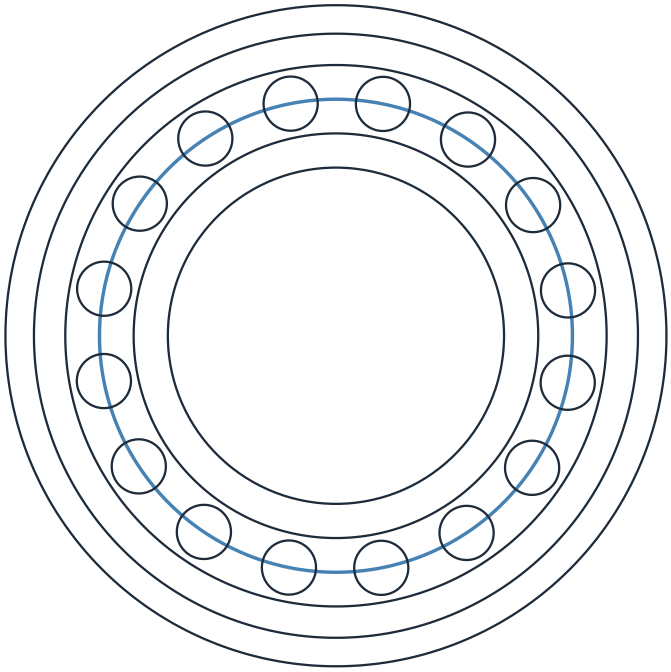


TIMKEN

# TIMKEN

## Angular Contact Ball Bearing Catalog

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← استعلام قیمت و خرید بلبرینگ TIMKEN

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TIMKEN




# TIMKEN® ANGULAR CONTACT BALL BEARING CATALOG

## ABOUT THE TIMKEN COMPANY

As a global leader in bearings and power transmission systems, Timken focuses on precise solution design, materials and craftsmanship to deliver reliable and efficient performance that improves productivity and uptime. Timken offers a full range of bearings, belts, chains, couplings, gears and lubricants, along with rebuild and repair services.

Timken (NYSE; TKR; www.timken.com) applies its proven expertise in metallurgy, tribology and mechanical power transmission to create innovative approaches to customers' complex needs. Global availability of products and engineering talent, combined with exceptional service delivery across markets, makes Timken a preferred choice worldwide.

To view more Timken catalogs, go to www.timken.com/catalogs for interactive versions, or to download our catalog app to your smart phone or mobile device.



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# *TIMKEN® ANGULAR CONTACT BALL BEARINGS*

## ALL-AROUND RELIABILITY

Designed for reliable performance in pump, compressor, electric motor and many other industrial applications, our angular contact ball bearings are able to handle high speeds and both radial and axial loading. These bearings follow ISO standards and are dimensionally interchangeable with competitor metric products.

## MORE CHOICES

We have added 250-new part numbers to our growing portfolio of single-row and double-row products. Now, you have more options from a dependable supplier known for quality and performance.

## PRODUCT FEATURES

- Enhanced raceway finish
- Quiet running
- High-speed capabilities
- Robust seals

## GET THE MOST OUT OF YOUR OPERATIONS

Every Timken angular contact ball bearing is backed by premium customer service, leveraging our global sales and distribution network. It is also supported by the knowledge of our industry-leading experts. They are ready to assist you with product design, application knowledge and field engineering support – anything you need to help improve uptime and maximize equipment performance.



# *HOW TO USE THIS CATALOG*

We designed this catalog to help you find the Timken bearings best suited to your equipment needs and specifications.

This publication contains dimensions, tolerances and load ratings, as well as engineering sections describing fitting practices for shafts and housings, internal clearances and other bearing features. For more information, please use the Timken Engineering Manual (order no. 10424). It provides valuable assistance in the initial consideration of the type and characteristics of the bearings that may best suit your particular needs.

# *SHELF LIFE AND STORAGE OF GREASE-LUBRICATED BEARINGS AND COMPONENTS*

To help you get the most value from our products, Timken provides guidelines for the shelf life of grease-lubricated ball and roller bearings, components and assemblies. Shelf life information is based on Timken and industry test data and experience.

## SHELF LIFE

Shelf life should be distinguished from lubricated bearing component design life as follows:

Shelf life of the grease-lubricated bearing/component represents the period of time prior to use or installation.

The shelf life is a portion of the anticipated aggregate design life. It is impossible to accurately predict design life due to variations in lubricant bleed rates, oil migration, operating conditions, installation conditions, temperature, humidity and extended storage.

**TIMKEN IS NOT RESPONSIBLE FOR THE SHELF LIFE OF ANY BEARING/COMPONENT LUBRICATED BY ANOTHER PARTY.**

### European REACH compliance

Timken lubricants, greases and similar products sold in stand alone containers or delivery systems are subject to the European REACH (Registration, Evaluation, Authorization and Restriction of Chemicals) directive. For import into the European Union, Timken can sell and provide only those lubricants and greases that are registered with ECHA (European Chemicals Agency). For further information, please contact your Timken engineer.

## STORAGE

Timken suggests the following storage guidelines for our finished products (bearings, components and assemblies, referred to as "products"):

- Unless directed otherwise by Timken, products should be kept in their original packaging until they are ready to be placed into service.
- Do not remove or alter any labels or stencil markings on the packaging.
- Products should be stored in such a way that the packaging is not pierced, crushed or otherwise damaged.
- After a product is removed from its packaging, it should be placed into service as soon as possible.
- When removing a product that is not individually packaged from a bulk pack container, the container should be resealed immediately after the product is removed.
- Do not use product that has exceeded its shelf life as defined in the Timken shelf life guidelines statement.
- The storage area temperature should be maintained between 0° C (32° F) and 40° C (104° F); temperature fluctuations should be minimized.
- The relative humidity should be maintained below 60 percent and the surfaces should be dry.
- The storage area should be kept free from airborne contaminants such as, but not limited to, dust, dirt, harmful vapors, etc.
- The storage area should be isolated from undue vibration.
- Extreme conditions of any kind should be avoided.

Due to the fact that Timken is not familiar with your particular storage conditions, we strongly suggest following these guidelines. However, you may be required by circumstances or applicable government requirements to adhere to stricter storage requirements.

Most bearing components typically ship protected with a corrosion-preventive compound that is not a lubricant. These components may be used in oil-lubricated applications without removal of the corrosion-preventive compound. When using some specialized grease lubrications, we advise you to remove the corrosion-preventive compound before packing the bearing components with suitable grease.

Be careful in selecting lubrication, however, since different lubricants are often incompatible.

When you receive a bearing shipment, do not remove products from their packaging until they are ready for mounting so they do not become corroded or contaminated.

Store bearings and bearing housings in an appropriate atmosphere so they remain protected for the intended period.

**⚠ WARNING**

***Failure to observe the following warnings could create a risk of death or serious injury.***

Proper maintenance and handling practices are critical. Always follow installation instructions and maintain proper lubrication.

Tensile stresses can be very high in tightly fitted bearing components. Attempting to remove such components by cutting the inner ring may result in a sudden shattering of the component, causing fragments of metal to be forcefully expelled. Always use properly guarded presses or bearing pullers to remove bearings from shafts, and always use suitable personal protective equipment, including safety glasses.

**CAUTION**

***Failure to follow these cautions may result in property damage.***

The products cataloged are application-specific. Any use in applications other than those intended could lead to equipment failure or to reduced equipment life.

Use of improper bearing fits may cause damage to equipment.

Do not use damaged bearings. The use of a damaged bearing can result in equipment damage.



## DISCLAIMER

***This catalog is provided solely to give you analysis tools and data to assist you in your product selection. Product performance is affected by many factors beyond the control of Timken. Therefore, the suitability and feasibility of all product selection must be validated by you.***

***Timken products are sold subject to Timken's terms and conditions of sale, including its limited warranty and remedy, which may be found at http://www.timken.com/termsandconditionsofsale. Please consult with your Timken sales engineer for more information and assistance.***

***Every reasonable effort has been made to ensure the accuracy of the information in this writing, but no liability is accepted for errors, omissions or for any other reason.***

## COMPLIANCE

***To view the complete engineering catalog, please visit www.timken.com. To order the catalog, please contact your Timken sales engineer and request a copy of the Timken Engineering Manual (order number 10424). For further information, please contact your Timken sales engineer.***

***The Timken Company products shown in this catalog may be directly or indirectly subject to a number of regulatory standards and directives originating from authorities in the USA, European Union and around the world including: REACH (EC 1907/2006, RoHS (2011/65/EU), ATEX (94/9/EC), 'CE' MARKING (93/68/EEC), CONFLICT MINERALS (Section 1502 of the Dodd-Frank Wall Street Reform and Consumer Protection Act).***

***For any questions or concerns regarding the compliancy or applicability of Timken products to these or other unspecified standards, please contact your Timken sales engineer or customer services representative.***

***Updates are made periodically to this catalog. Visit www.timken.com for the most recent version of the Timken® Angular Contact Ball Bearing Catalog.***




# *ENGINEERING*

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Metric System Tolerances .....7
Bearing Life.....8
Mounting and Fitting.....9
Lubrication .....18

This engineering section is not intended to be comprehensive, but does serve as a useful guide in bearing selection.

*To view the complete engineering catalog and other Timken catalogs, go to* ***www.timken.com/catalogs*** *for interactive versions, or to download a catalog app for your smart phone or mobile device scan the QR code or go to* ***www.timkencatalogs.com.***

# BEARING TYPES AND CAGES

Angular contact ball bearings are available from Timken in single-row 7200 and 7300 series and double-row 3200 and 3300 series. Designed to take both radial and thrust loading, angular contact ball bearings are commonly used in pumps, compressors, electric motors and many other industrial applications.

Our expanded portfolio includes a range of single-row standard, single-row universally matched, and double-row designs (see table 1). These angular contact ball bearings follow ISO standards and are dimensionally interchangeable with competitor metric products.

**TABLE 1.**
**PRODUCT TYPES**

| Bearing Type | Series | Bore Range | O.D. Range | Contact Angle | Tolerance | Cage Types |
|---|---|---|---|---|---|---|
| | | mm | mm | | | |
| Single-Row Standard Design | 7200 | 10-130 | 30-230 | 40° | Class P0 | Brass or Polyamide |
| | 7300 | 12-110 | 37-240 | | | |
| Single-Row Universally Matched Design[1] | 7200 | 10-130 | 30-230 | 40° | Class P5 | Brass or Polyamide |
| | 7300 | 12-110 | 37-240 | | | |
| Double-Row Design[2] | 3200 | 12-65 | 32-120 | 30° | Class P0 | Polyamide or Steel |
| | 3300 | 15-70 | 42-150 | | | |

[1]Designed to be used in sets.
[2]Normal clearance and C3 clearances are available for this series.

## CAGES

Cages maintain uniform ball spacing in the bearing as the balls pass into and out of the load zone. They can impact several bearing operational characteristics such as:

- Maximum rotational speed
- Torque characteristics
- Temperature limits
- Lubricant flow

There are a number of different cage types that are commonly used in angular contact ball bearings. Figs. 1 and 2 show the cage variances. Table 2 describes the most common cage types.

