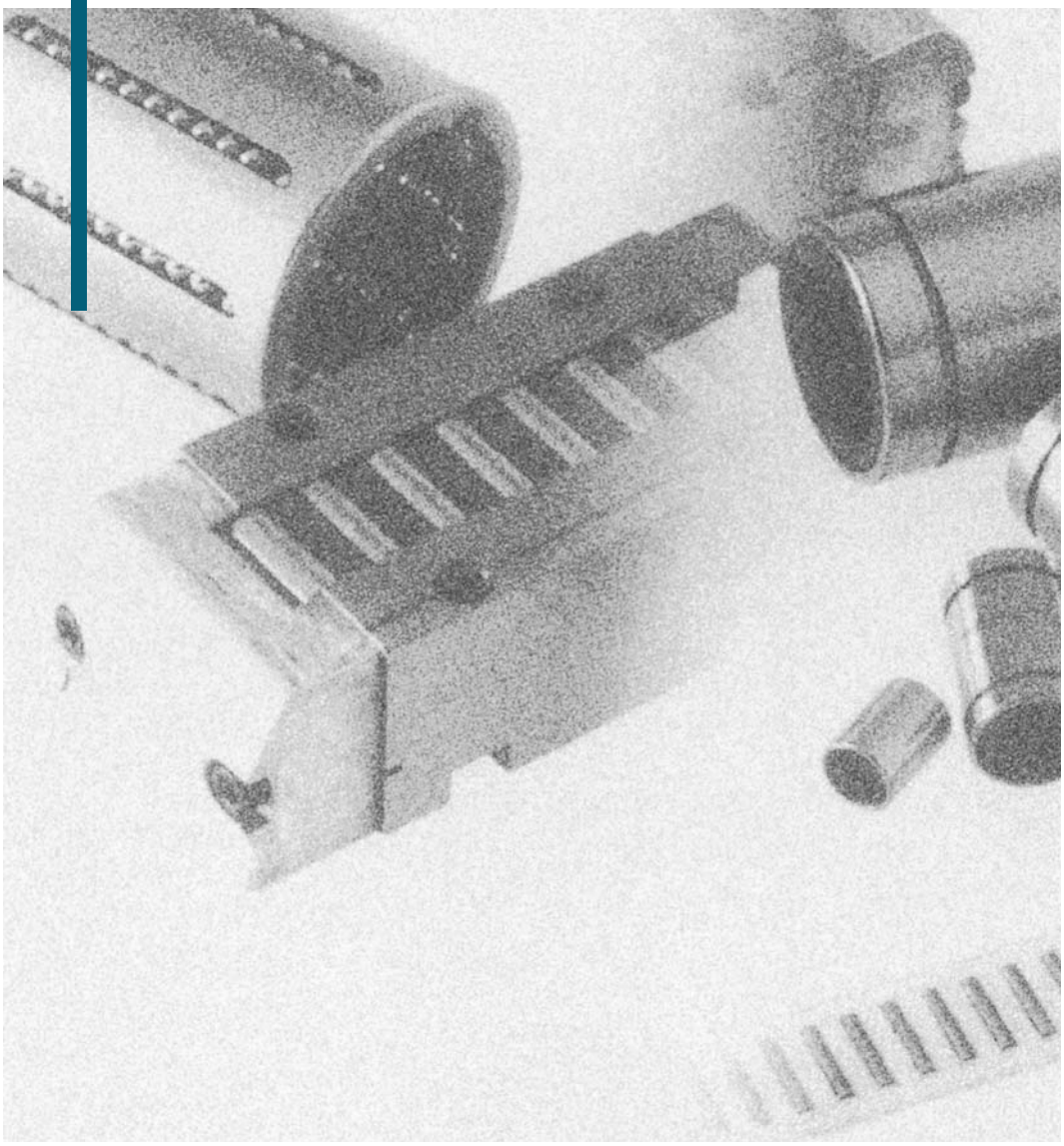
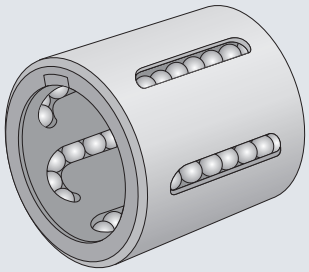
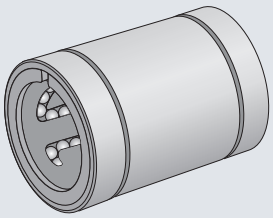
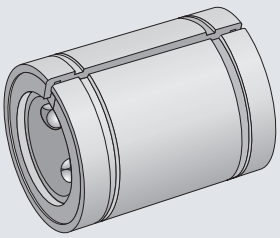
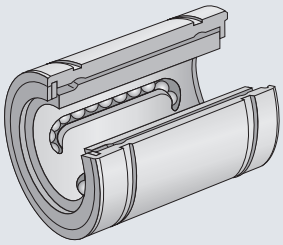
# LINEAR BEARINGS

