1.5	
460	580	56	1	1030	2020	503	539	553	3	3	
	620	95	1	2310	4580	516	557	579	4	4	
500	620	56	1	1070	2190	544	579	593	3	3	
530	650	56	1	1100	2320	574	610	624	3	3	
600	730	60	1	1170	2610	645	681	695	3	3	
630	780	69	1	1410	3080	681	722	738	4	4	
710	870	74	1	1740	3900	768	813	831	4	4	

NCF



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	Calculation Factors	Weight (Kg)	Reference Thermal Speed Ratings (rpm)		Part Numbers	
	Cg		Oil	Grease	World	Timken
	0.111	2.52	730	600	**NCF1840V**	CP888795
	0.118	2.92	660	540	**NCF1844V**	CP893357
	0.145	10.9	650	550	**NCF2944V**	CP896582
	0.136	4.8	570	470	**NCF1852V**	CP902548
	0.165	18.5	530	450	**NCF2952V**	CP908789
	0.145	7.2	540	440	**NCF1856V**	CP914453
	0.156	10	500	410	**NCF1860V**	CP924699
	0.190	31.5	420	370	**NCF2960V**	CP930628
	0.163	10.6	460	380	**NCF1864V**	CP941080
	0.198	32.9	390	340	**NCF2964V**	CP946349
	0.170	11.2	420	350	**NCF1868V**	CP949915
	0.222	97.7	350	310	**NCF3068V**	CP957288
	0.175	11.4	390	330	**NCF1872V**	CP960013
	0.188	19.1	370	310	**NCF1876V**	CP963855
	0.227	52.9	300	260	**NCF2976V**	CP218100
	0.193	20.6	340	290	**NCF1880V**	CP970038
	0.205	22.3	300	250	**NCF1888V**	CP973511
	0.219	34.2	290	240	**NCF1892V**	CP982466
	0.261	84	240	210	**NCF2992V**	CP986564
	0.232	36	260	220	**NCF18/500V**	CP991661
	0.239	37.8	240	200	**NCF18/530V**	CP992526
	0.259	50.2	210	180	**NCF18/600V**	CP998904
	0.273	72.2	200	170	**NCF18/630V**	CP217594
	0.300	91.6	170	140	**NCF18/710V**	CP204493

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Principal Dimensions (mm)			Fig.	Basic Load Ratings (kN)			
				1 mil rev	90 mil rev		
d	D	B		C1(4)	C90(4)	Co	
230	330	206	1	2120	550	3956	
240	330	220	1	1924	498	4320	
240	320	200	2	1990	516	3896	
280	390	220	1	2620	680	5200	
300	420	300	3	4080	1058	8360	
340	480	350	3	5180	1342	10800	
379.950	540	400	4	6900	1790	14640	
380	540	400	4	6900	1790	14640	
390	540	320	4	5720	1482	11880	
550	740	510	4	11780	3060	28160	
571.1	812.97	594	4	15440	4000	34720	
-	920	670	4	19540	5060	45200	
700	930	620	4	16920	4380	44000	
-	1030	750	4	24600	6360	58800	
750	1000	670	4	20000	5200	50400	
800	1080	700	4	22600	5880	58800	
820	1130	800	4	27400	7120	68400	
820	1100	720	4	23000	5960	57600	
850	1150	840	4	28800	7460	74800	
850	1180	850	4	29600	7680	72800	
900	1220	840	4	30200	7820	78000	
1040	1439.89	1000	4	42600	11060	101200	

Fig. 1

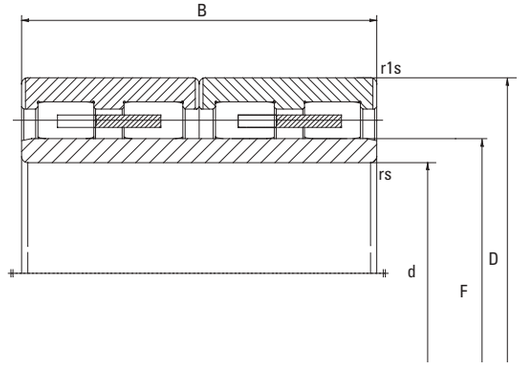
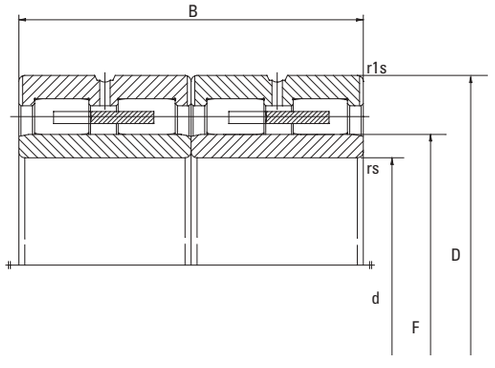


Fig. 2



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	Calculation Factors Cg	Weight (kg)	Diameter Under Rollers (mm) F	Fillet Dimensions (mm) Inner rs	Outer r1s	Part Number
	0.147	58	260	2.1	2.1	RZ-230AA
	0.157	56,7	270	2.1	2.1	RZ-240AA
	0.148	44,6	260	2.1	2.1	RZ-240AC
	0.168	82,5	312	3	3	RZ-280AA
	0.191	130	332	7x20°	1.5	RZ-300AA
	0.212	207	378	8x20°	1.5	RZ-340AA
	0.234	296	422	5	2	RZ-380AA
	0.234	296	422	10x20°	2	RZ-380AB
	0.225	230	431	10x20°	2	RZ-390AA
	0.310	648	600	15x20°	2	RZ-550AA
	0.327	1030	636	14x20°	5	RZ-571AA
	-	1066	723	-	4	RZ-650PA
	0.377	1190	763	18x20°	3	RZ-700AA
	-	1534	809	-	6	RZ-730PA
	0.393	1500	813	20x20°	3	RZ-750AA
	0.419	1960	878	20x20°	3	RZ-800AA
	0.433	2510	903	23x20°	7.5	RZ-820AA
	0.417	2000	892	22x20°	3	RZ-820AC
	0.449	2680	928	23x20°	4	RZ-850AA
	0.445	2940	940	25x11°20'	7.5	RZ-850ABDR
	0.464	3030	989	24x24°	4	RZ-900AA
	0.505	5060	1133	27x20°	7.5	RZ-1040AA

Fig. 3

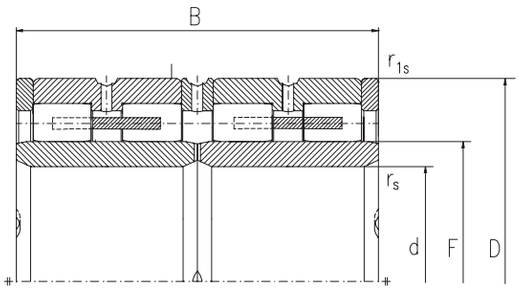
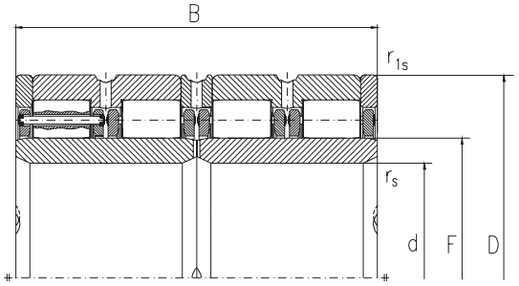


Fig. 4



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