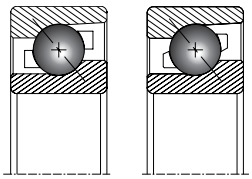



**Fig. 1. Cage variants: single-row.**

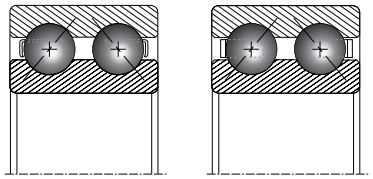



**Fig. 2. Cage variants: double-row.**

**TABLE 2.**
**COMMON CAGE TYPES**

| Type | Molded Polymer Cage Single-Row | Machined-Brass Cage Single-Row | Polymer Crown-Type Cage Double-Row | Pressed-Steel Cage Double-Row |
|---|---|---|---|---|
| Design |  |  |  |  |
| Construction | Made of polyamide 66 glass fiber reinforced cage; ball-piloted cage. | Made from solid brass; ball-piloted cage. | Snap-in polyamide 66 glass fiber reinforced cage; ball-piloted cage. | One-piece snap-in pressed-steel cage; ball-piloted cage. |
| Advantages | Designed to reduce functional torque and provide additional misalignment capability; resistant to most solvents, oils and greases. | Superior strength enables this cage to be used in heavily loaded, high-speed and high-temperature applications. | Additional misalignment capability and reduced functional torque; resistant to most solvents, oils and greases. | Rigid, strong and economical; this cage is suitable for most applications. |

# METRIC SYSTEM TOLERANCES

Ball bearings are manufactured to a number of specifications with each having classes that define tolerances on dimensions such as bore, outer diameter, width and runout.

Standard Timken angular contact ball bearings maintain normal tolerances (P0) according to the current ISO 492 standard. Universally matched bearings are manufactured according to P5 class tolerances.

The term "deviation" is defined as the difference between a single ring dimension and the nominal dimension. For metric tolerances, the nominal dimension is at a +0 mm tolerance. The deviation is the tolerance range for the listed parameter. Variation is defined as the difference between the largest and smallest measurement of a given parameter for an individual ring. Contact a Timken sales engineer when running tolerance is critical.

**TABLE 3.**
**CLASS P0 INNER RING – TOLERANCES**

| Bearing Bore | | Bore Deviation High: +0 | Radial Runout | Width Deviation High: +0 | Width Variation |
|---|---|---|---|---|---|
| d | | $\Delta_{dmp}$ | $K_{ia}$ | $\Delta_{BS}$ | $V_{BS}$ |
| Over | Incl. | Low | Max. | Low | Max. |
| mm | mm | µm | µm | µm | µm |
| 2.5 | 10 | -8 | 10 | -120 | 15 |
| 10 | 18 | -8 | 10 | -120 | 20 |
| 18 | 30 | -10 | 13 | -120 | 20 |
| 30 | 50 | -12 | 15 | -120 | 20 |
| 50 | 80 | -15 | 20 | -150 | 25 |
| 80 | 120 | -20 | 25 | -200 | 25 |
| 120 | 150 | -25 | 30 | -250 | 30 |
| 150 | 180 | -25 | 30 | -250 | 30 |
| 180 | 250 | -30 | 40 | -300 | 30 |
| 250 | 315 | -35 | 50 | -350 | 35 |
| 315 | 400 | -40 | 60 | -400 | 40 |

**TABLE 4.**
**CLASS P0 OUTER RING – TOLERANCES**

| Bearing O.D. | | Outside Deviation High: +0 | Radial Runout | Width Deviation High: +0 | Width Variation |
|---|---|---|---|---|---|
| D | | $\Delta_{Dmp}$ | $K_{ea}$ | $\Delta_{CS}$ | $V_{CS}$ |
| Over | Incl. | Low | Max. | Low | Max. |
| mm | mm | µm | µm | µm | µm |
| 6 | 18 | -8 | 15 | Identical to $\Delta_{BS}$ of the inner ring of the same bearing | Identical to $V_{BS}$ of the inner ring of the same bearing |
| 18 | 30 | -9 | 15 | | |
| 30 | 50 | -11 | 20 | | |
| 50 | 80 | -13 | 25 | | |
| 80 | 120 | -15 | 35 | | |
| 120 | 150 | -18 | 40 | | |
| 150 | 180 | -25 | 45 | | |
| 180 | 250 | -30 | 50 | | |
| 250 | 315 | -35 | 60 | | |
| 315 | 400 | -40 | 70 | | |
| 400 | 500 | -45 | 80 | | |

**TABLE 5.**
**CLASS P5 INNER RING – TOLERANCES**

| Bearing Bore | | Bore Deviation High: +0 | Radial Runout | Face Runout to Bore | Axial Runout | Width Deviation High: +0 | | Width Variation |
|---|---|---|---|---|---|---|---|---|
| d | | $\Delta_{dmp}$ | $K_{ia}$ | $S_d$ | $S_{ia}$ | $\Delta_{BS}$ | $\Delta_{BSu}$ [1] | $V_{BS}$ |
| Over | Incl. | Low | Max. | Max. | Max. | Low | | Max. |
| mm | mm | µm | µm | µm | µm | µm | µm | µm |
| 2.5 | 10 | -5 | 4 | 7 | 7 | -40 | -250 | 5 |
| 10 | 18 | -5 | 4 | 7 | 7 | -80 | -250 | 5 |
| 18 | 30 | -6 | 4 | 8 | 8 | -120 | -250 | 5 |
| 30 | 50 | -8 | 5 | 8 | 8 | -120 | -250 | 5 |
| 50 | 80 | -9 | 5 | 8 | 8 | -150 | -250 | 6 |
| 80 | 120 | -10 | 6 | 9 | 9 | -200 | -380 | 7 |
| 120 | 150 | -13 | 8 | 10 | 10 | -250 | -380 | 8 |
| 150 | 180 | -13 | 8 | 10 | 10 | -250 | -380 | 8 |
| 180 | 250 | -15 | 10 | 11 | 13 | -300 | -500 | 10 |
| 250 | 315 | -18 | 13 | 13 | 15 | -350 | -500 | 13 |
| 315 | 400 | -23 | 15 | 15 | 20 | -400 | -630 | 15 |

[1]Applies to single-row universally matched design.

**TABLE 6.**
**CLASS P5 OUTER RING – TOLERANCES**

| Bearing O.D. | | Outside Deviation High: +0 | Radial Runout | Face Runout to Bore | Axial Runout | Width Deviation High: +0 | | Width Variation |
|---|---|---|---|---|---|---|---|---|
| D | | $\Delta_{Dmp}$ | $K_{ea}$ | $S_D$ | $S_{ea}$ | $\Delta_{CS}$ | $\Delta_{CSu}$ [1] | $V_{CS}$ |
| Over | Incl. | Low | Max. | Max. | Max. | Low | | Max. |
| mm | mm | µm | µm | µm | µm | µm | µm | µm |
| 6 | 18 | -5 | 5 | 8 | 8 | Identical to $\Delta_{BS}$ of the inner ring of the same bearing | | 5 |
| 18 | 30 | -5 | 6 | 8 | 8 | | | 5 |
| 30 | 50 | -6 | 7 | 8 | 8 | | | 5 |
| 50 | 80 | -8 | 8 | 8 | 10 | | | 5 |
| 80 | 120 | -9 | 10 | 9 | 11 | | | 6 |
| 120 | 150 | -10 | 11 | 10 | 13 | | | 7 |
| 150 | 180 | -13 | 13 | 10 | 14 | | | 8 |
| 180 | 250 | -13 | 15 | 11 | 15 | | | 8 |
| 250 | 315 | -15 | 18 | 13 | 18 | | | 10 |
| 315 | 400 | -18 | 20 | 13 | 20 | | | 13 |
| 400 | 500 | -23 | 23 | 15 | 23 | | | 15 |

[1]Applies to single-row universally matched design.

# *BEARING LIFE*

The selection of the appropriate bearing for a given application is dependent on several performance criteria. These include bearing fatigue life, rotating precision, power loss requirement, temperature limits, speed capabilities and sound requirements. This section deals primarily with bearing life as related to material-associated fatigue.

Bearing life is defined as the length of time, or number of revolutions, until a fatigue spall of 6 $mm^2$ develops. Since 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 the accepted standard for predicting the life of a population of bearings 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 reaching criteria develops. The $L_{10}$ life also is associated with 90 percent reliability for a single bearing under a certain load.

## DYNAMIC LOAD RATING

Published dynamic load ratings for angular contact ball bearings are based on the industry standard procedure outlined in ISO 281:2007. This rating is designated as $C_r$ and is defined as the radial load under which a population of bearings will achieve a $L_{10}$ life of one million revolutions. Radial load is assumed to be constant in magnitude and direction for radial ball bearings.

## STATIC LOAD RATING

The standard static load rating for Timken bearings (designated as $C_{0r}$) as defined in ISO 76:2006 is based on a maximum contact stress within a non-rotating bearing of 4200 MPa at the center of the most heavily loaded rolling element and raceway contact.

Such stress levels may cause visible light Brinell marks on the bearing raceways. This degree of marking will not have a measurable effect on fatigue life when the bearing is subsequently rotated under a lower application load. If sound, vibration or torque are critical or if a pronounced shock load is present, a lower load limit should be applied. For more information on selecting a bearing for static load conditions, consult your Timken sales engineer.

## SPEED RATING

### THERMAL REFERENCE SPEED

The thermal reference speed is the bearing thermal equilibrium speed based on industry standard reference conditions outlined in ISO 15312: 2003. Thermal equilibrium balances the heat generated by the bearing, with heat conduction through the housing and shaft. This standard applies to both bath oil lubricated and 30 percent grease fill packed bearings. It excludes any heat removed by a circulating lubricant. This standard also excludes the outer ring rotating application and heat generated by contact seals.

The ISO 15312 thermal reference speed rating calculations are based on the following assumptions:

- The bearing ambient temperature is 20° C.
- The tolerable bearing/housing interface temperature is 70° C.
- Oil and grease lubricants are considered.
  - For radial bearings with oil lubrication: ISO VG 32 oil.
  - For radial bearings with grease lubrication: ISO VG 150 grease.
- The radial loads assume a normal clearance (C0 or CN).
- For radial bearings, the applied load is 5 percent of the static load rating ($C_{0r}$).

Thermal reference speed ratings assume the bearing has been sufficiently broken in. During the break-in process, temperatures may exceed the tolerable limit. Break-in commonly takes between 10 to 36 hours.

Standard bearing materials and lubricants can generally withstand temperatures up to and beyond 100° C. For this reason, a permissible temperature of 100° C was assumed for the thermal speed rating calculation. Contact your Timken sales engineer if your application requires speeds above the Timken published values.

### LIMITING SPEED

The limiting speeds for single- and double-row open bearings are listed in the product data section (pages 23 to 27). The values depend on grease or oil lubrication, and on the various designs of open, sealed, and shielded configurations. The values listed for single-row designs reflect the lubrication types and are valid only for open bearing design configuration. For the double-row sealed bearing configuration, the seals themselves become the limiting factor due to the additional heat generation at the contact points; therefore the grease speed values take into account the seals. The values listed for double-row bearings with oil lubrication are for the open bearing configuration.

# *MOUNTING AND FITTING*

## SINGLE-ROW BEARING DESIGN

Single-row angular contact ball bearings are designed to handle radial and axial loads simultaneously. However, they can only accommodate axial loads in one direction. As a result, most single-row angular contact ball bearings are mounted in pairs. Single-row angular contact ball bearings are available in either standard or universally matched designs.

In angular contact ball bearing design, the forces are transmitted from one raceway to the other along a given contact angle. This angle is defined as the angle between the line of action of forces and a radial plane (Fig. 3). The result is a larger contact angle increasing the bearing's axial load capability.