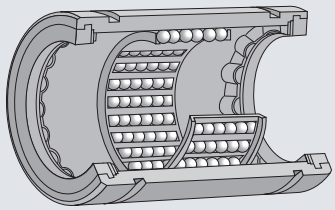
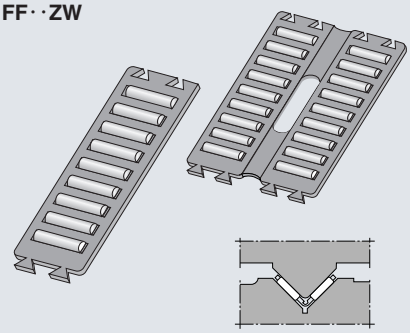
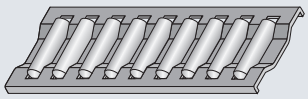
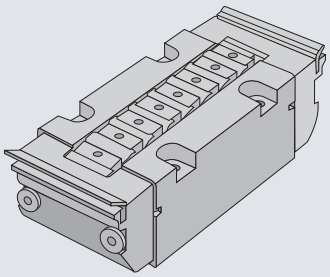
## LINEAR BALL BEARINGS:
## Drawn Cup, Solid, Stroke, Linear Flat Roller, and Linear Roller Bearing Types



# Linear Ball Bearings

| Type | | Applicable shaft diameter (mm) | Composition of bearing number |
|---|---|---|---|
| **KH**<br>  | This type is composed of an outer ring, steel balls and a cage and the outer ring is cylindrical similarly to that of Type KLM and drawn from a steel plate by precision deep drawing, then enabling to design a compact bearing construction of low section and lightweight. This type also ensures precise and smooth infinite linear motion similarly to other types. | $\phi$6—$\phi$50<br>With seal<br>$\phi$10—$\phi$50 | **KH 20 30 LL/3AS**<br>Suffix<br>LL: Seal<br>3AS: Grease code<br>Width<br>Roller set bore diameter<br>Type code |
| **KLM**<br>  | This type composed of an outer ring, steel balls and a cage is a cylindrical bearing for the most universal applications, which ensures precise and smooth infinite linear motion due to its outer ring of high rigidity. | $\phi$3—$\phi$40 | **KLM 06 L/3AS**<br>Suffix<br>LL: Seal<br>3AS: Grease code<br>Roller set bore diameter<br>Type code |
| **KLM··S**<br>  | his type is composed of an outer ring, steel balls and a cage. And both of the outer ring and the cage have an axial slit, as illustrated, so as to enable to shrink the inscribed circle diameter of the cage by pressing the outer ring in radial direction from the housing and to thereby adjust radial clearance from shaft.<br>Thus, this type also ensures precise and smooth infinite linear motion. | $\phi$16—$\phi$40 | **KLM 30 S**<br>Suffix<br>S: Clearance-adjustable<br>Roller set bore diameter<br>Type code |
| **KLM··P**<br>  | This type is composed of an outer ring, steel balls and a cage. And the outer ring and the cage are of arc sectional shape, from which one row of balls (equivalent to 50˚ to 60˚ degree spacing) is removed. Thus, the arc cross-sectional ring and cage with 50˚ to 60˚ degree opening allows the bearing assy to pass through a shaft support truss or a shaft support stand on midway of the shaft stroke.<br>This type also ensures precise and smooth infinite linear motion, similarly to other types.<br>The bearing radial clearance can be also adjusted. | $\phi$16—$\phi$40 | **KLM 30 P LL/3AS**<br>Suffix<br>P: Open configuration<br>LL: Seal<br>3AS: Grease code<br>Roller set bore diameter<br>Type code |

