FBJ

# 3. Tolerances

For dimensional accuracy standards prescribe tolerances and allowable error limitations for those boundary dimensions (bore diameter, outside diameter, width, assembled bearing width, chamfer, and taper) necessary when installing bearings on shafts or in housings. For machining accuracy the standards provide allowable variation limits on bore, mean bore, outside diameter, mean outside diameter and raceway width or all thickness (for thrust bearings). Running accuracy is defined as the allowable limits for bearing runout. Bearing runout tolerances are included in the standards for inner and outer ring radial and axial runout; inner ring side runout with bore; and outer ring outside surface runout with side. Tolerances and allowable error limitations are established for each tolerance grade or class.

A comparison of relative tolerance class standards is shown in the Table 3.1.

**Table 3.1 Comparison of tolerance classifications of national standards**

| Standard | | Tolerence Class | | | | | Bearing Types |
|---|---|---|---|---|---|---|---|
| International Organization for Standardization | ISO 492 | Normal Class Class 6X | Class 6 | Class 5 | Class4 | Class 2 | Radial bearings |
| | ISO 199 | Normal Class | Class 6 | Class 5 | Class4 | - | Thrust ball bearings |
| | ISO 578 | Class 4 | - | Class 3 | Class 0 | Class 00 | Tapered roller Bearings (Inch series) |
| | ISO 1224 | - | - | Class 5A | Class 4A | - | Precision instrument Bearings |
| Japanese Industrial Standard | JIS B 1514 | class 0 class 6X | Class 6 | Class 5 | Class 4 | Class 2 | All type |
| Deutsches Institut | DIN 620 | P0 | P6 | P5 | P4 | P2 | All type |
| American National Standards Institute (ANSI) Anti-Friction Bearing Manufacturers (AFBMA) | ANSI/AFBMA Std.201) | ABEC-1 RBEC-1 | ABEC-3 RBEC-3 | ABEC-5 RBEC-5 | ABEC-7 | ABEC-9 | Radial bearings (Except tapered Roller bearings) |
| | ANSI/AFBMA Std. 19.1 | Class K | Class N | Class C | Class B | Class A | Tapered roller bearing (Metric series) |
| | ANSI / B 3.19 AFBMA Std.19 | Class 4 | Class 2 | Class 3 | Class 0 | Class 00 | Tapered roller bearings (Inch Series) |
| | ANSI/AFBMA Std. 12.1 | - | Class 3P | Class 5P Class 5T | Class 7P Class 7T | Class 9P | Precision instrument ball bearings (Metric Series) |
| | ANSI/AFBMA | - Std. 12.2 | Class 3P | Class 5P | Class 7P Class 5T | Class 9P Class 7T | Precision instrument ball bearings (Inch Series) |

**Table 3.2 Bearing types and applicable tolerance**

| Bearing type | | Applicable standard | Applicable tolerence | | | | |
|---|---|---|---|---|---|---|---|
| Deep groove ball bearing | | ISO 492 | Class 0 | Class 6 | Class 5 | Class 4 | Class 2 |
| Angular contact ball bearings | | | Class 0 | Class 6 | Class 5 | Class 4 | Class 2 |
| Self-aligning ball bearings | | | Class 0 | - | - | - | - |
| Cylindrical roller bearings | | | Class 0 | Class 6 | Class 5 | Class 4 | Class 2 |
| Needle roller bearings | | | Class 0 | Class 6 | Class 5 | Class 4 | - |
| Spherical roller bearings | | | Class 0 | - | - | - | - |
| Tapered Roller Bearings | Metric | ISO 492 | Class 0,6X | Class 6 | Class 5 | Class 4 | - |
| | Inc | AFBMA Std.19 | Class 4 | Class 2 | Class 3 | Class 0 | Class 00 |
| Thrust ball bearings | | ISO 199 | Class 0 | Class 6 | Class 5 | Class 4 | - |

# Codes and Symbols

### Dimension

$d$ : Nominal bore diameter
$d_2$ : Nominal bore diameter (double direction thrust ball bearing)
$D$ : Nominal outside diameter
$B$ : Nominal inner ring width or nominal center washer height
$C$ : Nominal outer ring width1)
Note 1) For radial bearings (except tapered roller bearings) this is equivalent to the norminal bearings width.
$T$ : Nominal bearing width of single row tapered roller bearing, or nominal height of single direction thrust bearing.
$T_1$ : Nominal height of double direction thrust ball bearing, or nominal effective width of inner ring and roller assembly of tapered roller bearing
$T_2$ : Nominal heigh form back face of housing washer to back face of center washer on double direction thrust ball bearings, or nominal effective outer ring width of tapered roller bearing.
$r$ : Chamfer dimensions of inner and outer rings (for tapered roller bearings, large end of inner ring only)
$r_1$ : Chamfer dimensions of center washer, or small end of inner and outer ring of angular contact ball bearing, and large end of outer ring of tapered roller bearing.
$r_2$ : Chamfer dimensions of small end of inner and outer rings of tapered roller bearing

FBJ™

## Dimension Deviation

- $\Delta_{ds}$ : Single bore diameter deviation
- $\Delta_{dmp}$ : Single plane mean bore diameter deviation
- $\Delta_{d2mp}$ : Single plane mean bore diameter deviation (double direction thrust ball bearing)
- $\Delta_{Ds}$ : Single outside diameter deviation
- $\Delta_{Dmp}$ : Single plane mean outside diameter deviation
- $\Delta_{Bs}$ : Inner ring width deviation, or Centre washer height deviation
- $\Delta_{Cs}$ : Outer ring width deviation
- $\Delta_{Ts}$ : Overall width deviation of assembled signle row tapered roller bearing, or height deviation of single direction thrust bearing
- $\Delta_{T1s}$ : Height deviation of double direction thrust ball bearing, or effective width deviation of roller and inner ring assembly of tapered roller bearing
- $\Delta_{T2s}$ : Double direction thrust ball bearing housing washer back face to center washer back face height deviation, or tapered roller bearing outer ring effective width deviation

