

3. Boundary Dimensions and Bearing Number Codes

3.1 Boundary dimensions

To facilitate international interchangeability and economic bearing production, the boundary dimensions of rolling bearings have been internationally standardized by the International Organization for Standardization (ISO) ISO 15 (radial bearings-except tapered roller bearings), ISO 355 (tapered roller bearings), and ISO 104 (thrust bearings).

In Japan, standard boundary dimensions for rolling bearings are regulated by Japanese Industrial Standards (JIS B 1512) in conformity with the ISO standards.

Those boundary dimensions which have been standardized; i.e. bore diameter, outside diameter, width or height and chamfer dimensions are shown in cross-section in Figs. 3.1-3.4. However, as a general rule, bearing internal construction dimensions are not covered by these standards.

The 90 standardized bore diameters (d) for rolling bearings under the metric system range from 0.6 mm - 2500 mm and are shown in Table 3.1.

For all types of standard bearings there has been established a combined series called the dimension series. In all radial bearings (except tapered roller bearings) there are eight major outside diameters (D) for each standard bore diameter. This series is called the diameter series and is expressed by the number sequence (7, 8, 9, 0, 1, 2, 3, 4) in order of ascending magnitude (7 being the smallest and 4 being the largest).

For the same bore and outside diameter combination there are eight width designations (B). This series is called the width series and is expressed by the number sequence (8, 0, 1, 2, 3, 4, 5, 6) in order of ascending size (i.e. 8 narrowest and 6 widest). The combination of these two series, the diameter series and the width series, forms the dimension series.

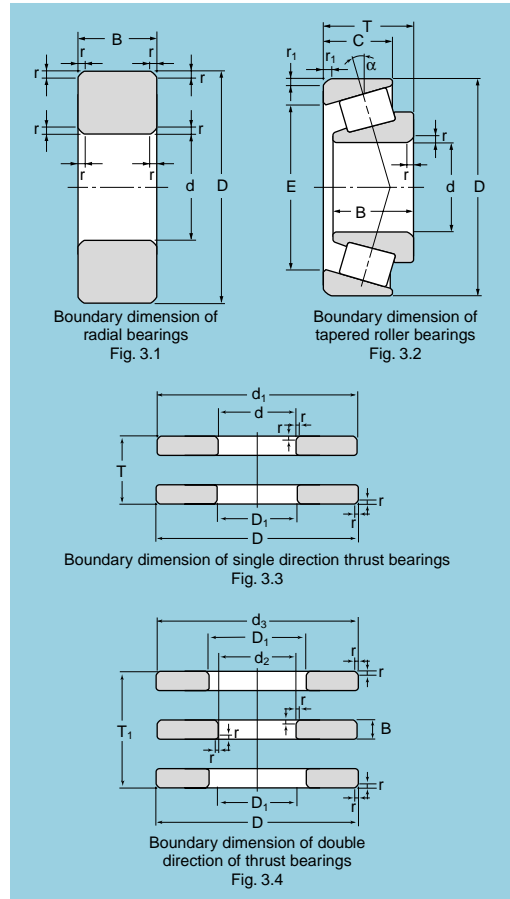


Table 3.1 Standardized bore diameter

| Bore diameter for nominal bearing d | | Standardized bore diameter mm | Standard |
|---------------------------------------|---------|-------------------------------|----------------------------|
| over | include | | |
| — | 1.0 | 0.6 | — |
| 1.0 | 3.0 | 1, 1.5, 2.5 | Every 0.5 mm |
| 3.0 | 10 | 3, 4, ..., 9 | Every 1 mm |
| 10 | 20 | 10, 12, 15, 17 | — |
| 20 | 35 | 20, 22, 25, 28, 30, 32 | Standard number R20 series |
| 35 | 110 | 35, 40, ..., 105 | Every 5 mm |
| 110 | 200 | 110, 120, ..., 190 | Every 10 mm |
| 200 | 500 | 200, 220, ..., 480 | Every 20 mm |
| 500 | 2500 | 500, 530, 2500 | Standard number R40 series |

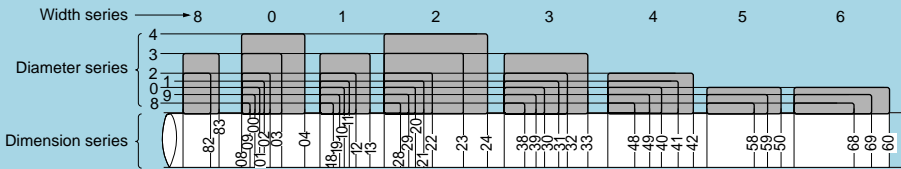


Fig. 3.5 Comparison of dimension series (Except tapered roller bearings) for radial bearings of same bore diameter