| Components | Infinite motion | Finite motion | Rotating motion | Remarks |
|---|---|---|---|---|
| Roller set bore diameter: $\phi$20<br>Width: 30<br>Seal: Double-side seal<br>Grease: Prefilled | ○ | ○ | × | The cages of the bearing types KLM, KLM, S, KLM,P and KH are all molded from polyamide resin and, therefore, these bearing types shall be used at allowable temperature 120˚C and, under continuous running, at 100˚C and less.<br><br>To avoid deterioration of seal and grease, use a bearing in a temperature range of -20 to 120˚C. For continuous machine operation, limit the maximum permissible operating temperature to 100˚C.<br><br>These bearing types can't rotate. |
| Roller set bore diameter: $\phi$6<br>Seal: Single-side seal<br>Grease: Prefilled | ○ | ○ | × | |
| Roller set bore diameter: $\phi$30<br>Type: Clearance-adjustable type | ○ | ○ | × | |
| Roller set bore diameter: $\phi$30<br>Type: Open type<br>Seal: Double-side seal<br>Grease: Prefilled | ○ | ○ | × | |

| Type | | Applicable shaft diameter (mm) | Composition of bearing number |
|---|---|---|---|
| **KD**<br>  | This type composed of an outer ring, steel balls and a cage is a cylindrical bearing for the most universal applications, which ensures precise and smooth infinite linear motion due to its outer ring of high rigidity. | Shaft diameter<br>$\phi$10—$\phi$80 | **KD 20 32 45 LL/3AS**<br>Suffix<br>LL: Seal<br>3AS: Grease<br>Width<br>Outer diameter<br>Roller set bore diameter<br>Type code |
| **FF**<br>**FF··ZW**<br>  | This type composed of a cage and needle rollers ensures smooth reciprocating motion of less friction actor by being inserted between two planes in relative position. The cage made of polyamide resin is provided with grooved joint at its both ends so several cages can be jointed together into one unit. | Roller diameter<br>$\phi$2—$\phi$3.5 | **FF 25 18 ZW**<br>Suffix<br>ZW: Double row<br>Width<br>Roller diameter ×10<br>Type code |
| **BF（RF）**<br>  | This type composed of a cage and needle rollers ensures smooth reciprocating motion of less friction factor by being inserted between two planes in relative position. Press-formed steel plate cage (BF) and polyamde resin cage (RF) are selectively available. However, in the case of this bearing type several bearings can't not be jointed together into one unit. | Roller diameter<br>$\phi$3—$\phi$7 | **BF 30 20 / 1000**<br>Cage overall length<br>Width<br>Roller diameter ×10<br>Type code |
| **RLM**<br>  | This type is composed of a track frame, a separator and rollers. This type has the function enabling cylindrical rollers to circulate within the track frame and ensures infinite linear motion on a plane. | Section height<br>16—38 | **RLM 26 × 86**<br>Bearing overall length<br>Section height<br>Type code |

| Components | Infinite motion | Finite motion | Rotating motion | Remarks |
|---|---|---|---|---|
| Roller set bore diameter: $\phi$20<br>Outer diameter: f32<br>Width: 45<br>Seal: Double-side seal<br>Grease: Prefilled | × | ○ | ○ | To avoid deterioration of seal and grease, use a bearing in a temperature range of -20 to 120°C. For continuous machine operation, limit the maximum permissible operating temperature to 100˚C. |
| Roller diameter: $\phi$2.5<br>Width: 18<br>ZW: Double-row type<br>Number of rows: Two | ○ | ○ | × | Due to its resin cage, this bearing shall be used at allowable temperature 90˚C and, under continuous running, at 80˚C and less. The double-row type has an elastic joint on the cage center so double rows of flat rollers can be bent to any optional angle along the elastic joint by heating them in oil of 70 to 90˚C. By cooling down the double-row rollers with the bent angle held unchanged for several seconds after having bent them to any optional angle, the bent shape of the double rows can be held unchanged so that the double-row rollers can be mounted on a V-shaped surface as illustrated. |
| Roller diameter: $\phi$3<br>Width: 20<br>Cage length: 1000 | ○ | ○ | × | Where the resin cage RF is used, the bearing shall be used at allowable temperature 90˚C and, under continuous running, at 80˚C and less.<br><br>The standard length of the bearing unit with BF cage is 1000 mm.<br>The standard length of the bearing unit with RF cage is 705 mm.<br>Two or more bearings of this type can't be jointed with each other, but it can be supplied at any desired length on request. |
| Section height: 26<br>Bearing overall length: 86 | ○ | ○ | × | |