## Dimension Variation

- $V_{dp}$ : Single radial plane bore diameter variation
- $V_{d2p}$ : Single radial plane bore diameter variation (double direction thrust ball bearing)
- $V_{dmp}$ : Mean single plane bore diameter variation
- $V_{Dp}$ : Single radial plane outside diameter variation
- $V_{Dmp}$ : Mean single plane outside diameter variation
- $V_{Bs}$ : Inner ring width variation
- $V_{Cs}$ : Outer ring width variation

## Chamfer Boundary

- $r_{s\,min}$ : Minimum allowable chamfer dimension for inner/outer ring, or small end of inner ring on tapered roller bearing
- $r_{s\,max}$ : Maximum allowable chamfer dimension for inner/outer ring, or large end of inner ring on tapered roller bearing
- $r_{1s\,min}$ : Minimum allowable chamfer dimension for double direction thrust ball bearing center washer, small end of inner/outer ring of angular contact ball bearing, large end of outer ring of tapered roller bearing
- $r_{1s\,max}$ : Maximum allowable chamfer dimension for double direction thrust ball bearing center washer, small end of inner/outer ring of angular contact ball bearing, large end of outer ring of tapered roller bearing
- $r_{2s\,min}$ : Minium allowable chamfer dimension for small end of inner/outer ring of tapered roller bearing
- $r_{2s\,max}$ : Maximum allowable chamfer dimension for small end of inner/outer ring of tapered roller bearing

## Rotation Tolerance

- $K_{ia}$ : Inner ring radial runout
- $S_{ia}$ : Inner ring axial runout (with side)
- $S_d$ : Face runout with bore
- $K_{ea}$ : Outer ring radial runout
- $S_{ea}$ : Outer ring axial runout
- $S_D$ : Outside surface inclination
- $S_i$ : Thrust bearing shaft washer raceway (or center washer receway) thickness variation
- $S_e$ : Thrust bearing housing washer raceway thickness variation

## Table 3.3 Tolerance for radial bearings (Except tapered roller bearings)
## Inner Rings

| Nominal bore diameter $d$ (mm) over | incl | $\Delta_{dmp}$ class 0 high | low | class 6 high | low | class 5 high | low | class 4 high | low | class 2 high | low | $V_{dp}$ diameter series 7.8.9 class 0 | class 6 | class 5 | class 4 | class 2 Max | diameter series 0.1 class 0 | class 6 | class 5 | class 4 | class 2 Max | diameter series 2.3.4 class 0 | class 6 | class 5 | class 4 | class 2 Max |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.61 | 2.5 | 0 | -8 | 0 | -7 | 0 | -5 | 0 | -4 | 0 | -2.5 | 10 | 9 | 5 | 4 | 2.5 | 8 | 7 | 4 | 3 | 2.5 | 6 | 5 | 4 | 3 | 2.5 |
| 2.5 | 10 | 0 | -8 | 0 | -7 | 0 | -5 | 0 | -4 | 0 | -2.5 | 10 | 9 | 5 | 4 | 2.5 | 8 | 7 | 4 | 3 | 2.5 | 6 | 5 | 4 | 3 | 2.5 |
| 10 | 18 | 0 | -8 | 0 | -7 | 0 | -5 | 0 | -4 | 0 | -2.5 | 10 | 9 | 5 | 4 | 2.5 | 8 | 7 | 4 | 3 | 2.5 | 6 | 5 | 4 | 3 | 2.5 |
| 18 | 30 | 0 | -10 | 0 | -8 | 0 | -6 | 0 | -5 | 0 | -2.5 | 13 | 10 | 6 | 5 | 2.5 | 10 | 8 | 5 | 4 | 2.5 | 8 | 6 | 5 | 4 | 2.5 |
| 30 | 50 | 0 | -12 | 0 | -10 | 0 | -8 | 0 | -6 | 0 | -2.5 | 15 | 13 | 8 | 6 | 2.5 | 12 | 10 | 6 | 5 | 2.5 | 9 | 8 | 6 | 5 | 2.5 |
| 50 | 80 | 0 | -15 | 0 | -12 | 0 | -9 | 0 | -7 | 0 | -4 | 19 | 15 | 9 | 7 | 4 | 19 | 15 | 7 | 5 | 4 | 11 | 9 | 7 | 5 | 4 |
| 80 | 120 | 0 | -20 | 0 | -15 | 0 | -10 | 0 | -8 | 0 | -5 | 25 | 19 | 10 | 8 | 5 | 25 | 19 | 8 | 6 | 5 | 15 | 11 | 8 | 6 | 5 |
| 120 | 150 | 0 | -25 | 0 | -18 | 0 | -13 | 0 | -10 | 0 | -7 | 31 | 23 | 13 | 10 | 7 | 31 | 23 | 10 | 8 | 7 | 19 | 14 | 10 | 8 | 7 |
| 150 | 180 | 0 | -25 | 0 | -18 | 0 | -13 | 0 | -10 | 0 | -7 | 31 | 23 | 13 | 10 | 7 | 31 | 23 | 10 | 8 | 7 | 19 | 14 | 10 | 8 | 7 |
| 180 | 250 | 0 | -30 | 0 | -22 | 0 | -15 | 0 | -12 | 0 | -8 | 38 | 28 | 15 | 12 | 8 | 38 | 28 | 12 | 9 | 8 | 23 | 17 | 12 | 9 | 8 |
| 250 | 315 | 0 | -35 | 0 | -25 | 0 | -18 | - | - | - | - | 44 | 31 | 18 | - | - | 44 | 31 | 14 | - | - | 26 | 19 | 14 | - | - |
| 315 | 400 | 0 | -40 | 0 | -30 | 0 | -23 | - | - | - | - | 50 | 38 | 23 | - | - | 50 | 38 | 18 | - | - | 30 | 23 | 18 | - | - |
| 400 | 500 | 0 | -45 | 0 | -35 | - | - | - | - | - | - | 56 | 44 | - | - | - | 56 | 44 | - | - | - | 34 | 26 | - | - | - |
| 500 | 630 | 0 | -50 | 0 | -40 | - | - | - | - | - | - | 63 | 50 | - | - | - | 63 | 50 | - | - | - | 38 | 30 | - | - | - |
| 630 | 800 | 0 | -75 | - | - | - | - | - | - | - | - | 94 | - | - | - | - | 94 | - | - | - | | 55 | - | - | - | - |
| 800 | 1000 | 0 | -100 | - | - | - | - | - | - | - | - | - | 125 | - | - | - | - | 125 | - | - | - | - | 75 | - | - | - |
| 1000 | 1250 | 0 | -125 | - | - | - | - | - | - | - | - | - | 155 | - | - | - | - | 155 | - | - | - | - | 94 | - | - | - |
| 1250 | 1600 | 0 | -160 | - | - | - | - | - | - | - | - | - | 200 | - | - | - | - | 200 | - | - | - | - | 120 | - | - | - |
| 1600 | 2000 | 0 | -200 | - | - | - | - | - | - | - | - | - | 250 | - | - | - | - | 250 | - | - | - | - | 150 | - | - | - |