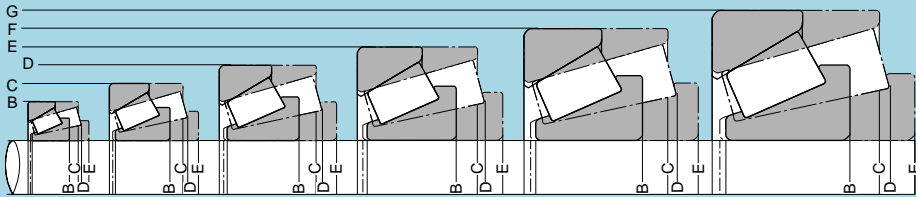


Fig. 3.6 Comparison of dimension series for tapered roller bearings

The relationship of these three series is illustrated in Fig. 3.5.

For tapered roller bearings, the standard bore (d) and outside diameter (D) combined series (i.e. diameter series) has six major divisions and is expressed by the letter sequence (B, C, D, E, F, G) in ascending order of the outside diameter size (B is the smallest outside diameter and G is the largest outside diameter). The width (T) is expressed in the width series by a four letter sequence (B, C, D, E) in ascending order; i.e. E being the widest.

The contact angle (α) is shown by a six number contact angle series (2, 3, 4, 5, 6, 7) in ascending order (i.e. 2 being the smallest angle and 7 the largest angle). The combination of the contact angle series, the diameter series and the width series form the dimension series for tapered roller bearings (example: 2FB). This series relationship is shown in Fig. 3.6.

For thrust bearings, the standard bore diameter (d) and the outside diameter (D) relationship is expressed by the five major number diameter series (0, 1, 2, 3, 4). For the same bore and outside diameter combination, the height dimensions (T) is standardized into 4 steps and is expressed by the number sequence (7, 9, 1, 2). This relationship is shown in Fig. 3.7.

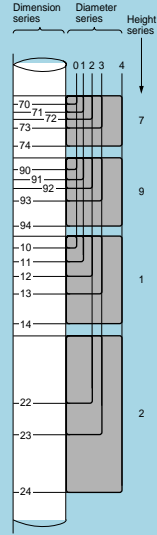


Fig. 3.7 Comparison of dimension series for thrust bearing of the same bore diameter

Chamfer dimensions (r) are covered by ISO standard 582 and JIS standard B1512 ($r_{s\ min}$: minimum allowable chamfer dimension). There are twenty-two standardized dimensions for chamfers ranging from 0.1 mm to 19 mm (0.05, 0.08, 0.1, 0.15, 0.2, 0.3, 0.6, 1, 1.1, 1.5, 2, 2.1, 2.5, 3, 4, 5, 6, 7.5, 9.5, 12, 15, 19).

Not all of the above mentioned standard boundary dimensions and size combinations (bore diameter, diameter series, width or height series) are standardized. Moreover, there are many standard bearing sizes which are not manufactured. Please refer to the bearing dimension tables in this catalog.

3.2 Bearing numbers

The bearing numbers indicate the bearing design, dimensions, accuracy, internal construction, etc.

The bearing number is derived from a series of number and letter codes, and is composed of three main groups of codes; i.e. two supplementary codes and a basic number code. The sequence and definition of these codes is shown in Table 3.2.

The basic number indicates general information such as bearing design, boundary dimensions, etc.: and is composed of the bearing series code, the bore diameter number and the contact angle code. These coded series are shown in Tables 3.4, 3.5, and 3.6 respectively.

The supplementary codes are derived from a prefix code series and a suffix code series. These codes designate bearing accuracy, internal clearance and other factors relating to bearing specifications and internal construction. These two codes are shown in Tables 3.3 and 3.7.