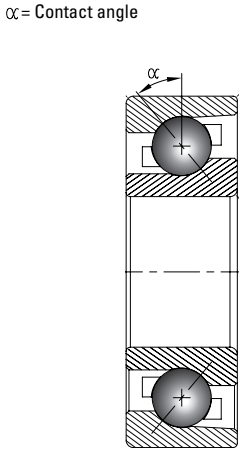



**Fig. 3. Single-row bearing design.**

## CONTACT ANGLE

The contact angle of an angular contact ball bearing is the angle between a line through the ball center perpendicular to the bearing axis and a line through the two points where the ball contacts the races when the bearing axial play is removed.

Timken single-row angular contact ball bearings of series 7200 and 7300 have a contact angle of 40 degrees and Timken double-row angular contact ball bearings of series 3200 and 3300 have a contact angle of 30 degrees which allow them to accommodate high axial loads.

## STANDARD DESIGN

Standard design angular contact ball bearings are in applications when one bearing is used for each bearing side. The mounting can be either back-to-back (DB, Fig. 4) or face-to-face (DF, Fig. 5). Because standard design bearings need to be adjusted for optimum performance, they are not suitable to mount immediately adjacent to each other.

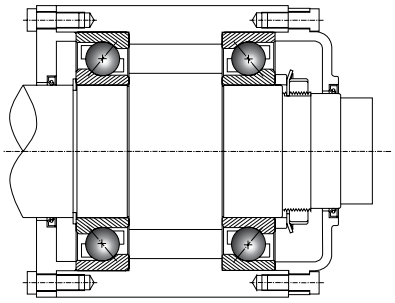


**Fig. 4. Two single angular contact ball bearings in standard DB arrangement.**

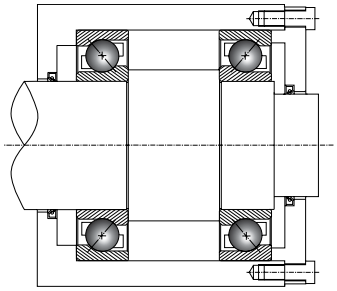


**Fig. 5. Two single angular contact ball bearings in standard DF arrangement.**

# UNIVERSALLY MATCHED DESIGN

Universally matched angular contact ball bearings, which are intended for fitting in pairs, have width and standout of the rings manufactured to closer tolerances. The bearings can be fitted in back-to-back (DB), face-to-face (DF), or tandem arrangement (DT).

The bearings are ground to achieve pre-defined clearances/ preloads, and adjustment is achieved directly by clamping the bearings. This results in uniform load distribution between the paired bearings and eliminates the need for spacers or shims.

The universally matched bearings have a suffix indicating the axial clearance and preload values:

- Axial clearance
  **CN** - Normal
  **CS** - Smaller than normal
  **CL** - Larger than normal
- Preload
  **UL** - Light
  **UM** - Medium
  **UH** - Heavy

The axial clearances and preload values corresponding to these suffixes are given in table 8 on page 12.

## BACK-TO-BACK (DB) ARRANGEMENT

Bearings in a back-to-back arrangement can accommodate axial loads in either direction and have the highest moment/ tilting load-handling capability owing to an increased bearing spread. With increasing operating temperatures, the radial shaft expansion tends to increase the bearing preload. However, the resulting axial growth allows the bearings to move apart to balance the expansion, thereby mitigating the increase in preload. Therefore this type of this type of arrangement is best-suited for and most commonly used for high-temperature and high-speed applications.

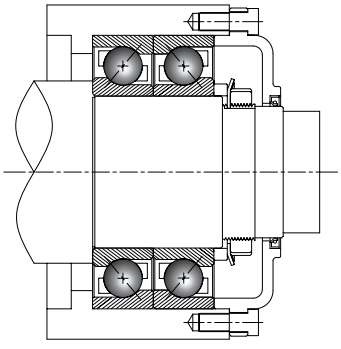


**Fig. 6. Back-to-back (DB) arrangement.**

## FACE-TO-FACE (DF) ARRANGEMENT

Bearings in face-to-face arrangement also accommodate axial loads in either direction, but with reduced stiffness as provided by the back-to-back arrangement. This type of arrangement is not suitable for high-temperature usage applications as the preload in the bearings tends to increase with radial and axial shaft growth.

Since the face-to-face mounting has inherent disadvantages it should only be considered with proper application analysis and if required due to assembly constraints.

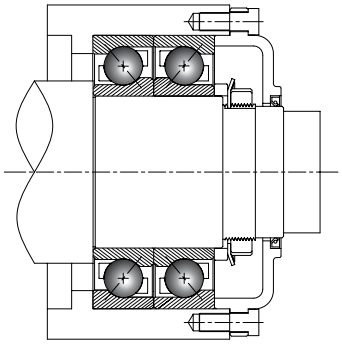


**Fig. 7. Face-to-face (DF) arrangement.**

## TANDEM (DT) ARRANGEMENT

Bearings in tandem arrangement can accommodate loads in only one direction and are used when the required load-carrying capacity exceeds that of a single bearing. Tandem sets must be adjusted against another bearing in order to completely constrain the system.

More than two bearings can be used in tandem if additional load-carrying capability is required.

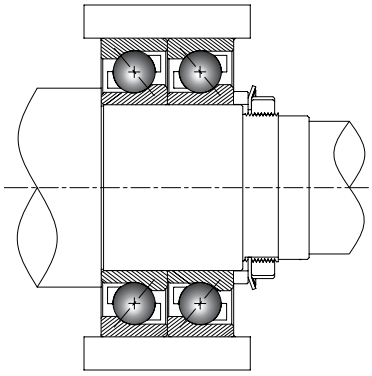


**Fig. 8 Tandem (DT) arrangement.**

## DOUBLE-ROW BEARING DESIGN AND CONFIGURATIONS

Double-row angular contact ball bearings consist of two single-row angular contact ball bearings in back-to-back (DB) arrangement with integral double inner and outer rings. Double-row bearings require less axial space than two single-row bearings and can take radial loads as well as axial loads in both directions. The back-to-back arrangement provides a high moment/tilting load-handling capability.

Double-row angular contact ball bearings can be open on both sides, or closed by seals (2RS suffix) or shields (ZZ suffix).

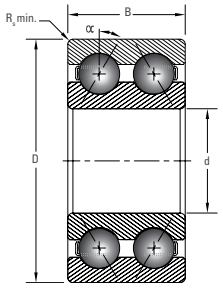



**Fig. 9. Double-row bearing design.**

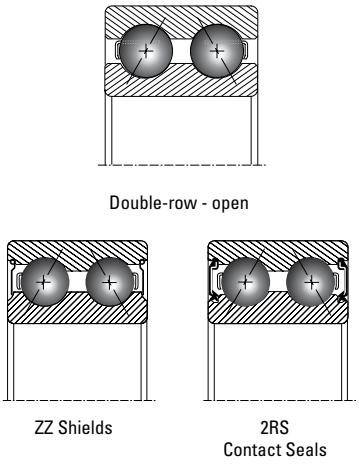
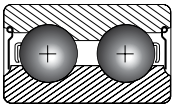
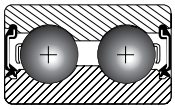



**Fig. 10. Double-row bearing configurations.**

**TABLE 7.**
**CHARACTERISTICS OF SHIELDS AND SEALS**

| Type | Shields ZZ | Contact Seals 2RS |
|---|---|---|
| Construction |  |  |
| Material | Low-carbon pressed steel | Nitrile (Buna-N) rubber with steel insert |
| Speed Capability | High speed | Less than shielded bearing |
| Operating Temperature | -50° C to +120° C | -40° C to +120° C |
| Grease Retention | Good | Excellent |
| Dust Resistance | Good | Excellent |
| Torque | Low | Greater than shielded bearing |

## AXIAL CLEARANCE

Axial clearance for universally matched bearings when arranged face-to-face (DF) or back-to-back (DB).

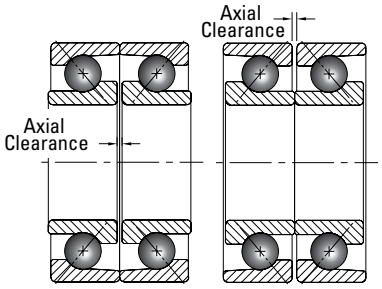



**Fig. 11. Axial clearance for universally matched bearings.**

## AXIAL PRELOAD

Light, medium and heavy preloads for universally matched bearings when arranged back-to-back (DB) or face-to-face (DF).

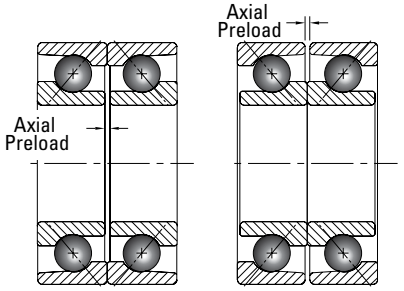



**Fig. 12. Axial preload for universally matched bearings.**

**TABLE 8.**
**AXIAL CLEARANCE AND PRELOAD OF SINGLE-ROW UNIVERSALLY MATCHED**

| Bore Diameter (d) | | Axial Clearance for Pairs | | | | | |
|---|---|---|---|---|---|---|---|
| | | CS | | CN | | CL | |
| Over | Incl. | Min. | Max. | Min. | Max. | Min. | Max. |
| mm | | µm | µm | µm | µm | µm | µm |
| 1 | 18 | 5 | 13 | 15 | 23 | 24 | 32 |
| 18 | 30 | 7 | 15 | 18 | 26 | 32 | 40 |
| 30 | 50 | 9 | 17 | 22 | 30 | 40 | 48 |
| 50 | 80 | 11 | 23 | 26 | 38 | 48 | 60 |
| 80 | 120 | 14 | 26 | 32 | 44 | 55 | 67 |
| 120 | 160 | 17 | 29 | 35 | 47 | 62 | 74 |

| Bore Diameter (d) | | Preload Values for Pairs | | | | | |
|---|---|---|---|---|---|---|---|
| | | UL | | UM | | UH | |
| Over | Incl. | Min. | Max. | Min. | Max. | Min. | Max. |
| mm | | µm | µm | µm | µm | µm | µm |
| 1 | 18 | 4 | –4 | –2 | –10 | –8 | –16 |
| 18 | 30 | 4 | –4 | –2 | –10 | –8 | –16 |
| 30 | 50 | 4 | –4 | –2 | –10 | –8 | –16 |
| 50 | 80 | 6 | –6 | –3 | –15 | –12 | –24 |
| 80 | 120 | 6 | –6 | –3 | –15 | –12 | –24 |
| 120 | 160 | 6 | –6 | –3 | –15 | –12 | –24 |

## DOUBLE-ROW AXIAL CLEARANCE

**TABLE 9.**
**AXIAL INTERNAL CLEARANCE OF DOUBLE-ROW ANGULAR CONTACT BALL BEARINGS**

| Bore Diameter | | Axial Internal Clearance | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | C2 | | C0 | | C3 | | C4 | |
| Over | Incl. | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. |
| mm | | µm | µm | µm | µm | µm | µm | µm | µm |
| 1 | 10 | 1 | 11 | 5 | 21 | 12 | 28 | 25 | 45 |
| 10 | 18 | 1 | 12 | 6 | 23 | 13 | 31 | 27 | 47 |
| 18 | 24 | 2 | 14 | 7 | 25 | 16 | 34 | 28 | 48 |
| 24 | 30 | 2 | 15 | 8 | 27 | 18 | 37 | 30 | 50 |
| 30 | 40 | 2 | 16 | 9 | 29 | 21 | 40 | 33 | 54 |
| 40 | 50 | 2 | 18 | 11 | 33 | 23 | 44 | 36 | 58 |
| 50 | 65 | 3 | 22 | 13 | 36 | 26 | 48 | 40 | 63 |
| 65 | 80 | 3 | 24 | 15 | 40 | 30 | 54 | 46 | 71 |

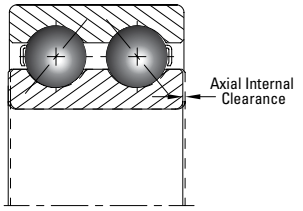



**Fig. 13. Double-row axial clearance.**

## FITTING PRACTICES

As a general guideline, bearing rings mounted on a rotating member should have an interference fit. Loose fits may permit the ring to creep or turn and wear the mating surface and backing shoulder. This wear can result in excessive bearing looseness and damage the bearing, shaft or housing.