## Table 3.3.2 Outer rings

| Nominal bore diameter $D$ (mm) over | incl | $\Delta_{Dmp}$ class 0 high | low | class 6 high | low | class 5 high | low | class 4 high | low | class 2 high | low | $V_{Dp}$ diameter series 7.8.9 class 0 | class 6 | class 5 | class 4 | class 2 Max | diameter series 0.1 class 0 | class 6 | class 5 | class 4 | class 2 Max | diameter series 2.3.4 class 0 | class 6 | class 5 | class 4 | class 2 Max |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.5 | 6 | 0 | -8 | 0 | -7 | 0 | -5 | 0 | -4 | 0 | -2.5 | 10 | 9 | 5 | 4 | 2.5 | 8 | 7 | 4 | 3 | 2.5 | 6 | 5 | 4 | 3 | 2.5 |
| 6 | 18 | 0 | -8 | 0 | -7 | 0 | -5 | 0 | -4 | 0 | -2.5 | 10 | 9 | 5 | 4 | 2.5 | 8 | 7 | 4 | 3 | 2.5 | 6 | 5 | 4 | 3 | 2.5 |
| 18 | 30 | 0 | -9 | 0 | -8 | 0 | -6 | 0 | -5 | 0 | -4 | 12 | 10 | 6 | - | 4 | 9 | 8 | 5 | 4 | 4 | 7 | 6 | 5 | 4 | 4 |
| 30 | 50 | 0 | -11 | 0 | -9 | 0 | -7 | 0 | -6 | 0 | -4 | 14 | 11 | 7 | - | 4 | 11 | 9 | 5 | 5 | 4 | 8 | 7 | 5 | 5 | 4 |
| 50 | 80 | 0 | -13 | 0 | -11 | 0 | -9 | 0 | -7 | 0 | -4 | 16 | 14 | 9 | 7 | 4 | 13 | 11 | 7 | 5 | 4 | 10 | 8 | 7 | 5 | 4 |
| 80 | 120 | 0 | -15 | 0 | -13 | 0 | -10 | 0 | -8 | 0 | -5 | 19 | 16 | 10 | - | 5 | 19 | 16 | 8 | 6 | 5 | 11 | 10 | 8 | 6 | 5 |
| 120 | 150 | 0 | -18 | 0 | -15 | 0 | -11 | 0 | -9 | 0 | -5 | 23 | 19 | 11 | - | 5 | 23 | 19 | 8 | 7 | 5 | 14 | 11 | 8 | 7 | 5 |
| 150 | 180 | 0 | -25 | 0 | -18 | 0 | -13 | 0 | -10 | 0 | -7 | 31 | 23 | 13 | - | 7 | 31 | 23 | 10 | 8 | 7 | 19 | 14 | 10 | 8 | 7 |
| 180 | 250 | 0 | -30 | 0 | -20 | 0 | -15 | 0 | -11 | 0 | -8 | 38 | 25 | 15 | 11 | 8 | 38 | 25 | 11 | 8 | 8 | 23 | 15 | 11 | 8 | 8 |
| 250 | 315 | 0 | -35 | 0 | -25 | 0 | -18 | 0 | -13 | 0 | -8 | 44 | 31 | 18 | 13 | 8 | 44 | 31 | 14 | 10 | 8 | 26 | 19 | 14 | 10 | 8 |
| 315 | 400 | 0 | -40 | 0 | -28 | 0 | -20 | 0 | -15 | 0 | -10 | 50 | 35 | 20 | 15 | 10 | 50 | 35 | 15 | 11 | 10 | 30 | 21 | 15 | 11 | 10 |
| 400 | 500 | 0 | -45 | 0 | -33 | 0 | 23 | - | - | - | - | 56 | 41 | 23 | - | - | 56 | 41 | 17 | - | - | 34 | 25 | 17 | - | - |
| 500 | 630 | 0 | -50 | 0 | -38 | 0 | -28 | - | - | - | - | 63 | 48 | 28 | - | - | 63 | 48 | 21 | - | - | 38 | 29 | 21 | - | - |
| 630 | 800 | 0 | -75 | 0 | -45 | 0 | -35 | - | - | - | - | 94 | 56 | 35 | - | - | 94 | 56 | 26 | - | - | 55 | 34 | 26 | - | - |
| 800 | 1000 | 0 | -100 | 0 | -60 | - | - | - | - | - | - | 125 | 75 | - | - | - | 125 | 75 | - | - | - | 75 | 45 | - | - | - |
| 1000 | 1250 | 0 | -125 | - | - | - | - | - | - | - | - | 155 | - | - | - | - | 155 | - | - | - | - | 94 | - | - | - | - |
| 1250 | 1600 | 0 | -160 | - | - | - | - | - | - | - | - | 200 | - | - | - | - | 200 | - | - | - | - | 120 | - | - | - | - |
| 1600 | 2000 | 0 | -200 | - | - | - | - | - | - | - | - | 250 | - | - | - | - | 250 | - | - | - | - | 150 | - | - | - | - |
| 2000 | 2500 | 0 | -250 | - | - | - | - | - | - | - | - | 310 | - | - | - | - | 310 | - | - | - | - | 190 | - | - | - | - |