# Linear Ball Bearings, Drawn Cup and Solid Types

Four to nine rows of balls are configured equally in the outer ring (outer cylinder). The ball rows circulate in axial direction while being guided by the cage. Thus, these bearing types move infinitely on a shaft in axial direction. However, these bearing types can't rotate.

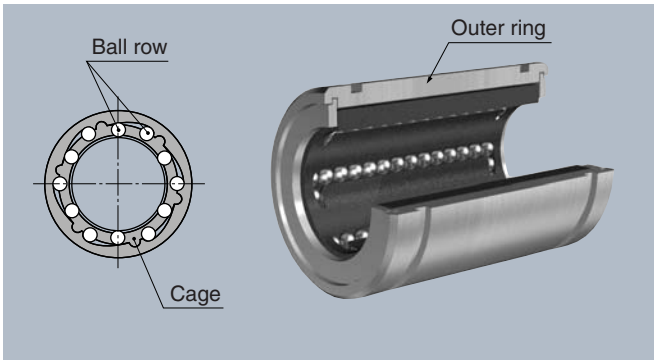



**Fig. 1**

## Dimensional accuracy

Because of its thin-walled outer ring, the **Type KH** (drawn cup type) unavoidably develops certain degree of deformation in various manufacturing steps, in particular in the heat treatment process. Nevertheless, this bearing type has been designed so that when press-fitted into a housing of accurate dimensions, its deformation is corrected and it can restore its original accuracy to fully develop its design functions. For a method for determining dimensional accuracy of this bearing, contact **NTN** Engineering for technical assistance.

The dimensional accuracies in boundary dimensions, ball set bore diameter ($F_w$), outside diameter ($D$) and width ($C$) of the **Type KLM** (solid type) are listed in the relevant dimension table. Upon request, **NTN** will supply linear ball bearing products for higher accuracy. For details, contact **NTN** Engineering.

## Bearing fit

By employing a shaft or housing featuring dimensional tolerance in **Table 1** in this page, an appropriate radial internal clearance can be provided in the installed bearing. When a further smaller radial internal clearance is needed, achieve selective fit to obtain an intended radial internal clearance by selecting a relevant bearing-shaft or bearing-housing combination.

**Table 1 Bearing fit**

| Type | Shaft | Housing |
|---|---|---|
| series HK<br>Drawn-cup type | h6 (j5) | H7 (H6) - steel series -<br>K7 (K6) - light metal alloy series - |
| series KLM<br>Solid type | g6 (g5) | H7 (H6) |

Note) The parenthesized data is applied to shaft/housing subjected to higher accuracy or of vertical construction.

## Shaft and housing requirements

Any shaft /housing on/in which these bearing types are fitted must meet the requirements specified in **Table 2**.

**Table 2 Shaft and housing requirements (recommended)**

| Characteristics | Shaft | Housing |
|---|---|---|
| Roundness (max) | IT3 | IT4 |
| Cylindricity (max) | IT2 | IT4 |
| Surface roughness (max.) | 0.4a | 1.6a |
| Surface hardness | HRC58～64 | — |
| Case depth (min) | 0.4mm | — |

## How to mount

**The Type KH** (drawn cup) bearing is press-fitted into the housing in interference fit mode: therefore this type of bearing does not need axial positioning with a means such as a snap ring. For press-fitting, force the marking side on the outer ring with a mandrel illustrated in **Fig. 2**.