The choice of fitting practices will mainly depend upon the following parameters:

- Precision class of the bearing.
- Rotating or stationary ring.
- Type of layout (single- or double-row bearings).
- Type and direction of load (continuous/alternate rotating).
- Particular running conditions like shocks, vibrations, over-loading or high speed.
- Capability for machining the bearing seats (grinding, turning or boring).
- Shaft and housing section and material.
- Mounting and setting conditions.

Fig. 14 is a graphical representation of bearing shaft and housing fit selection that conforms to accepted industry standards and practices. The bars designated g6, h6, etc., represent shaft/housing diameter and tolerance ranges to achieve various loose and interference fits required for various load and ring rotation conditions.

Tables 10 and 11, on the following pages, provide the resultant fits based on standard ISO tolerances for shaft and housing.

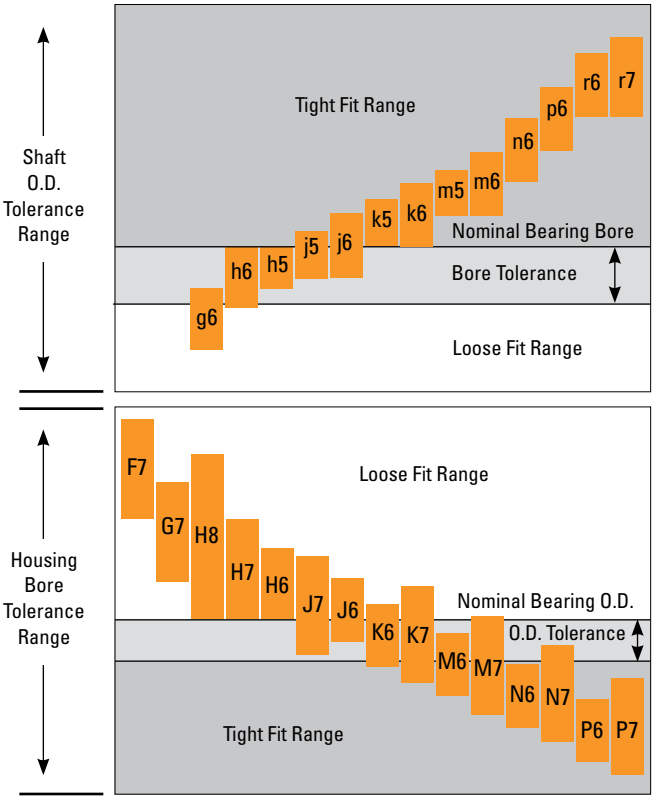



**Fig. 14. Bearing shaft and housing fit selections.**

# SHAFT AND HOUSING FITS

## SHAFT TOLERANCES: ANGULAR CONTACT BALL BEARINGS

**TABLE 10.**
**SHAFT TOLERANCES: ANGULAR CONTACT BALL BEARINGS**

| Bearing Bore | | | | g6 | | | h5 | | | h6 | | | j5 | | | js5 | | | js6 | | | j6 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nominal (Max.) | | Tolerance | | Shaft Diameter | | Fit | Shaft Diameter | | Fit | Shaft Diameter | | Fit | Shaft Diameter | | Fit | Shaft Diameter | | Fit | Shaft Diameter | | Fit | Shaft Diameter | | Fit |
| Over | Incl. | Max. | Min. | Max. | Min. | | Max. | Min. | | Max. | Min. | | Max. | Min. | | Max. | Min. | | Max. | Min. | | Max. | Min. | |
| mm | | µm | | µm | | | µm | | | µm | | | µm | | | µm | | | µm | | | µm | | |
| – | 3 | 0 | -5 | -2 | -8 | -8L 3T | 0 | -4 | -4L 5T | 0 | 6 | 6L 5T | 2 | -2 | 2L 7T | 2 | -2 | 2L 7T | 3 | -3 | 3L 8T | 4 | -2 | 2L 9T |
| 3 | 6 | 0 | -5 | -4 | -12 | 12L 1T | 0 | -5 | 5L 5T | 0 | -8 | 8L 5T | 3 | -2 | 2L 8T | 2.5 | -2.5 | 2.5L 7.5T | 4 | -4 | 4L 9T | 6 | -2 | 2L 11T |
| 6 | 10 | 0 | -5 | -5 | -14 | 14L 0L | 0 | -6 | 6L 5T | 0 | -9 | 9L 5T | 4 | -2 | 2L 9T | 3 | -3 | 3L 8T | 4.5 | -4.5 | 4.5L 9.5T | 7 | -2 | 2L 12T |
| 10 | 18 | 0 | -5 | -6 | -17 | 17L 1L | 0 | -8 | 8L 5T | 0 | -11 | 11L 5T | 5 | -3 | 3L 10T | 4 | -4 | 4L 9T | 5.5 | -5.5 | 5.5L 10.5T | 8 | -3 | 3L 13T |
| 18 | 30 | 0 | -6 | -7 | -20 | 20L 1L | 0 | -9 | 9L 6T | 0 | -13 | 13L 6T | 5 | -4 | 4L 11T | 4.5 | -4.5 | 4.5L 10.5T | 6.5 | -6.5 | 6.5L 12.5T | 9 | -4 | 4L 15T |
| 30 | 50 | 0 | -8 | -9 | -25 | 25L 1L | 0 | -11 | 11L 8T | 0 | -16 | 16L 8T | 6 | -5 | 5L 14T | 5.5 | -5.5 | 5.5L 13.5T | 8 | -8 | 8L 16T | 11 | -5 | 5L 19T |
| 50 | 80 | 0 | -9 | -10 | -29 | 29L 1L | 0 | -13 | 13L 9T | 0 | -19 | 19L 9T | 6 | -7 | 7L 15T | 6.5 | -6.5 | 6.5L 15.5T | 9.5 | -9.5 | 9.5L 18.5T | 12 | -7 | 7L 21T |
| 80 | 120 | 0 | -10 | -12 | -34 | 34L 2L | 0 | -15 | 15L 10T | 0 | -22 | 22L 10T | 6 | -9 | 9L 16T | 7.5 | -7.5 | 7.5L 17.5T | 11 | -11 | 11L 21T | 13 | -9 | 9L 23T |
| 120 | 180 | 0 | -13 | -14 | -39 | 39L 1L | 0 | -18 | 18L 13T | 0 | -25 | 25L 13T | 7 | -11 | 11L 20T | 9 | -9 | 9L 22T | 12.5 | -12.5 | 12.5L 25.5T | 14 | -11 | 11L 27T |
| 180 | 200 | 0 | -15 | -15 | -44 | 44L 0L | 0 | -20 | 20L 15T | 0 | -29 | 29L 15T | 7 | -13 | 13L 22T | 10 | -10 | 10L 25T | 14.5 | -14.5 | 14.5L 29.5T | 16 | -13 | 13L 31T |
| 200 | 225 | 0 | -15 | -15 | -44 | 44L 0L | 0 | -20 | 20L 15T | 0 | -29 | 29L 15T | 7 | -13 | 13L 22T | 10 | -10 | 10L 25T | 14.5 | -14.5 | 14.5L 29.5T | 16 | -13 | 13L 31T |
| 225 | 250 | 0 | -15 | -15 | -44 | 44L 0L | 0 | -20 | 20L 15T | 0 | -29 | 29L 15T | 7 | -13 | 13L 22T | 10 | -10 | 10L 25T | 14.5 | -14.5 | 14.5L 29.5T | 16 | -13 | 13L 31T |
| 250 | 280 | 0 | -18 | -17 | -49 | 49L 1T | 0 | -23 | 23L 18T | 0 | -32 | 32L 18T | 7 | -16 | 16L 25T | 11.5 | -12 | 11.5L 29.5T | 16 | -16 | 16L 34T | 16 | -16 | 16L 34T |
| 280 | 315 | 0 | -18 | -17 | -49 | 49L 1T | 0 | -23 | 23L 18T | 0 | -32 | 32L 18T | 7 | -16 | 16L 25T | 11.5 | -12 | 11.5L 29.5T | 16 | -16 | 16L 34T | 16 | -16 | 16L 34T |
| 315 | 355 | 0 | -23 | -18 | -54 | 54L 5T | 0 | -25 | 25L 23T | 0 | -36 | 36L 23T | 7 | -18 | 18L 30T | 12.5 | -13 | 12.5L 35.5T | 18 | -18 | 18L 41T | 18 | -18 | 18L 41T |
| 355 | 400 | 0 | -23 | -18 | -54 | 54L 5T | 0 | -25 | 25L 23T | 0 | -36 | 36L 23T | 7 | -18 | 18L 30T | 12.5 | -13 | 12.5L 35.5T | 18 | -18 | 18L 41T | 18 | -18 | 18L 41T |

NOTE: L = loose fit; T = tight (or interference) fit.