FBJ

Unit μm

| $V_{dmp}$ | | | | | $K_{ia}$ | | | | | $S_D$ | | | $S_{ia}$ (1) | | | $\Delta_{Bs}$ | | | | | | $V_{Bs}$ | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| class 0 | class 6 | class 5 | class 4 | class 2 | class 0 | class 6 | class 5 | class 4 | class 2 | class 5 | class 4 | lass 2 | class 5 | class 4 | lass 2 | class 0.6 | | class 5.4 | | class 2 | | class 0 | class 6 | class 5 | class 4 | class 2 |
| Max | | | | | Max | | | | | Max | | | Max | | | high | low | high | low | high | low | Max | | | | |
| 6 | 5 | 3 | 2 | 1.5 | 10 | 5 | 4 | 2.5 | 1.5 | 7 | 3 | 1.5 | 7 | 3 | 1.5 | 0 | -40 | 0 | -40 | 0 | -40 | 12 | 12 | 5 | 2.5 | 1.5 |
| 6 | 5 | 3 | 2 | 1.5 | 10 | 6 | 4 | 2.5 | 1.5 | 7 | 3 | 1.5 | 7 | 3 | 1.5 | 0 | -120 | 0 | -40 | 0 | -40 | 15 | 15 | 5 | 2.5 | 1.5 |
| 6 | 5 | 3 | 2 | 1.5 | 10 | 7 | 4 | 2.5 | 1.5 | 7 | 3 | 1.5 | 7 | 3 | 1.5 | 0 | -120 | 0 | -80 | 0 | -80 | 20 | 20 | 5 | 2.5 | 1.5 |
| 8 | 6 | 3 | 2.5 | 1.5 | 13 | 8 | 4 | 3 | 2.5 | 8 | 4 | 1.5 | 8 | 4 | 2.5 | 0 | -120 | 0 | -120 | 0 | -120 | 20 | 20 | 5 | 2.5 | 1.5 |
| 9 | 8 | 4 | 3 | 1.5 | 15 | 10 | 5 | 4 | 2.5 | 8 | 4 | 1.5 | 8 | 4 | 2.5 | 0 | -120 | 0 | -120 | 0 | -120 | 20 | 20 | 5 | 3 | 1.5 |
| 11 | 9 | 5 | 3.5 | 2 | 20 | 10 | 5 | 4 | 2.5 | 8 | 5 | 1.5 | 8 | 5 | 2.5 | 0 | -150 | 0 | -150 | 0 | -150 | 25 | 25 | 6 | 4 | 1.5 |
| 15 | 11 | 5 | 4 | 2.5 | 25 | 13 | 6 | 5 | 2.5 | 9 | 5 | 2.5 | 9 | 5 | 2.5 | 0 | -200 | 0 | -200 | 0 | -200 | 25 | 25 | 7 | 4 | 2.5 |
| 19 | 14 | 7 | 5 | 3.5 | 30 | 18 | 8 | 6 | 2.5 | 10 | 6 | 2.5 | 10 | 7 | 2.5 | 0 | -250 | 0 | -250 | 0 | -250 | 30 | 30 | 8 | 5 | 2.5 |
| 19 | 14 | 7 | 5 | 3.5 | 30 | 18 | 8 | 6 | 5 | 10 | 6 | 4 | 10 | 7 | 5 | 0 | -250 | 0 | -250 | 0 | -300 | 30 | 30 | 8 | 5 | 4 |
| 23 | 17 | 8 | 6 | 4 | 40 | 20 | 10 | 8 | 5 | 11 | 7 | 5 | 13 | 8 | 5 | 0 | -300 | 0 | -300 | 0 | -350 | 30 | 30 | 10 | 6 | 5 |
| 26 | 19 | 9 | - | - | 50 | 25 | 13 | - | - | 13 | - | - | 15 | - | - | 0 | -350 | 0 | -350 | - | - | 35 | 35 | 13 | - | - |
| 30 | 23 | 12 | - | - | 60 | 30 | 15 | - | - | 15 | - | - | 20 | - | - | 0 | -400 | 0 | -400 | - | - | 40 | 40 | 15 | - | - |
| 34 | 26 | - | - | - | 65 | 35 | - | - | - | - | - | - | - | - | - | 0 | -450 | - | - | - | - | 50 | 45 | - | - | - |
| 38 | 30 | - | - | - | 70 | 40 | - | - | | - | - | - | - | - | - | 0 | -500 | - | - | - | - | 60 | 50 | - | - | - |
| 55 | - | - | - | - | 80 | - | - | - | - | - | - | - | - | - | - | 0 | -750 | - | - | - | - | 70 | - | - | - | - |
| 75 | - | - | - | - | 90 | - | - | - | - | - | - | - | - | - | - | 0 | -1 000 | - | - | - | - | 80 | - | - | - | - |
| 94 | - | - | - | - | 100 | - | - | - | - | - | - | - | - | - | - | 0 | -1 250 | - | - | - | - | 100 | - | - | - | - |
| 120 | - | - | - | - | 120 | - | - | - | - | - | - | - | - | - | - | 0 | -1 600 | - | - | - | - | 120 | - | - | - | - |
| 150 | - | - | - | - | 140 | - | - | - | - | - | - | - | - | - | - | 0 | -2 000 | - | - | - | - | 140 | - | - | - | - |

(1) To be applied for deep groove ball bearing and angular contact ball bearings.