Table 3.2 Bearing number sequence

| Number and code arrangement | | | TS2 | - | 7 | 3 | 05 | B | L1 | DF | +10 | C3 | P5 | | |
|-----------------------------|------------------------------|-----------------------|--------------------------|---|---|---|----|---|----|----|-----|----|----|--|--|
| Supplementary prefix code | Special application code | | ← | | | | | | | | | | | | |
| | Material/heat treatment code | | ← | | | | | | | | | | | | |
| Basic number | Bearing series | Design code | ← | | | | | | | | | | | | |
| | | Dimension series code | Width/height series code | ← | | | | | | | | | | | |
| | | | Diameter series code | ← | | | | | | | | | | | |
| | Bore diameter number | | ← | | | | | | | | | | | | |
| Contact angle code | | ← | | | | | | | | | | | | | |
| Supplementary suffix code | Internal modification code | | ← | | | | | | | | | | | | |
| | Cage codes | | ← | | | | | | | | | | | | |
| | Seal/Shield code | | ← | | | | | | | | | | | | |
| | Ring configuration code | | ← | | | | | | | | | | | | |
| | Duplex arrangement code | | ← | | | | | | | | | | | | |
| | Internal clearance code | | ← | | | | | | | | | | | | |
| | Tolerances code | | ← | | | | | | | | | | | | |
| Lubrication code | | ← | | | | | | | | | | | | | |

Table 3.3 Supplementary prefix code

| Code | Definition |
|------|---|
| TS- | Dimension stabilized bearing for high temperature use |
| M- | Hard chrome plated bearings |
| F- | Stainless steel bearings |
| H- | High speed steel bearings |
| N- | Special material bearings |
| TM- | Specially treated long-life bearings |
| EC- | Expansion compensation bearings |
| 4T- | NTN 4 Top tapered roller bearings |
| ET- | ET Tapered roller bearings |

Table 3.4 Bearing series symbol

| Bearing series | Type symbol | Dimension series | | Bearing type |
|----------------|-------------|------------------|-----------------|--|
| | | width series | diameter series | |
| 67 | 6 | (1) | 7 | Single row deep groove ball bearings |
| 68 | | (1) | 8 | |
| 69 | | (1) | 9 | |
| 60 | | (1) | 0 | |
| 62 | | (0) | 2 | |
| 63 | | (0) | 3 | |
| 78 | 7 | (1) | 8 | Single row angular contact ball bearings |
| 79 | | (1) | 9 | |
| 70 | | (1) | 0 | |
| 72 | | (0) | 2 | |
| 73 | | (0) | 3 | |
| 12 | 1 | (0) | 2 | Self-aligning ball bearings |
| 13 | 1 | (0) | 3 | |
| 22 | 2 | (2) | 2 | |
| 23 | 2 | (2) | 3 | |
| NU10 | NU | 1 | 0 | Cylindrical roller bearings |
| NU2 | | (0) | 2 | |
| NU22 | | 2 | 2 | |
| NU3 | | (0) | 3 | |
| NU23 | | 2 | 3 | |
| NU4 | (0) | 4 | | |
| N10 | N | 1 | 0 | |
| N2 | | (0) | 2 | |
| N3 | | (0) | 3 | |
| N4 | | (0) | 4 | |
| NF2 | NF | (0) | 2 | |
| NF3 | | (0) | 3 | |
| NA48 | NA | 4 | 8 | Needle roller bearings |
| NA49 | | 4 | 9 | |
| NA59 | | 5 | 9 | |

| Bearing series | Type symbol | Dimension series | | Bearing type |
|----------------|-------------|------------------|-----------------|------------------------------------|
| | | width series | diameter series | |
| 329X | 3 | 2 | 9 | Tapered roller bearings |
| 320X | | 2 | 0 | |
| 302 | | 0 | 2 | |
| 322 | | 2 | 2 | |
| 303 | | 0 | 3 | |
| 303D | | 0 | 3 | |
| 313X | | 1 | 3 | |
| 323 | | 2 | 3 | |
| 239 | | 2 | 3 | |
| 230 | 3 | | 0 | |
| 240 | 4 | | 0 | |
| 231 | 3 | | 1 | |
| 241 | 4 | | 1 | |
| 222 | 2 | | 2 | |
| 232 | 3 | | 2 | |
| 213 | 0 | | 3 | |
| 223 | 2 | 3 | | |
| 511 | 5 | | 1 | Single-thrust ball bearings |
| 512 | | | 2 | |
| 513 | | 1 | 3 | |
| 514 | | | 4 | |
| 522 | 5 | | 2 | Double-thrust ball bearings |
| 523 | | 2 | 3 | |
| 524 | | | 4 | |
| 811 | 8 | 1 | 1 | Cylindrical roller thrust bearings |
| 812 | | 1 | 2 | |
| 893 | | 9 | 3 | |
| 292 | 2 | | 2 | Spherical roller thrust bearings |
| 293 | | 9 | 3 | |
| 294 | | | 4 | |