**TABLE 10.**
**SHAFT TOLERANCES: ANGULAR CONTACT BALL BEARINGS - CONTINUED**

| k5 | | | k6 | | | m5 | | | m6 | | | n6 | | | p6 | | | r6 | | | r7 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Shaft Diameter | | Fit | Shaft Diameter | | Fit | Shaft Diameter | | Fit | Shaft Diameter | | Fit | Shaft Diameter | | Fit | Shaft Diameter | | Fit | Shaft Diameter | | Fit | Shaft Diameter | | Fit |
| Max. | Min. | | Max. | Min. | | Max. | Min. | | Max. | Min. | | Max. | Min. | | Max. | Min. | | Max. | Min. | | Max. | Min. | |
| µm | | | µm | | | µm | | | µm | | | µm | | | µm | | | µm | | | µm | | |
| 4 | 0 | 0T 9T | 6 | 0 | 0T 11T | 6 | 2 | 2T 11T | 8 | 2 | 22T 13T | - | - | - | - | - | - | - | - | - | - | - | - |
| 6 | 1 | 1T 11T | 9 | 1 | 1T 14T | 9 | 4 | 4T 14T | 12 | 4 | 4T 17T | 16 | 8 | 8T 21T | 20 | 12 | 12T 25T | 23 | 15 | 15T 28T | 27 | 15 | 15T 32T |
| 7 | 1 | 1T 12T | 10 | 1 | 1T 15T | 12 | 6 | 6T 17T | 15 | 6 | 6T 20T | 19 | 10 | 10T 24T | 24 | 15 | 15T 29T | 28 | 19 | 19T 33T | 34 | 19 | 19T 39T |
| 9 | 1 | 1T 14T | 12 | 1 | 1T 17T | 15 | 7 | 7T 20T | 18 | 7 | 7T 23T | 23 | 12 | 12T 28T | 29 | 18 | 18T 34T | 34 | 23 | 23T 39T | 41 | 23 | 23T 46T |
| 11 | 2 | 2T 17T | 15 | 2 | 2T 21T | 17 | 8 | 8T 23T | 21 | 8 | 8T 27T | 28 | 15 | 15T 34T | 35 | 22 | 22T 41T | 41 | 28 | 28T 47T | 49 | 28 | 28T 55T |
| 13 | 2 | 2T 21T | 18 | 2 | 2T 26T | 20 | 9 | 9T 28T | 25 | 9 | 9T 33T | 33 | 17 | 17T 41T | 42 | 26 | 26T 50T | 50 | 34 | 34T 58T | 59 | 34 | 34T 67T |
| 15 | 2 | 2T 24T | 21 | 2 | 2T 30T | 24 | 11 | 11T 33T | 30 | 11 | 11T 39T | 39 | 20 | 20T 48T | 51 | 32 | 32T 60T | 62 | 41 | 41T 71T | 73 | 41 | 41T 82T |
| 18 | 3 | 3T 28T | 25 | 3 | 3T 35T | 28 | 13 | 13T 38T | 35 | 13 | 13T 45T | 45 | 23 | 23T 55T | 59 | 37 | 37T 69T | 76 | 51 | 51T 86T | 89 | 51 | 51T 99T |
| 21 | 3 | 3T 34T | 28 | 3 | 3T 41T | 33 | 15 | 15T 46T | 40 | 15 | 15T 53T | 52 | 27 | 27T 65T | 68 | 43 | 43T 81T | 90 | 65 | 65T 103T | 105 | 65 | 65T 118T |
| 24 | 4 | 4T 39T | 33 | 4 | 4T 48T | 37 | 17 | 17T 52T | 46 | 17 | 17T 61T | 60 | 31 | 31T 75T | 79 | 50 | 50T 94T | 106 | 77 | 77T 121T | 123 | 77 | 77T 138T |
| 24 | 4 | 4T 39T | 33 | 4 | 4T 48T | 37 | 17 | 17T 52T | 46 | 17 | 17T 61T | 60 | 31 | 31T 75T | 79 | 50 | 50T 94T | 109 | 80 | 80T 124T | 126 | 80 | 80T 141T |
| 24 | 4 | 4T 39T | 33 | 4 | 4T 48T | 37 | 17 | 17T 52T | 46 | 17 | 17T 61T | 60 | 31 | 31T 75T | 79 | 50 | 50T 94T | 113 | 84 | 84T 128T | 130 | 84 | 84T 145T |
| 27 | 4 | 4T 45T | 36 | 4 | 4T 54T | 43 | 20 | 20T 61T | 52 | 20 | 20T 70T | 66 | 34 | 34T 84T | 88 | 56 | 56T 106T | 126 | 94 | 94T 144T | 146 | 94 | 94T 164T |
| 27 | 4 | 4T 45T | 36 | 4 | 4T 54T | 43 | 20 | 20T 61T | 52 | 20 | 20T 70T | 66 | 34 | 34T 84T | 88 | 56 | 56T 106T | 130 | 98 | 98T 148T | 150 | 98 | 98T 168T |
| 29 | 4 | 4T 52T | 40 | 4 | 4T 63T | 46 | 21 | 21T 69T | 57 | 21 | 21T 80T | 73 | 37 | 37T 96T | 98 | 62 | 62T 121T | 144 | 108 | 108T 167T | 165 | 108 | 108T 188T |
| 29 | 4 | 4T 52T | 40 | 4 | 4T 6 3T | 46 | 21 | 21T 69T | 57 | 21 | 21T 80T | 73 | 37 | 37T 96T | 98 | 62 | 62T 121T | 150 | 114 | 114T 173T | 171 | 114 | 114T 194T |

NOTE: L = loose fit; T = tight (or interference) fit.

## HOUSING TOLERANCES: ANGULAR CONTACT BALL BEARINGS

**TABLE 11.**
**HOUSING TOLERANCES: ANGULAR CONTACT BALL BEARINGS**

| Bearing O.D. | | | | F7 | | | G7 | | | H6 | | | H7 | | | H8 | | | J6 | | | J7 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nominal (Max.) | | Tolerance | | Housing Bore | | Fit | Housing Bore | | Fit | Housing Bore | | Fit | Housing Bore | | Fit | Housing Bore | | Fit | Housing Bore | | Fit | Housing Bore | | Fit |
| Over | Incl. | Max. | Min. | Max. | Min. | | Max. | Min. | | Max. | Min. | | Max. | Min. | | Max. | Min. | | Max. | Min. | | Max. | Min. | |
| mm | | µm | | µm | | | µm | | | µm | | | µm | | | µm | | | µm | | | µm | | |
| 6 | 10 | 0 | -5 | 28 | 13 | 13L 33L | 20 | 5 | 5L 25L | 9 | 0 | 0L 14L | 15 | 0 | 0L 20L | 22 | 0 | 0L 27L | 5 | -4 | 4T 10L | 8 | -7 | 7T 13L |
| 10 | 18 | 0 | -5 | 34 | 16 | 16L 39L | 24 | 6 | 6L 29L | 11 | 0 | 0L 16L | 18 | 0 | 0L 23L | 27 | 0 | 0L 32L | 6 | -5 | 5T 11L | 10 | -8 | 8T 15L |
| 18 | 30 | 0 | -6 | 41 | 20 | 20L 47L | 28 | 7 | 7L 34L | 13 | 0 | 0L 19L | 21 | 0 | 0L 27L | 33 | 0 | 0L 39L | 8 | -5 | 5T14L | 12 | -9 | 9T 18L |
| 30 | 50 | 0 | -7 | 50 | 25 | 25L 57L | 34 | 9 | 9L 41L | 16 | 0 | 0L 23L | 25 | 0 | 0L 32L | 39 | 0 | 0L 46L | 10 | -6 | 6T 17L | 14 | -11 | 11T 21L |
| 50 | 80 | 0 | -9 | 60 | 30 | 30L 69L | 40 | 10 | 10L 49L | 19 | 0 | 0L 28L | 30 | 0 | 0L 39L | 46 | 0 | 0L 55L | 13 | -6 | 6T 22L | 18 | -12 | 12T 27L |
| 80 | 120 | 0 | -10 | 71 | 36 | 36L 81L | 47 | 12 | 12L 57L | 22 | 0 | 0L 32L | 35 | 0 | 0L 45L | 54 | 0 | 0L 64L | 16 | -6 | 6T 26L | 22 | -13 | 13T 32L |
| 120 | 150 | 0 | -11 | 83 | 43 | 43L 94L | 54 | 14 | 14L 65L | 25 | 0 | 0L 36L | 40 | 0 | 0L 51L | 63 | 0 | 0L 74L | 18 | -7 | 7T 29L | 26 | -14 | 14T 37L |
| 150 | 180 | 0 | -13 | 83 | 43 | 43L 96L | 54 | 14 | 14L 67L | 25 | 0 | 0L 38L | 40 | 0 | 0L 53L | 63 | 0 | 0L 76L | 18 | -7 | 7T 31L | 26 | -14 | 14T 39L |
| 180 | 250 | 0 | -15 | 96 | 50 | 50L 111L | 61 | 15 | 15L 76L | 29 | 0 | 0L 44L | 46 | 0 | 0L 61L | 72 | 0 | 0L 87L | 22 | -7 | 7T 37L | 30 | -16 | 16T 45L |
| 250 | 315 | 0 | -18 | 108 | 56 | 56L 126L | 69 | 17 | 17L 87L | 32 | 0 | 0L 50L | 52 | 0 | 0L 70L | 81 | 0 | 0L 99L | 25 | -7 | 7T 43L | 36 | -16 | 16T 54L |
| 315 | 400 | 0 | -20 | 119 | 62 | 62L 139L | 75 | 18 | 18L 95L | 36 | 0 | 0L 56L | 57 | 0 | 0L 77L | 89 | 0 | 0L 109L | 29 | -7 | 7T 49L | 39 | -18 | 18T 59L |
| 400 | 500 | 0 | -23 | 131 | 68 | 68L 154L | 83 | 20 | 20L 106L | 40 | 0 | 0L 63L | 63 | 0 | 0L 86L | 97 | 0 | 0L 120L | 33 | -7 | 7T 56L | 43 | -20 | 20T 66L |
| 500 | 630 | 0 | -28 | 146 | 76 | 76L 174L | 92 | 22 | 22L 120L | 44 | 0 | 0L 72L | 70 | 0 | 0L 98L | 110 | 0 | 0L 138L | 37 | -7 | 7T 65L | 48 | -22 | 22T 76L |
| 630 | 800 | 0 | -35 | 160 | 80 | 80L 195L | 104 | 24 | 24L 139L | 50 | 0 | 0L 85L | 80 | 0 | 0L 115L | 125 | 0 | 0L 160L | 40 | -10 | 10T 75L | 56 | -24 | 24T 91L |

NOTE: L = loose fit; T = tight (or interference) fit.