Unit μm

| $V_{dp}$ (2) capped bearings diameter series | | $V_{Dmp}$ | | | | | $K_{ea}$ | | | | | $S_D$ | | | $S_{ea}$ | | | $\Delta_{Cs}$ | $V_{Cs}$ | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| class 0 | class6 | class 0 | class 6 | class 5 | class 4 | class 2 | class 0 | class 6 | class 5 | class 4 | class 2 | class 5 | class 4 | lass 2 | class 5 | class 4 | lass 2 | all type | class 0.6 | class 5 | class 4 | class 2 |
| Max | | Max | | | | | Max | | | | | Max | | | Max | | | Max | | Max | | |
| 10 | 9 | 6 | 5 | 3 | 2 | 1.5 | 15 | 8 | 5 | 3 | 1.5 | 8 | 4 | 1.5 | 8 | 5 | 1.5 | identical to | identical to | 5 | 2.5 | 1.5 |
| 10 | 9 | 6 | 5 | 3 | 2 | 1.5 | 15 | 8 | 5 | 3 | 1.5 | 8 | 4 | 1.5 | 8 | 5 | 1.5 | $\Delta_{Bs}$ of inner | $\Delta_{Bs}$ and $\Delta_{Bs}$ | 5 | 2.5 | 1.5 |
| 12 | 10 | 7 | 6 | 3 | 2.5 | 2 | 15 | 9 | 6 | 4 | 2.5 | 8 | 4 | 1.5 | 8 | 5 | 2.5 | ring of same | of inner ring | 5 | 2.5 | 1.5 |
| 16 | 13 | 8 | 7 | 4 | 3 | 2 | 20 | 10 | 7 | 5 | 2.5 | 8 | 4 | 1.5 | 8 | 5 | 2.5 | bearing | of same | 5 | 2.5 | 1.5 |
| 20 | 16 | 10 | 8 | 5 | 3.5 | 2 | 25 | 13 | 8 | 5 | 4 | 8 | 4 | 1.5 | 10 | 5 | 4 | | bearing | 6 | 3 | 1.5 |
| 26 | 20 | 11 | 10 | 5 | 4 | 2.5 | 35 | 18 | 10 | 6 | 5 | 9 | 5 | 2.5 | 11 | 6 | 5 | | | 8 | 4 | 2.5 |
| 30 | 25 | 14 | 11 | 6 | 5 | 2.5 | 40 | 20 | 11 | 7 | 5 | 10 | 5 | 2.5 | 13 | 7 | 5 | | | 8 | 5 | 2.5 |
| 38 | 30 | 19 | 14 | 7 | 5 | 3.5 | 45 | 23 | 13 | 8 | 5 | 10 | 5 | 2.5 | 14 | 8 | 5 | | | 8 | 5 | 2.5 |
| - | - | 23 | 15 | 8 | 6 | 4 | 50 | 25 | 15 | 10 | 7 | 11 | 7 | 4 | 15 | 10 | 7 | | | 10 | 7 | 4 |
| - | - | 26 | 19 | 9 | 7 | 4 | 60 | 30 | 18 | 11 | 7 | 13 | 8 | 5 | 18 | 10 | 7 | | | 11 | 7 | 5 |
| - | - | 30 | 21 | 10 | 8 | 5 | 70 | 35 | 20 | 13 | 8 | 13 | 10 | 7 | 20 | 13 | 8 | | | 13 | 8 | 7 |
| - | - | 34 | 25 | 12 | - | - | 80 | 40 | 23 | - | - | 15 | - | - | 23 | - | - | | | 15 | - | - |
| - | - | 38 | 29 | 14 | - | - | 100 | 50 | 25 | - | - | 18 | - | - | 25 | - | - | | | 18 | - | - |
| - | - | 55 | 34 | 18 | - | - | 120 | 60 | 30 | - | - | 20 | - | - | 30 | - | - | | | 20 | - | - |
| - | - | 75 | 45 | - | - | - | 140 | 75 | - | - | - | - | - | - | - | - | - | | | - | - | - |
| - | - | 94 | - | - | - | - | 160 | - | - | - | - | | - | - | - | - | - | | | - | - | - |
| - | - | 120 | - | - | - | - | 190 | - | - | - | - | - | - | - | - | - | - | | | - | - | - |
| - | - | 150 | - | - | - | - | 220 | - | - | - | - | - | - | - | - | - | - | | | - | - | - |
| - | - | 190 | - | - | - | - | 250 | - | - | - | - | - | - | - | - | - | - | | | - | - | - |

(2) To be applied in case snap rings are not installed on the bearings.