The **Type KLM** (solid type) cannot be locked to the housing by interference alone. This type of bearing needs to be axially located with a snap ring.

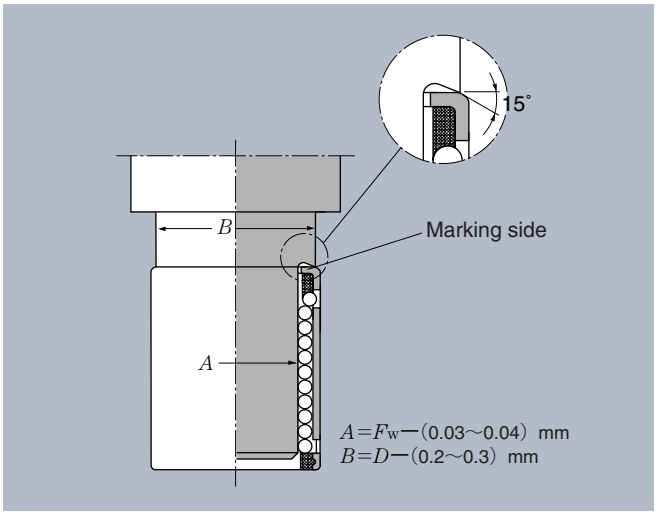
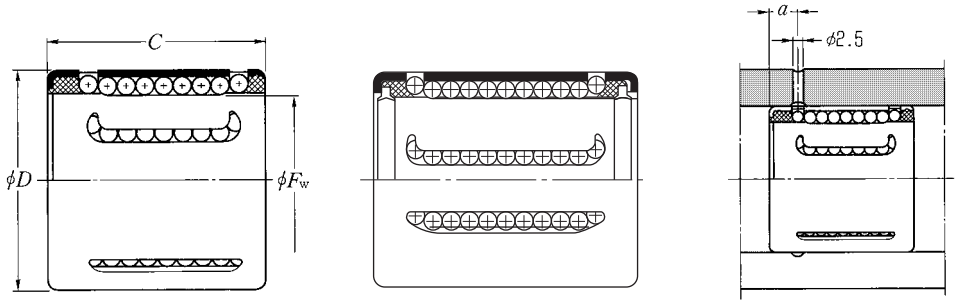



**Fig. 2 Series KH**

## Accessories

Shafts, shaft support stands and housings exclusive for **NTN** linear ball bearings are also offerable. Feel free to contact **NTN** for the detailed information.