**TABLE 11.**
**HOUSING TOLERANCES: ANGULAR CONTACT BALL BEARINGS - CONTINUED**

| JS6 | | | K6 | | | K7 | | | M6 | | | M7 | | | N6 | | | N7 | | | P6 | | | P7 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Shaft Diameter | | Fit | Shaft Diameter | | Fit | Shaft Diameter | | Fit | Shaft Diameter | | Fit | Shaft Diameter | | Fit | Shaft Diameter | | Fit | Shaft Diameter | | Fit | Shaft Diameter | | Fit | Shaft Diameter | | Fit |
| Max. | Min. | | Max. | Min. | | Max. | Min. | | Max. | Min. | | Max. | Min. | | Max. | Min. | | Max. | Min. | | Max. | Min. | | Max. | Min. | |
| µm | | | µm | | | µm | | | µm | | | µm | | | µm | | | µm | | | µm | | | µm | | |
| 4.5 | -4.5 | 4.5T 9.5L | 2 | -7 | 7T 7L | 5 | -10 | 10T 10L | -3 | -12 | 12T 2L | 0 | -15 | 15T 5L | -7 | -16 | 16T 2T | -4 | -19 | 19T 1L | -12 | -21 | 21T 7T | -9 | -24 | 24T 4T |
| 5.5 | -5.5 | 5.5T 10.5L | 2 | -9 | 9T 7L | 6 | -12 | 12T 11L | -4 | -15 | 15T 1L | 0 | -18 | 18T 5L | -9 | -20 | 20T 4T | -5 | -23 | 23T 0L | -15 | -26 | 26T 10T | -11 | -29 | 29T 6T |
| 6.5 | -6.5 | 6.5T 12.5L | 2 | -11 | 11T 8L | 6 | -15 | 15T 12L | -4 | -17 | 17T 2L | 0 | -21 | 21T 6L | -11 | -24 | 24T 5T | -7 | -28 | 28T 1T | -18 | -31 | 31T 12T | -14 | -35 | 35T 8T |
| 8 | -8 | 8T 15L | 3 | -13 | 13T 10L | 7 | -18 | 18T 14L | -4 | -20 | 20T 3L | 0 | -25 | 25T 7L | -12 | -28 | 28T 5T | -8 | -33 | 33T 1T | -21 | -37 | 37T 14T | -17 | -42 | 42T 10T |
| 9.5 | -9.5 | 9.5T 18.5L | 4 | -15 | 15T 13L | 9 | -21 | 21T 18L | -5 | -24 | 24T 4L | 0 | -30 | 30T 9L | -14 | -33 | 33T 5T | -9 | -39 | 39T 0L | -26 | -45 | 45T 17T | -21 | -51 | 51T 12T |
| 11 | -11 | 11T 21L | 4 | -18 | 18T 14L | 10 | -25 | 25T 20L | -6 | -28 | 28T 4L | 0 | -35 | 35T 10L | -16 | -38 | 38T 6T | -10 | -45 | 45T 0L | -30 | -52 | 52T 20T | -24 | -59 | 59T 14T |
| 12.5 | -12.5 | 12.5T 23.5L | 4 | -21 | 21T 15L | 12 | -28 | 28T 23L | -8 | -33 | 33T 3L | 0 | -40 | 40T 11L | -20 | -45 | 45T 9T | -12 | -52 | 52T 1T | -36 | -61 | 61T 25T | -28 | -68 | 68T 17T |
| 12.5 | -12.5 | 12.5T 25.5L | 4 | -21 | 21T 17L | 12 | -28 | 28T 25L | -8 | -33 | 33T 5L | 0 | -40 | 40T 13L | -20 | -45 | 45T 7T | -12 | -52 | 52T 1L | -36 | -61 | 61T 23T | -28 | -68 | 68T 15T |
| 14.5 | -14.5 | 14.5T 29.5L | 5 | -24 | 24T 20L | 13 | -33 | 33T 28L | -8 | -37 | 37T 7L | 0 | -46 | 46T 15L | -22 | -51 | 51T 7T | -14 | -60 | 60T 1L | -41 | -70 | 70T 26T | -33 | -79 | 79T 18T |
| 16 | -16 | 16T 34L | 5 | -27 | 27T 23L | 16 | -36 | 36T 34L | -9 | -41 | 41T 9L | 0 | -52 | 52T 18L | -25 | -57 | 57T 7T | -14 | -66 | 66T 4L | -47 | -79 | 79T 29T | -36 | -88 | 88T 18T |
| 18 | -18 | 18T 38L | 7 | -29 | 29T 27L | 17 | -40 | 40T 37L | -10 | -46 | 46T 10L | 0 | -57 | 57T 20L | -26 | -62 | 62T 6T | -16 | -73 | 73T 4L | -51 | -87 | 87T 31T | -41 | -98 | 98T 21T |
| 20 | -20 | 20T 43L | 8 | -32 | 32T 31L | 18 | -45 | 45T 41L | -10 | -50 | 50T 13L | 0 | -63 | 63T 23L | -27 | -67 | 67T 4T | -17 | -80 | 80T 6L | -55 | -95 | 95T 32T | -45 | -108 | 108T 22T |
| 22 | -22 | 22T 50L | 0 | -44 | 44T 28L | 0 | -70 | 70T 28L | -26 | -70 | 70T 2L | -26 | -96 | 96T 2L | -44 | -88 | 88T 16T | -44 | -114 | 114T 16T | -78 | -122 | 122T 50T | -78 | -148 | 148T 50T |
| 25 | -25 | 25T 60L | 0 | -50 | 50T 35L | 0 | -80 | 80T 35L | -30 | -80 | 80T 5L | -30 | -110 | 110T 5L | -50 | -100 | 100T 15T | -50 | -130 | 130T 15T | -88 | -138 | 138T 53T | -88 | -168 | 168T 53T |

NOTE: L = loose fit; T = tight (or interference) fit.

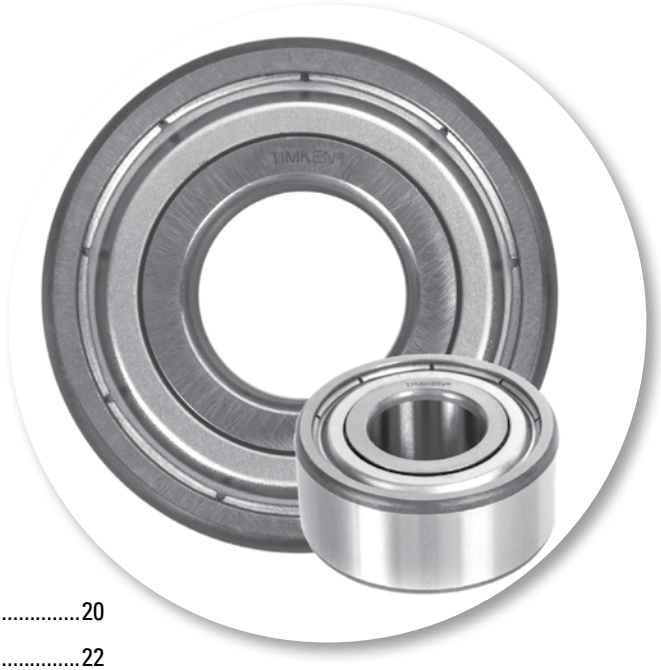
# *LUBRICATION*

Bearings must be lubricated to minimize friction between balls and raceways, as well as between balls and cages. Lubricants also help protect the bearings from corrosion and, in some cases, to dissipate heat.

Timken single-row open and double-row open angular contact ball bearings are covered with rust preventive (RP) covering all bearing surfaces. For such bearings, the end user selects and applies the desired lubrication type and quantity as required by the application.

Timken double-sealed and shielded angular contact ball bearings are covered with RP and factory pre-lubricated with water-resistant grease chosen for chemical and mechanical stability.

The standard factory grease fill is 30 to 50 percent of bearing free volume for Timken double-sealed/shielded ball bearings. The type and amount of grease needed varies depending on operating conditions and bearing series. Most bearings can be filled with customer-specified greases upon request to meet specific application needs.



# *ANGULAR CONTACT BALL BEARINGS*

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# *NOMENCLATURES*

## SINGLE ROW

### ISO 7000 SERIES

**Contact Angle = 40°**

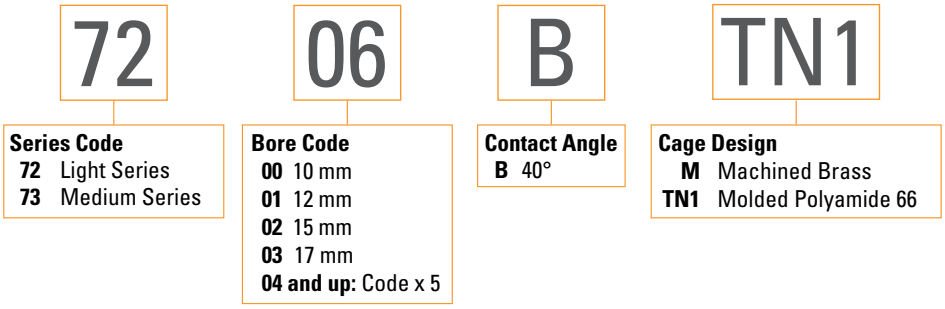



**Fig. 15. Single-row standard design angular contact ball bearing nomenclature.**

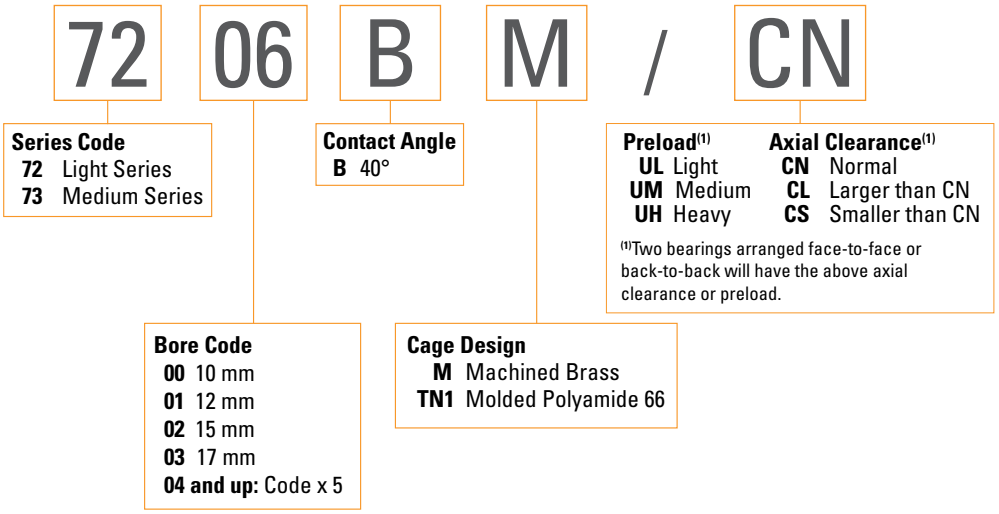



**Fig. 16. Single-row universally matched design angular contact ball bearing nomenclature.**

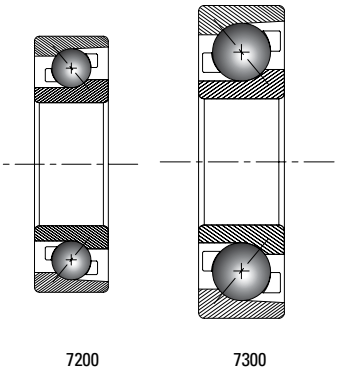



**Fig. 17. Single-row angular contact ball bearing series.**

# *NOMENCLATURES*

## DOUBLE ROW

### ISO 3000 SERIES

**Contact Angle = 30˚**

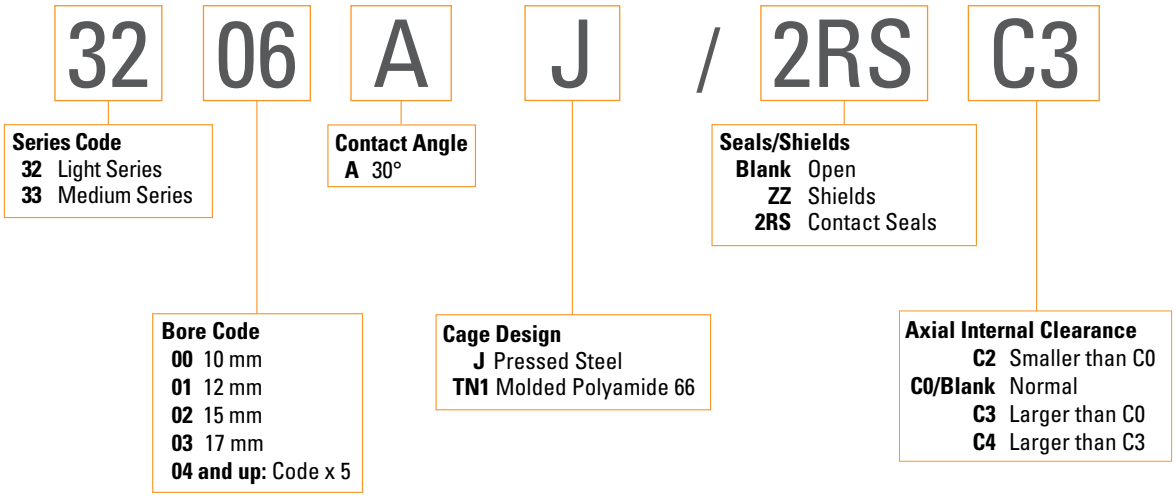



**Fig. 18. Double-row design angular contact ball bearing nomenclature.**

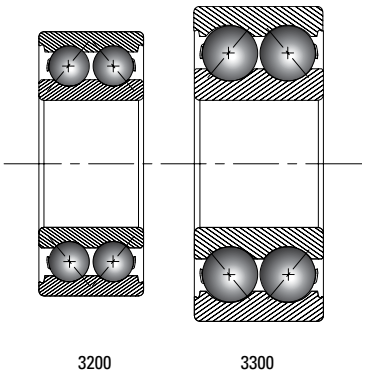
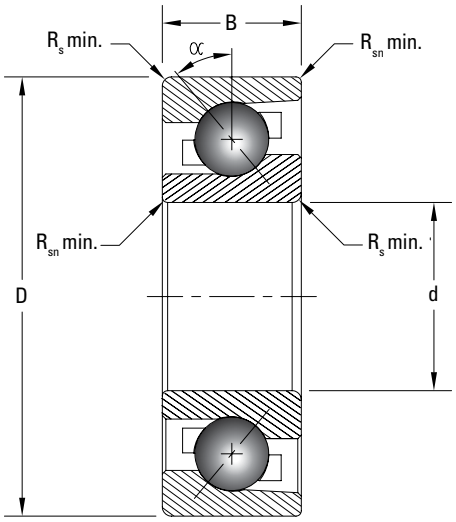