## Table 3.4 Tolerance of tapered roller bearings (Metric)
## Inner rings

| Nominal bore diameter $d$ (mm) over | incl. | $\Delta_{dmp}$ class 0.6x high | low | class 5,6 high | low | class 4 high | low | $V_{dp}$ class 0.6x | class 6 | class 5 | class 4 Max | $V_{dmp}$ class 0.6x | class 6 | class 5 | class 4 Max | $K_{ia}$ class 0.6x | class 6 | class 5 | class 4 Max | $S_d$ class 5 | class 4 Max |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 18 | 0 | -12 | 0 | -7 | 0 | -5 | 12 | 7 | 5 | 4 | 9 | 5 | 5 | 4 | 15 | 7 | 5 | 3 | 7 | 3 |
| 18 | 30 | 0 | -12 | 0 | -8 | 0 | -6 | 12 | 8 | 6 | 5 | 9 | 6 | 5 | 4 | 18 | 8 | 5 | 3 | 8 | 4 |
| 30 | 50 | 0 | -12 | 0 | -10 | 0 | -8 | 12 | 10 | 8 | 6 | 9 | 8 | 5 | 5 | 20 | 10 | 6 | 4 | 8 | 4 |
| 50 | 80 | 0 | -15 | 0 | -12 | 0 | -9 | 15 | 12 | 9 | 7 | 11 | 9 | 6 | 5 | 25 | 10 | 7 | 4 | 8 | 5 |
| 80 | 120 | 0 | -120 | 0 | -15 | 0 | -10 | 20 | 15 | 11 | 8 | 15 | 11 | 8 | 5 | 30 | 13 | 8 | 5 | 9 | 5 |
| 120 | 180 | 0 | -25 | 0 | -18 | 0 | -13 | 25 | 18 | 14 | 10 | 19 | 14 | 9 | 7 | 35 | 18 | 11 | 6 | 10 | 6 |
| 180 | 250 | 0 | -30 | 0 | -22 | 0 | -15 | 30 | 22 | 17 | 11 | 23 | 16 | 11 | 8 | 50 | 20 | 13 | 8 | 11 | 7 |
| 250 | 315 | 0 | -35 | - | - | - | - | 35 | - | - | - | 26 | - | - | - | 60 | - | - | - | - | - |
| 315 | 400 | 0 | -40 | - | - | - | - | 40 | - | - | - | 30 | - | - | - | 70 | - | - | - | - | - |
| 400 | 500 | 0 | -45 | - | - | - | - | 45 | - | - | - | 34 | - | - | - | 80 | - | - | - | - | |
| 500 | 630 | - | -50 | - | - | - | - | 50 | - | - | - | 38 | - | - | - | 90 | - | - | - | - | |
| 630 | 800 | 0 | -75 | - | - | - | - | 75 | - | - | - | 56 | - | - | - | 105 | - | - | - | - | |
| 800 | 1000 | 0 | -100 | - | — | - | - | 100 | - | - | - | 75 | - | - | - | 120 | - | - | - | - | |

## Outer rings

| Nominal outside diameter $D$ (mm) over | incl. | $\Delta_{Dmp}$ class 0.6x high | low | class 5,6 high | low | class 4 high | low | $V_{Dp}$ class 0.6x | class 6 | class 5 | class 4 Max | $V_{Dmp}$ class 0.6x | class 6 | class 5 | class 4 Max | $K_{ea}$ class 0.6x | class 6 | class 5 | class 4 Max | $S_D$ class 5 | class 4 Max |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 18 | 30 | 0 | -12 | 0 | -8 | 0 | -6 | 12 | 8 | 6 | 5 | 9 | 6 | 5 | 4 | 18 | 9 | 6 | 4 | 8 | 4 |
| 30 | 50 | 0 | -14 | 0 | -9 | 0 | -7 | 14 | 9 | 7 | 5 | 11 | 7 | 5 | 5 | 20 | 10 | 7 | 5 | 8 | 4 |
| 50 | 80 | 0 | -16 | 0 | -11 | 0 | -9 | 16 | 11 | 8 | 7 | 12 | 8 | 6 | 5 | 25 | 13 | 8 | 5 | 8 | 4 |
| 80 | 120 | 0 | -18 | 0 | -13 | 0 | -10 | 18 | 13 | 10 | 8 | 14 | 10 | 7 | 5 | 35 | 18 | 10 | 6 | 9 | 5 |
| 120 | 150 | 0 | -20 | 0 | -15 | 0 | -11 | 20 | 15 | 11 | 8 | 15 | 11 | 8 | 6 | 40 | 20 | 11 | 7 | 10 | 5 |
| 150 | 180 | 0 | -25 | 0 | -18 | 0 | -13 | 25 | 18 | 14 | 10 | 19 | 14 | 9 | 7 | 45 | 23 | 13 | 8 | 10 | 5 |
| 180 | 250 | 0 | -30 | 0 | -20 | 0 | -15 | 30 | 20 | 15 | 11 | 23 | 15 | 10 | 8 | 50 | 25 | 15 | 10 | 11 | 7 |
| 250 | 315 | 0 | -35 | 0 | -25 | 0 | -18 | 35 | 25 | 19 | 14 | 26 | 19 | 13 | 9 | 60 | 30 | 18 | 11 | 13 | 8 |
| 315 | 400 | 0 | -40 | 0 | -28 | 0 | -20 | 40 | 28 | 22 | 15 | 30 | 21 | 14 | 10 | 70 | 35 | 20 | 13 | 13 | 10 |
| 400 | 500 | 0 | -45 | - | - | - | - | 45 | - | - | - | 34 | - | - | - | 80 | - | - | - | - | - |
| 500 | 630 | 0 | -50 | - | - | - | - | 50 | - | - | - | 38 | - | - | - | 100 | - | - | - | - | |
| 630 | 800 | 0 | -75 | - | - | - | - | 75 | - | - | - | 56 | - | - | - | 120 | - | - | - | - | |
| 800 | 1 000 | 0 | -100 | - | - | - | - | 100 | - | - | - | 75 | - | - | - | 140 | - | - | - | - | |
| 1 000 | 1 250 | 0 | -125 | - | - | - | - | 125 | - | - | - | 84 | - | - | - | 165 | - | - | - | - | |
| 1 250 | 1 600 | 0 | -160 | - | - | - | - | 160 | - | - | - | 120 | - | - | - | 190 | - | - | - | - | |