## Type KH
## Type KH··LL



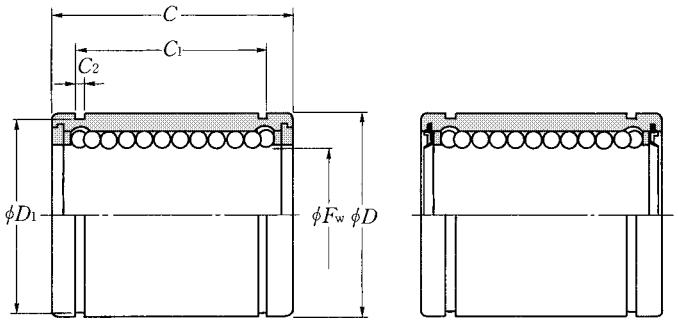

With seal

$F_w$ 6～50mm

| Boundary dimensions mm | | | | Bearing numbers | Basic load ratings dynamic N | static N | dynamic kgf | static kgf | Number of ball rows | Mass kg |
|---|---|---|---|---|---|---|---|---|---|---|
| $F_w$ | $D$ | $C$ | $a$[1] | | $C_r$ | $C_{or}$ | $C_r$ | $C_{or}$ | | (approx.) |
| **6** | 12 | 22 | 4 | **KH0622**[2] | 380 | 225 | 39 | 23 | 4 | 0.007 |
| **8** | 15 | 24 | 5 | **KH0824**[2] | 420 | 255 | 43 | 26 | 4 | 0.012 |
| **10** | 17 | 26 | 5 | **KH1026**[2] | 480 | 325 | 49 | 33 | 4 | 0.015 |
| **12** | 19 | 28 | 6 | **KH1228** | 605 | 495 | 62 | 51 | 5 | 0.018 |
| | 19 | 28 | 6 | **KH1228LL/3AS** | 605 | 495 | 62 | 51 | 5 | 0.018 |
| **14** | 21 | 28 | 6 | **KH1428** | 600 | 505 | 61 | 51 | 5 | 0.021 |
| **16** | 24 | 30 | 7 | **KH1630** | 775 | 600 | 79 | 61 | 5 | 0.027 |
| | 24 | 30 | 7 | **KH1630LL/3AS** | 775 | 600 | 79 | 61 | 5 | 0.027 |
| **20** | 28 | 30 | 7 | **KH2030** | 1 050 | 880 | 107 | 90 | 6 | 0.033 |
| | 28 | 30 | 7 | **KH2030LL/3AS** | 1 050 | 880 | 107 | 90 | 6 | 0.033 |
| **25** | 35 | 40 | 8 | **KH2540** | 1 930 | 1 560 | 196 | 159 | 6 | 0.066 |
| | 35 | 40 | 8 | **KH2540LL/3AS** | 1 930 | 1 560 | 196 | 159 | 6 | 0.066 |
| **30** | 40 | 50 | 8 | **KH3050** | 2 700 | 2 450 | 275 | 250 | 7 | 0.095 |
| | 40 | 50 | 8 | **KH3050LL/3AS** | 2 700 | 2 450 | 275 | 250 | 7 | 0.095 |
| **40** | 52 | 60 | 9 | **KH4060** | 4 250 | 4 000 | 435 | 410 | 8 | 0.18 |
| **50** | 62 | 70 | 9 | **KH5070** | 5 300 | 5 700 | 540 | 580 | 9 | 0.24 |

Note 1) Showing a-value from the side face with stamped mark thereon.
2) Imported product from INA, Germany.

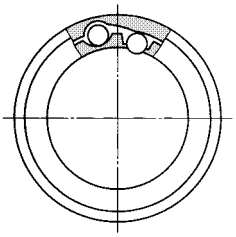
**Type KLM** **Type KLM··LL**
**Type KLM··S** **Type KLM··SLL**
**Type KLM··P** **Type KLM··PLL**