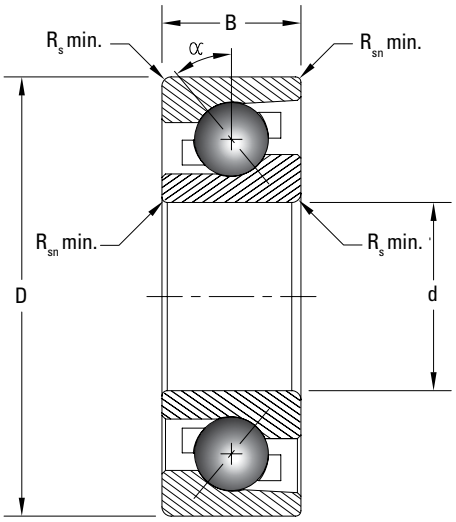

**Fig. 19. Double-row angular contact ball bearing series.**

# *SINGLE-ROW ANGULAR CONTACT BALL BEARINGS*

## 7200 - 7300 SERIES




| Bearing No. | Boundary Dimensions | | | | | Load Ratings | |
|---|---|---|---|---|---|---|---|
| Description | Bore d | O.D. D | Width B | Radius $R_s$ min | Radius $R_{sn}$ min | Dynamic $C_r$ | Static $C_{0r}$ |
| | mm | mm | mm | mm | mm | kN | kN |
| 7200 B | 10 | 30 | 9 | 0.6 | 0.3 | 5.65 | 2.58 |
| 7201 B | 12 | 32 | 10 | 0.6 | 0.3 | 7.40 | 3.70 |
| 7301 B | 12 | 37 | 12 | 1.0 | 0.6 | 10.50 | 5.00 |
| 7202 B | 15 | 35 | 11 | 0.6 | 0.3 | 7.90 | 4.30 |
| 7302 B | 15 | 42 | 13 | 1.0 | 0.6 | 13.00 | 6.60 |
| 7203 B | 17 | 40 | 12 | 0.6 | 0.3 | 9.93 | 5.54 |
| 7303 B | 17 | 47 | 14 | 1.0 | 0.6 | 16.00 | 8.30 |
| 7204 B | 20 | 47 | 14 | 1.0 | 0.6 | 13.30 | 7.63 |
| 7304 B | 20 | 52 | 15 | 1.1 | 0.6 | 17.30 | 9.70 |
| 7205 B | 25 | 52 | 15 | 1.0 | 0.6 | 14.00 | 8.67 |
| 7305 B | 25 | 62 | 17 | 1.1 | 0.6 | 24.40 | 14.10 |
| 7206 B | 30 | 62 | 16 | 1.0 | 0.6 | 20.50 | 13.50 |
| 7306 B | 30 | 72 | 19 | 1.1 | 0.6 | 31.00 | 19.30 |
| 7207 B | 35 | 72 | 17 | 1.1 | 0.6 | 27.10 | 18.40 |
| 7307 B | 35 | 80 | 21 | 1.5 | 1.0 | 38.40 | 24.40 |
| 7208 B | 40 | 80 | 18 | 1.1 | 0.6 | 34.50 | 23.90 |
| 7308 B | 40 | 90 | 23 | 1.5 | 1.0 | 42.20 | 27.70 |
| 7209 B | 45 | 85 | 19 | 1.1 | 0.6 | 34.30 | 24.40 |
| 7309 B | 45 | 100 | 25 | 1.5 | 1.0 | 55.00 | 36.80 |
| 7210 B | 50 | 90 | 20 | 1.1 | 0.6 | 37.40 | 28.60 |
| 7310 B | 50 | 110 | 27 | 2.0 | 1.0 | 68.20 | 47.90 |
| 7211 B | 55 | 100 | 21 | 1.5 | 1.0 | 46.30 | 36.00 |
| 7311 B | 55 | 120 | 29 | 2.0 | 1.0 | 78.80 | 56.30 |
| 7212 B | 60 | 110 | 22 | 1.5 | 1.0 | 56.10 | 44.40 |
| 7312 B | 60 | 130 | 31 | 2.1 | 1.1 | 84.90 | 60.00 |

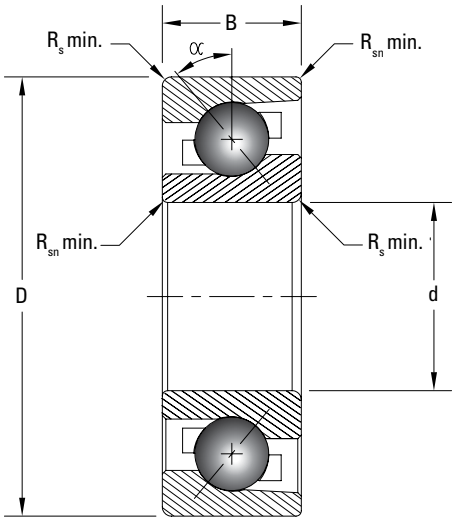



| Limiting Speed | | Design | | Cage | | Weight | Recommended Shaft Shoulder Diameter Min. | Recommended Housing Shoulder Diameter Max. |
|---|---|---|---|---|---|---|---|---|
| Grease[1][2] | Oil[1][2] | | | | | | | |
| RPM | RPM | Standard | Universally Matched | Brass | Polyamide | kg | mm | mm |
| 24000 | 32000 | • | • | | • | 0.03 | 15.0 | 25.0 |
| 21000 | 28000 | • | • | | • | 0.04 | 17.0 | 27.0 |
| 19000 | 26000 | • | • | | • | 0.05 | 18.0 | 31.0 |
| 18000 | 25000 | • | • | | • | 0.05 | 20.0 | 30.0 |
| 17000 | 22000 | • | • | | • | 0.06 | 21.0 | 36.0 |
| 17000 | 22000 | • | • | • | • | 0.07 | 22.0 | 35.0 |
| 15000 | 20000 | • | • | | • | 0.11 | 23.0 | 41.0 |
| 15000 | 20000 | • | • | • | • | 0.10 | 26.0 | 41.0 |
| 13000 | 18000 | • | • | • | • | 0.14 | 27.0 | 45.0 |
| 12000 | 16000 | • | • | • | • | 0.13 | 31.0 | 46.0 |
| 11000 | 15000 | • | • | • | • | 0.23 | 32.0 | 55.0 |
| 11000 | 14000 | • | • | • | • | 0.20 | 36.0 | 56.0 |
| 9600 | 13000 | • | • | • | • | 0.35 | 37.0 | 65.0 |
| 9300 | 12000 | • | • | • | • | 0.29 | 42.0 | 65.0 |
| 8400 | 11000 | • | • | • | • | 0.47 | 43.5 | 71.5 |
| 8300 | 11000 | • | • | • | • | 0.36 | 47.0 | 73.0 |
| 7400 | 9900 | • | • | • | • | 0.64 | 48.5 | 81.5 |
| 7400 | 9900 | • | • | • | • | 0.41 | 52.0 | 78.0 |
| 6600 | 8900 | • | • | • | • | 0.85 | 53.5 | 91.5 |
| 6700 | 9000 | • | • | • | • | 0.47 | 57.0 | 83.0 |
| 6000 | 8100 | • | • | • | • | 1.11 | 60.0 | 100.0 |
| 6100 | 8200 | • | • | • | • | 0.61 | 63.5 | 91.5 |
| 5500 | 7300 | • | • | • | • | 1.42 | 65.0 | 110.0 |
| 5700 | 7600 | • | • | • | • | 0.78 | 68.5 | 101.5 |
| 5100 | 6800 | • | • | • | • | 1.77 | 72.0 | 118.0 |

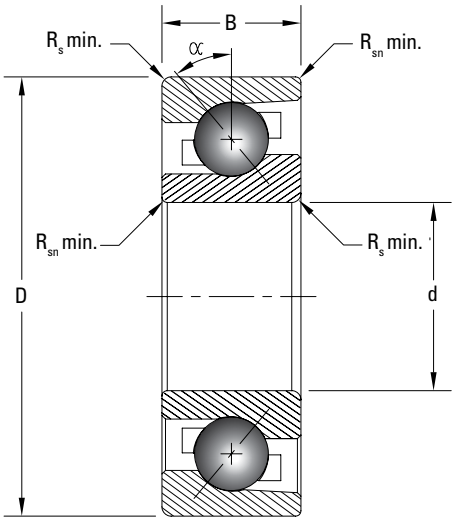
[1]Single-row values for both oil and grease lubrication are for an open bearing configuration.
[2]Single-row values when mounted in a duplex pair will have a lower limiting speed.