FBJ™

Unit μm

| $S_{ia}$ | $\Delta_{Bs}$ | | | | | | $\Delta_{Ts}$ | | | | | | $\Delta_{B1s}$,$\Delta_{C1s}$ | | $\Delta_{B2s}$,$\Delta_{C2s}$ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| class 4 max | class 0.6 | | class 6X | | class 4,5 | | class 0.6 | | class 6X | | class 4,5 | | class 0, 6, 5 | | class 0, 6, 5 | |
| | high | low | high | low | high | low | high | low | high | low | high | low | high | low | high | low |
| 3 | 0 | -120 | 0 | -50 | 0 | -200 | +200 | 0 | +100 | 0 | +200 | -200 | - | - | - | - |
| 4 | 0 | -120 | 0 | -50 | 0 | -200 | +200 | 0 | +100 | 0 | +200 | -200 | - | - | - | - |
| 4 | 0 | -120 | 0 | -50 | 0 | -240 | +200 | 0 | +100 | 0 | +200 | -200 | +240 | -240 | - | - |
| 4 | 0 | -150 | 0 | -50 | 0 | -300 | +200 | 0 | +100 | 0 | +200 | -200 | +300 | -300 | - | - |
| 5 | 0 | -200 | 0 | -50 | 0 | -400 | +200 | -200 | +100 | 0 | +200 | -200 | +400 | -400 | +500 | -500 |
| 7 | 0 | -250 | 0 | -50 | 0 | -500 | +350 | -250 | +150 | 0 | +350 | -250 | +500 | -500 | +600 | -600 |
| 8 | 0 | -300 | 0 | -50 | 0 | -600 | +350 | -250 | +150 | 0 | +350 | -250 | +600 | -600 | +750 | -750 |
| - | 0 | -350 | 0 | -50 | - | - | +350 | -250 | +200 | 0 | - | - | +700 | -700 | +900 | -900 |
| - | 0 | -400 | 0 | -50 | - | - | +400 | -400 | +200 | 0 | - | - | +800 | -800 | +1 000 | -1 000 |
| - | 0 | -450 | - | - | - | - | - | - | - | - | - | - | +900 | -900 | +1 200 | -1 200 |
| - | 0 | -500 | - | - | - | - | - | - | - | - | - | - | +1 000 | -1 000 | +1 200 | -1 200 |
| - | 0 | -750 | - | - | - | - | - | - | - | - | - | - | +1 500 | -1 500 | +1 500 | -1 500 |
| - | 0 | -1 000 | - | - | - | - | - | - | - | - | - | - | +1 500 | -1 500 | +1 500 | -1500 |

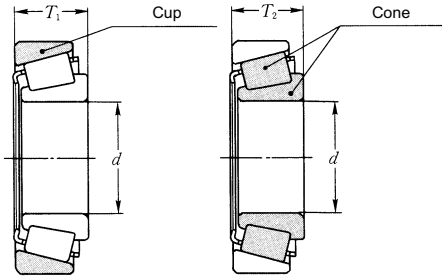
Unit μm

| $S_{ea}$ | $\Delta_{Cs}$ | | |
|---|---|---|---|
| class 4 max | class 0, 6, 5, 4 | class 6X | |
| low | high | low | high |
| 5 | Identical to $\Delta_{Bs}$ | 0 | -100 |
| 5 | inner ring of | 0 | -100 |
| 5 | same bearing | 0 | -100 |
| 6 | | 0 | -100 |
| 7 | | 0 | -100 |
| 8 | | 0 | -100 |
| 10 | | 0 | -100 |
| 13 | | 0 | -100 |
| - | | 0 | -100 |

## Effective width of outer and inner withroller

Unit μm

| Nominal bore diameter $d$ (mm) | | $\Delta_{R1s}$ | | | | $\Delta_{R2s}$ | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | class 0 | | class 6X | | class 0 | | class 6X | |
| over | incl. | high | low | high | low | high | low | high | low |
| 10 | 18 | +100 | 0 | +50 | 0 | +100 | 0 | +50 | 0 |
| 18 | 30 | +100 | 0 | +50 | 0 | +100 | 0 | +50 | 0 |
| 30 | 50 | +100 | 0 | +50 | 0 | +100 | 0 | +50 | 0 |
| 50 | 80 | +100 | 0 | +50 | 0 | +100 | 0 | +50 | 0 |
| 80 | 120 | +100 | -100 | +50 | 0 | +100 | -100 | +50 | 0 |
| 120 | 180 | +150 | -150 | +50 | 0 | +200 | -100 | +100 | 0 |
| 180 | 250 | +150 | -150 | +50 | 0 | +200 | -100 | +100 | 0 |