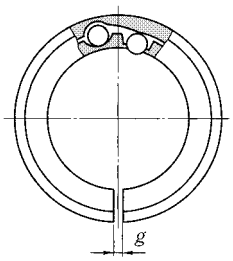

With seal

$F_W$ 3～35mm

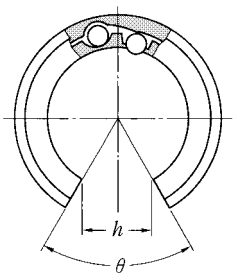
| Boundary dimensions mm | | | | | | | | | Basic load ratings N | | kgf | | Bearing numbers | Number of ball rows | Mass kg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $F_W$ | $D$ | $C$ | $C_1$ ±0.240 | $C_2$ | $D_1$ | $g$ | $h$ | $\theta$ | dynamic $C_r$ | static $C_{or}$ | dynamic $C_r$ | static $C_{or}$ | | | (approx.) |
| 3 $^{0}_{-0.008}$ | 7 $^{0}_{-0.010}$ | 10 $^{0}_{-0.120}$ | — | — | — | — | — | — | 51 | 40 | 5 | 4 | KLM03 | 4 | 0.002 |
| 4 $^{0}_{-0.008}$ | 8 $^{0}_{-0.010}$ | 12 $^{0}_{-0.120}$ | — | — | — | — | — | — | 71 | 52 | 7 | 5 | KLM04 | 4 | 0.003 |
| 5 $^{0}_{-0.009}$ | 10 $^{0}_{-0.010}$ | 15 $^{0}_{-0.120}$ | — | — | — | — | — | — | 118 | 90 | 12 | 9 | KLM05 | 4 | 0.005 |
| 6 $^{0}_{-0.009}$ | 12 $^{0}_{-0.010}$ | 19 $^{0}_{-0.120}$ | 13.3 | 1.1 | 11.5 | — | — | — | 130 | 107 | 13 | 11 | KLM06 | 4 | 0.009 |
| 8 $^{0}_{-0.009}$ | 15 $^{0}_{-0.010}$ | 17 $^{0}_{-0.120}$ | 11.3 | 1.1 | 14.3 | — | — | — | 115 | 94 | 12 | 9 | KLM08 | 4 | 0.012 |
| | 15 $^{0}_{-0.010}$ | 24 $^{0}_{-0.120}$ | 17.3 | 1.1 | 14.3 | — | — | — | 234 | 188 | 24 | 19 | KLM08-1 | 4 | 0.017 |
| 10 $^{0}_{-0.009}$ | 19 $^{0}_{-0.012}$ | 29 $^{0}_{-0.120}$ | 21.7 | 1.3 | 18 | — | — | — | 440 | 297 | 45 | 30 | KLM10 | 4 | 0.028 |
| 12 $^{0}_{-0.009}$ | 22 $^{0}_{-0.012}$ | 32 $^{-0}_{-0.120}$ | 22.7 | 1.3 | 21 | — | — | — | 545 | 455 | 55 | 46 | KLM12 | 5 | 0.042 |
| 13 $^{0}_{-0.009}$ | 23 $^{0}_{-0.012}$ | 32 $^{0}_{-0.120}$ | 22.7 | 1.3 | 22 | — | — | — | 540 | 455 | 55 | 46 | KLM13 | 5 | 0.045 |
| 16 $^{0}_{-0.009}$ | 28 | 37 | 26.5 | 1.6 | 27 | — | — | — | 995 | 805 | 102 | 82 | KLM16 | 5 | 0.075 |
| | 28 $^{0}_{-0.012}$ | 37 $^{0}_{-0.120}$ | 26.5 | 1.6 | 27 | 0.6 | — | — | 995 | 805 | 102 | 82 | KLM16S | 5 | 0.075 |
| | 28 | 37 | 26.5 | 1.6 | 27 | — | 8.2 | 60° | 995 | 805 | 102 | 82 | KLM16P | 4 | 0.062 |
| 20 $^{0}_{-0.010}$ | 32 | 42 | 30.3 | 1.6 | 30.5 | — | — | — | 1 320 | 1 150 | 135 | 117 | KLM20 | 6 | 0.10 |
| | 32 $^{0}_{-0.014}$ | 42 $^{0}_{-0.120}$ | 30.3 | 1.6 | 30.5 | 0.6 | — | — | 1 320 | 1 150 | 135 | 117 | KLM20S | 6 | 0.10 |
| | 32 | 42 | 30.3 | 1.6 | 30.5 | — | 8.6 | 50° | 1 320 | 1 150 | 135 | 117 | KLM20P | 5 | 0.085 |
| 25 $^{0}_{-0.010}$ | 40 | 59 | 40.7 | 1.85 | 38 | — | — | — | 2 560 | 2 340 | 261 | 238 | KLM25 | 6 | 0.22 |
| | 40 $^{0}_{-0.014}$ | 59 $^{0}_{-0.120}$ | 40.7 | 1.85 | 38 | 0.6 | — | — | 2 560 | 2 340 | 261 | 238 | KLM25S | 6 | 0.22 |
| | 40 | 59 | 40.7 | 1.85 | 38 | — | 10.8 | 50° | 2 560 | 2 340 | 261 | 238 | KLM25P | 5 | 0.19 |
| 30 $^{0}_{-0.010}$ | 45 | 64 | 44.2 | 1.85 | 43 | — | — | — | 2 540 | 2 370 | 259 | 241 | KLM30 | 6 | 0.26 |
| | 45 $^{0}_{-0.014}$ | 64 $^{0}_{-0.120}$ | 44.2 | 1.85 | 43 | 0.6 | — | — | 2 540 | 2 370 | 259 | 241 | KLM30S | 6 | 0.26 |
| | 45 | 64 | 44.2 | 1.85 | 43 | — | 13.0 | 50° | 2 540 | 2 370 | 259 | 241 | KLM30P | 5 | 0.22 |
| 35 $^{0}_{-0.012}$ | 52 | 70 | 49.2 | 2.2 | 49 | — | — | — | 3 650 | 3 350 | 375 | 340 | KLM35 | 6 | 0.40 |
| | 52 $^{0}_{-0.017}$ | 70 $^{0}_{-0.120}$ | 49.2 | 2.2 | 49 | 1.2 | — | — | 3 650 | 3 350 | 375 | 340 | KLM35S | 6 | 0.40 |
| | 52 | 70 | 49.2 | 2.2 | 49 | — | 15.1 | 50° | 3 650 | 3 350 | 375 | 340 | KLM35P | 5 | 0.34 |