Table 3.6 Contact angle code

| Code | Nominal contact angle | Bearing type | |
|-----------------|-----------------------|-------------------------------|-------------------------|
| A ¹⁾ | Standard 30° | Angular contact ball bearings | |
| B | Standard 40° | | |
| C | Standard 15° | | |
| B ¹⁾ | Over 10° | Incl. 17° | Tapered roller bearings |
| C | Over 17° | Incl. 24° | |
| D | Over 24° | Incl. 32° | |

Note 1) A and B are not usually included in bearing numbers.

Table 3.5 Bore diameter number

| Bore diameter number | Bore diameter <i>d</i> mm | Remark |
|----------------------|---------------------------|---|
| /0.6 | 0.6 | Slash (/) before bore diameter number |
| /1.5 | 1.5 | |
| /2.5 | 2.5 | |
| 1 | 1 | Bore diameter expressed in single digits without code |
| ⋮ | ⋮ | |
| 9 | 9 | |
| 00 | 10 | _____ |
| 01 | 12 | |
| 02 | 15 | |
| 03 | 17 | |
| /22 | 22 | Slash (/) before bore diameter number |
| /28 | 28 | |
| /32 | 32 | |
| 04 | 20 | Bore diameter number in double digits after dividing bore diameter by 5 |
| 05 | 25 | |
| 06 | 30 | |
| ⋮ | ⋮ | |
| 88 | 440 | |
| 92 | 460 | |
| 96 | 480 | |
| /500 | 500 | Slash (/) before bore diameter number |
| /530 | 530 | |
| /560 | 560 | |
| ⋮ | ⋮ | |
| /2360 | 2360 | |
| /2500 | 2500 | |

Table 3.7 Supplementary suffix code

| Code | Explanation |
|------------------------|---|
| Internal modifications | U Internationally interchangeable tapered roller bearings |
| | R Non-internationally interchangeable tapered roller bearings |
| | ST Low torque tapered roller bearings |
| | HT High axial load use cylindrical roller bearings |
| Cage | L1 Machined Brass cage |
| | F1 Machined steel cage |
| | G1 Machined brass cage for cylindrical roller bearings, rivetless |
| | G2 Pin-type steel cage for tapered roller bearings |
| | J Pressed steel cage |
| | T1 Phenolic cage |
| | T2 Plastic cage, nylon or teflon |
| Seal or shield | LLB Synthetic rubber seal (non-contact type) |
| | LLU Synthetic rubber seal (contact type) |
| | ZZ Shield |
| | ZZA Removable shield |
| Ring configuration | K Tapered inner ring bore, taper 1 : 12 |
| | K30 Tapered inner ring bore, taper 1 : 30 |
| | N Snap ring groove on outer ring, but without snap ring |
| | NR Snap ring on outer ring |
| | D Bearings with oil holes |
| Duplex arrangement | DB Back-to-back arrangement |
| | DF Face-to-face arrangement |
| | DT Tandem arrangement |
| | D2 Two identical paired bearings |
| | G Single bearings, flush ground side face for DB, DF and DT |
| | + α Spacer, (α =nominal width of spacer, mm) |

| Code | Explanation |
|---|---|
| Internal clearance | C2 Radial internal clearance less than Normal |
| | C3 Radial internal clearance greater than Normal |
| | C4 Radial internal clearance greater than C3 |
| | CM Radial internal clearance for electric motor bearings |
| | NA Non-interchangeable clearance (shown after clearance code) |
| | /GL Light preload |
| | /GN Normal preload |
| /GM Medium preload | |
| /GH Heavy preload | |
| Tolerance standard | P6 JIS standard Class 6 |
| | P6X JIS standard Class 6X (tapered roller brg.) |
| | P5 JIS standard Class 5 |
| | P4 JIS standard Class 4 |
| | P2 JIS standard Class 2 |
| | 2 Class 2 for inch series tapered roller bearings |
| | 3 Class 3 for inch series tapered roller bearings |
| 0 Class 0 for inch series tapered roller bearings | |
| 00 Class 00 for inch series tapered roller bearings | |
| Lubrication | /2A Shell Alvania 2 grease |
| | /5C Chevron SRI 2 |
| | /3E ESSO Beacon 325 grease |
| | /5K MUL-TEMP SRL |