## Table 3.7 Tolerance of thrust ball bearings

### Inner rings

| Nominal bore diameter $d$ (mm) over | incl. | $\Delta_{dmp}$, $\Delta_{d2mp}$ class 0, 6, 5 high | low | class 4 high | low | $V_{dp}$, $V_{d2D}$ class 0, 6, 5 max | class 4 max | $S_i$[2] class 0 | class 6 max | class 5 max | class 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| - | 18 | 0 | -8 | 0 | -7 | 6 | 5 | 10 | 5 | 3 | 2 |
| 18 | 30 | 0 | -10 | 0 | -8 | 8 | 6 | 10 | 5 | 3 | 2 |
| 30 | 50 | 0 | -12 | 0 | -10 | 9 | 8 | 10 | 6 | 3 | 2 |
| 50 | 80 | 0 | -15 | 0 | -12 | 11 | 9 | 10 | 7 | 4 | 3 |
| 80 | 120 | 0 | -20 | 0 | -15 | 15 | 11 | 15 | 8 | 4 | 3 |
| 120 | 180 | 0 | -25 | 0 | -18 | 19 | 14 | 15 | 9 | 5 | 4 |
| 180 | 250 | 0- | 30 | 0 | -22 | 23 | 17 | 20 | 10 | 5 | 4 |
| 250 | 315 | 0 | -35 | 0 | -25 | 26 | 19 | 25 | 13 | 7 | 5 |
| 315 | 400 | 0 | -40 | 0 | -30 | 30 | 23 | 30 | 15 | 7 | 5 |
| 400 | 500 | 0 | -45 | 0 | -35 | 34 | 26 | 30 | 18 | 9 | 6 |
| 500 | 630 | 0 | -50 | 0 | -40 | 38 | 30 | 35 | 21 | 11 | 7 |

1) The division of double type bearings will be in accordance with divion “d” of single direction tyep bearings corresponding to th identical nominal outer diameter of bearings, not according to division “d2”

### Outer rings

| Nominal outside diameter $D$ (mm) over | incl. | $\Delta_{Dmp}$ class 0, 6, 5 high | low | class 4 high | low | $V_{Dp}$ class 0, 6, 5 max | class 4 max | $S_e$[2] class 0 | class 6 max | class 5 max | class 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 18 | 0 | -11 | 0 | -7 | 8 | 5 | According to the tolerance of $S_1$ against “$d$” or “$d_2$” of the same bearings | | | |
| 18 | 30 | 0 | -13 | 0 | -8 | 10 | 6 | | | | |
| 30 | 50 | 0 | -16 | 0 | -9 | 12 | 7 | | | | |
| 50 | 80 | 0 | -19 | 0 | -11 | 14 | 8 | | | | |
| 80 | 120 | 0 | -22 | 0 | -13 | 17 | 10 | | | | |
| 120 | 180 | 0 | -25 | 0 | -15 | 19 | 11 | | | | |
| 180 | 250 | 0 | -30 | 0 | -20 | 23 | 15 | | | | |
| 250 | 315 | 0 | -35 | 0 | -25 | 26 | 19 | | | | |
| 315 | 400 | 0 | -40 | 0 | -28 | 30 | 21 | | | | |
| 400 | 500 | 0 | -45 | 0 | -33 | 34 | 25 | | | | |
| 500 | 630 | 0 | -50 | 0 | -38 | 38 | 29 | | | | |
| 630 | 800 | 0 | -75 | 0 | -45 | 55 | 34 | | | | |

2) To be applied only for bearings with flat

### Height of bearings center washer

Unit μm

| Nominal bore diameter $d$ (mm) over | incl. | Single direction type $\Delta_{Ts}$ high | low | Double direction type $\Delta_{T1s}$[3] high | low | $\Delta_{T2s}$[3] high | low | $\Delta_{T3s}$[3] high | low |
|---|---|---|---|---|---|---|---|---|---|
| - | 30 | 0 | -75 | +50 | -150 | 0 | -75 | 0 | -50 |
| 30 | 50 | 0 | -100 | +75 | -200 | 0 | -100 | 0 | -75 |
| 50 | 80 | 0 | -125 | +100 | -250 | 0 | -125 | 0 | -100 |
| 80 | 120 | 0 | -150 | +125 | -300 | 0 | -150 | 0 | -125 |
| 120 | 180 | 0 | -175 | +150 | -350 | 0 | 175 | 0 | -150 |
| 180 | 250 | 0 | -200 | +175 | -400 | 0 | -200 | 0 | -175 |
| 250 | 315 | 0 | -225 | +200 | -450 | 0 | -225 | 0 | -200 |
| 315 | 400 | 0 | -300 | +250 | -600 | 0 | -300 | 0 | -250 |
| 400 | 500 | 0 | -350 | - | - | - | - | - | - |
| 500 | 630 | 0 | -400 | - | - | - | - | - | - |

3) To be in accordance with the division “d” of single direction type bearings corresponding to the identical outer diameter of bearings in the same bearings series.

FBJ™

**Table 3.8 Tolerance of sphrical thrust roller bearing**

**Inner rings** Unit μm

| Nominal bore diameter $d$ (mm) | | $\Delta_{dmp}$ | | $V_{dp}$ | $S_d$ | $\Delta_{Ts}$ | |
|---|---|---|---|---|---|---|---|
| over | incl. | high | low | max | max | high | low |
| 50 | 80 | 0 | -15 | 11 | 25 | +150 | -15 |
| 80 | 120 | 0 | -20 | 15 | 25 | +200 | -200 |
| 120 | 180 | 0 | -25 | 19 | 30 | +250 | -250 |
| 180 | 250 | 0 | -30 | 23 | 30 | +300 | -300 |
| 250 | 315 | 0 | -35 | 26 | 35 | +350 | -300 |
| 315 | 400 | 0 | -40 | 30 | 40 | +400 | -400 |
| 400 | 500 | 0 | -45 | 34 | 45 | +450 | -450 |

**Outer ring** Unit μm

| Nominal bore diameter $D$ (mm) | | $\Delta_{Dmp}$ | |
|---|---|---|---|
| over | incl. | high | low |
| 120 | 180 | 0 | -25 |
| 180 | 250 | 0 | -30 |
| 250 | 315 | 0 | -35 |
| 315 | 400 | 0 | -40 |
| 400 | 500 | 0 | -45 |
| 500 | 630 | 0 | -50 |
| 630 | 800 | 0 | -75 |
| 800 | 1 000 | 0 | -100 |