# *SINGLE-ROW ANGULAR CONTACT BALL BEARINGS*

## 7200 - 7300 SERIES




| Bearing No. | Boundary Dimensions | | | | | Load Ratings | |
|---|---|---|---|---|---|---|---|
| Description | Bore d | O.D. D | Width B | Radius $R_s$ min | Radius $R_{sn}$ min | Dynamic $C_r$ | Static $C_{0r}$ |
| | mm | mm | mm | mm | mm | kN | kN |
| 7213 B | 65 | 120 | 23 | 1.5 | 1.0 | 63.60 | 52.60 |
| 7313 B | 65 | 140 | 33 | 2.1 | 1.1 | 101.80 | 75.40 |
| 7214 B | 70 | 125 | 24 | 1.5 | 1.0 | 69.10 | 57.80 |
| 7314 B | 70 | 150 | 35 | 2.1 | 1.1 | 114.40 | 86.00 |
| 7215 B | 75 | 130 | 25 | 1.5 | 1.0 | 69.00 | 58.30 |
| 7315 B | 75 | 160 | 37 | 2.1 | 1.1 | 124.50 | 97.30 |
| 7216 B | 80 | 140 | 26 | 2.0 | 1.0 | 80.50 | 69.20 |
| 7316 B | 80 | 170 | 39 | 2.1 | 1.1 | 134.80 | 109.20 |
| 7217 B | 85 | 150 | 28 | 2.0 | 1.0 | 79.70 | 70.20 |
| 7317 B | 85 | 180 | 41 | 3.0 | 1.1 | 145.40 | 122.00 |
| 7218 B | 90 | 160 | 30 | 2.0 | 1.0 | 106.60 | 93.70 |
| 7318 B | 90 | 190 | 43 | 3.0 | 1.1 | 147.40 | 124.00 |
| 7219 B | 95 | 170 | 32 | 2.0 | 1.1 | 115.80 | 100.70 |
| 7319 B | 95 | 200 | 45 | 3.0 | 1.1 | 162.30 | 141.30 |
| 7220 B | 100 | 180 | 34 | 2.1 | 1.1 | 130.00 | 114.00 |
| 7320 B | 100 | 215 | 47 | 3.0 | 1.1 | 190.00 | 178.00 |
| 7221 B | 105 | 190 | 36 | 2.1 | 1.1 | 142.00 | 129.00 |
| 7321 B | 105 | 225 | 49 | 3.0 | 1.1 | 189.80 | 180.30 |
| 7222 B | 110 | 200 | 38 | 2.1 | 1.1 | 153.90 | 144.30 |
| 7322 B | 110 | 240 | 50 | 3.0 | 1.1 | 213.00 | 206.50 |
| 7224 B | 120 | 215 | 40 | 2.1 | 1.1 | 165.40 | 161.40 |
| 7226 B | 130 | 230 | 40 | 3.0 | 1.1 | 171.00 | 174.00 |

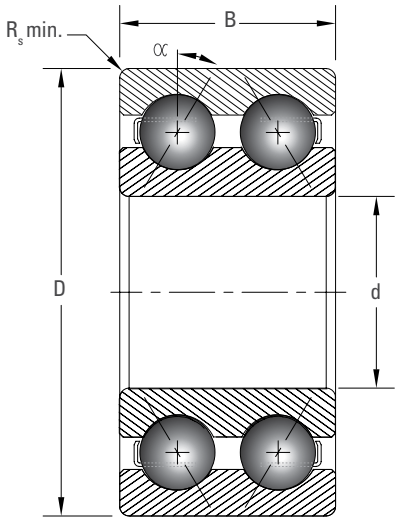



| Limiting Speed | | Design | | Cage | | Weight | Recommended Shaft Shoulder Diameter Min. | Recommended Housing Shoulder Diameter Max. |
|---|---|---|---|---|---|---|---|---|
| Grease[1][2] | Oil[1][2] | | | | | | | |
| RPM | RPM | Standard | Universally Matched | Brass | Polyamide | kg | mm | mm |
| 5200 | 7000 | • | • | • | • | 0.98 | 73.5 | 111.5 |
| 4700 | 6300 | • | • | • | • | 2.15 | 77.0 | 128.0 |
| 4900 | 6500 | • | • | • | • | 1.11 | 78.5 | 116.5 |
| 4400 | 5800 | • | • | • | • | 2.61 | 82.0 | 138.0 |
| 4500 | 6000 | • | • | • | • | 1.19 | 83.5 | 121.5 |
| 4100 | 5400 | • | • | • | • | 3.13 | 87.0 | 148.0 |
| 4300 | 5700 | • | • | • | • | 1.42 | 90.0 | 130.0 |
| 3800 | 5100 | | • | • | | 3.72 | 92.0 | 158.0 |
| 4000 | 5300 | | • | • | | 2.11 | 95.0 | 140.0 |
| 3600 | 4800 | | • | • | | 4.95 | 99.0 | 166.0 |
| 3800 | 5000 | | • | • | | 2.50 | 100.0 | 150.0 |
| 3400 | 4500 | | • | • | | 5.76 | 104.0 | 176.0 |
| 3500 | 4700 | | • | • | | 3.03 | 107.0 | 159.0 |
| 3200 | 4200 | | • | • | | 6.57 | 109.0 | 186.0 |
| 3400 | 4500 | | • | • | | 3.60 | 112.0 | 168.0 |
| 3000 | 4000 | | • | • | | 7.32 | 114.0 | 201.0 |
| 3200 | 4300 | | • | • | | 3.70 | 117.0 | 178.0 |
| 2900 | 3800 | | • | • | | 8.36 | 119.0 | 211.0 |
| 3000 | 4000 | | • | • | | 5.12 | 122.0 | 188.0 |
| 2700 | 3700 | | • | • | | 11.2 | 124.0 | 226.0 |
| 2800 | 3700 | | • | • | | 6.18 | 132.0 | 203.0 |
| 2500 | 3400 | | • | • | | 7.15 | 144.0 | 216.0 |

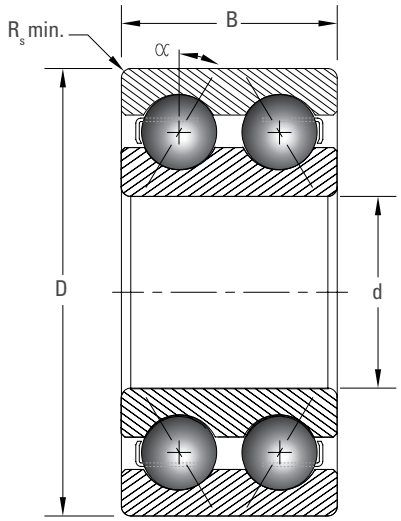
[1]Single-row values for both oil and grease lubrication are for an open bearing configuration.
[2]Single-row values when mounted in a duplex pair will have a lower limiting speed.

# *DOUBLE-ROW ANGULAR CONTACT BALL BEARINGS*

## 3200 - 3300 SERIES




| Bearing No. | Boundary Dimensions | | | | Load Ratings | |
|---|---|---|---|---|---|---|
| Description | Bore d | O.D. D | Width B | Radius $R_s$ min | Dynamic $C_r$ | Static $C_{0r}$ |
| | mm | mm | mm | mm | kN | kN |
| 3201 A | 12 | 32 | 15.9 | 0.6 | 9.40 | 5.20 |
| 3202 A | 15 | 35 | 15.9 | 0.6 | 11.35 | 6.87 |
| 3302 A | 15 | 42 | 19.0 | 1.0 | 14.20 | 8.70 |
| 3203 A | 17 | 40 | 17.5 | 0.6 | 12.75 | 8.41 |
| 3303 A | 17 | 47 | 22.2 | 1.0 | 15.80 | 10.00 |
| 3204 A | 20 | 47 | 20.6 | 1.0 | 15.30 | 10.40 |
| 3304 A | 20 | 52 | 22.2 | 1.1 | 22.60 | 14.70 |
| 3205 A | 25 | 52 | 20.6 | 1.0 | 16.30 | 12.00 |
| 3305 A | 25 | 62 | 25.4 | 1.1 | 28.90 | 19.40 |
| 3206 A | 30 | 62 | 23.8 | 1.0 | 28.60 | 20.60 |
| 3306 A | 30 | 72 | 30.2 | 1.1 | 39.50 | 29.20 |
| 3207 A | 35 | 72 | 27.0 | 1.1 | 30.50 | 23.70 |
| 3307 A | 35 | 80 | 34.9 | 1.5 | 49.50 | 35.30 |
| 3208 A | 40 | 80 | 30.2 | 1.1 | 40.20 | 32.30 |
| 3308 A | 40 | 90 | 36.5 | 1.5 | 60.50 | 44.20 |
| 3209 A | 45 | 85 | 30.2 | 1.1 | 40.00 | 32.60 |
| 3309 A | 45 | 100 | 39.7 | 1.5 | 66.40 | 49.60 |
| 3210 A | 50 | 90 | 30.2 | 1.1 | 43.90 | 39.90 |
| 3310 A | 50 | 110 | 44.4 | 2.0 | 78.90 | 60.10 |
| 3211 A | 55 | 100 | 33.3 | 1.5 | 56.90 | 47.90 |
| 3311 A | 55 | 120 | 49.2 | 2.0 | 92.20 | 71.00 |
| 3212 A | 60 | 110 | 36.5 | 1.5 | 59.90 | 53.60 |
| 3312 A | 60 | 130 | 54.0 | 2.1 | 121.50 | 95.30 |
| 3213 A | 65 | 120 | 38.1 | 1.5 | 73.50 | 66.60 |
| 3313 A | 65 | 140 | 58.7 | 2.1 | 129.60 | 103.60 |
| 3314 A | 70 | 150 | 63.5 | 2.1 | 154.00 | 125.00 |




| Limiting Speed | | Cage | | Features | | Weight | Recommended Shaft Shoulder Diameter Min. | Recommended Housing Shoulder Diameter Max. |
|---|---|---|---|---|---|---|---|---|
| Grease[1] | Oil[2] | | | | | | | |
| RPM | RPM | Polyamide | Steel | ZZ | 2RS | kg | mm | mm |
| 13400 | 17800 | • | | • | • | 0.06 | 16.4 | 27.6 |
| 11600 | 15100 | • | | • | • | 0.06 | 19.4 | 30.6 |
| 9800 | 13300 | • | | | • | 0.13 | 20.6 | 36.4 |
| 9800 | 13400 | • | | • | • | 0.10 | 21.4 | 35.6 |
| 8900 | 11600 | • | | | • | 0.19 | 22.6 | 41.4 |
| 8900 | 11600 | • | • | • | • | 0.17 | 25.6 | 41.4 |
| 8000 | 10700 | • | • | • | • | 0.21 | 27.0 | 45.0 |
| 7300 | 9800 | • | • | • | • | 0.18 | 31.0 | 46.0 |
| 6700 | 8900 | • | • | • | • | 0.19 | 32.0 | 55.0 |
| 6300 | 8400 | • | • | • | • | 0.30 | 36.0 | 56.0 |
| 5700 | 7600 | • | • | • | • | 0.55 | 37.0 | 65.0 |
| 5500 | 7400 | • | • | • | • | 0.39 | 42.0 | 65.0 |
| 5000 | 6600 | • | • | • | • | 0.75 | 43.5 | 71.5 |
| 4900 | 6600 | • | • | • | • | 0.61 | 47.0 | 73.0 |
| 4400 | 5900 | • | • | | • | 1.00 | 48.5 | 81.5 |
| 4400 | 5900 | • | • | • | • | 0.71 | 52.0 | 78.0 |
| 4000 | 5300 | • | • | | | 1.33 | 53.5 | 91.5 |
| 4000 | 5300 | • | • | • | • | 0.70 | 57.0 | 83.0 |
| 3600 | 4800 | • | • | | | 1.74 | 60.0 | 100.0 |
| 3600 | 4900 | | • | | • | 0.95 | 63.5 | 91.5 |
| 3300 | 4400 | | • | | | 2.42 | 65.0 | 110.0 |
| 3400 | 4500 | | • | | | 1.38 | 68.5 | 101.5 |
| 3000 | 4000 | | • | | • | 2.91 | 72.0 | 118.0 |
| 3100 | 4200 | | • | | | 1.66 | 73.5 | 111.5 |
| 2800 | 3700 | | • | | | 3.90 | 77.0 | 128.0 |
| 2600 | 3500 | | • | | | 3.90 | 82.0 | 138.0 |

[1]Double-row values for grease lubrication are for a sealed bearing configuration.
[2]Double-row values for oil lubrication are for an open bearing configuration.

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TIMKEN

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محرک چرخش

## تأمین‌کننده تخصصی بلبرینگ و رولبرینگ

BEARINGS · SEALS · BELTS · POWER TRANSMISSION

بلبرینگ | رولبرینگ | کاسه نمد | تسمه | اورینگ | یاتاقان | پکینگ | گریس


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