Type KLM
(Standard type)




Type KLM··S
(Clearance-adjustable type)




Type KLM··P
(Open type)

## $F_W$ 40mm

| Boundary dimensions mm | | | | | | | | | Basic load ratings dynamic N | static N | dynamic kgf | static kgf | Bearing numbers | Number of ball rows | Mass kg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $F_W$ | $D$ | $C$ | $C_1$ ±0.300 | $C_2$ | $D_1$ | $g$ | $h$ | $\theta$ | $C_r$ | $C_{or}$ | $C_r$ | $C_{or}$ | | | (approx.) |
| **40** $^{0}_{-0.012}$ | 60 $^{0}_{-0.017}$ | 80 $^{0}_{-0.120}$ | 60.3 | 2.1 | 57 | — | — | — | 3 950 | 3 750 | 400 | 380 | **KLM40** | 6 | 0.62 |
| | 60 $^{0}_{-0.017}$ | 80 $^{0}_{-0.120}$ | 60.3 | 2.1 | 57 | 1.2 | — | — | 3 950 | 3 750 | 400 | 380 | **KLM40S** | 6 | 0.62 |
| | 60 $^{0}_{-0.017}$ | 80 $^{0}_{-0.120}$ | 60.3 | 2.1 | 57 | — | 17.2 | 50° | 3 950 | 3 750 | 400 | 380 | **KLM40P** | 5 | 0.53 |

# Linear Ball Bearings, Stroke Type

The bearing cage with multiple ball rows (several balls per row) configured circumferentially therein can move within the outer ring in both circumferential and axial directions. Thus, this bearing type can rotate and reciprocate (but at a limited stroke) on a shaft.

## Bearing construction

Maximum available length of the reciprocal stroke is two times as long as the stroke at which the cage can reciprocate within the outer ring. The outer ring is provided at its both ends with a snap ring acting as a stopper and a wave spring is provided between the snap ring and the cage to damp a shock acting on the cage as well as to prevent wear of the cage.

In addition to the standard type, a special type with synthetic rubber seal (Tail code: **LL**) on the both ends of its outer ring is also available.

## Dimensional accuracy of Bearing

**Table 1** the bearing tolerance.

**Table 1 Dimensional accuracy**

| Characteristics | Dimensional tolerance |
|---|---|
| Ball inscribed circle diameter ($F_w$)<br>Outer ring outer diameter ($D$) | F6<br>h5 |

## Bearing fit and radial internal clearance

Linear ball bearings need to be used with minimum possible radial internal clearance. In particular, when a linear bearing is used on a vertical shaft or higher accuracy is needed, it is desirable to combine a bearing with a selected shaft and use the bearing-shaft combination with a radial internal clearance in a range of 0 to -5 mm (guideline).

**Table 2** shows the bearing fits on shaft and in housing.

**Table 2 Bearing fits (recommended)**

| Operating conditions | Shaft | Housing |
|---|---|---|
| Usual operating conditions | k5 (m5) | H6 (H7) |
| Vertical shaft and high accuracy applications | n5 (p5)❶ | J6 (J7) |

❶ Selective fit

## Shaft and housing requirements

**Table 3** specifies the requirements for shaft and housing which of the outer surfaces are used as the direct raceway.

**Table 3 Shaft and housing requirements (recommended)**

| Characteristics | Shaft | Housing |
|---|---|---|
| Roundness (max) | IT2 | IT4 |
| Cylindricality (max) | IT2 | IT4 |
| Surface roughness (max) | 0.2a | 1.6a |
| Surface hardness | HRC58～64 | — |
| Hardened layer depth (min) | 0.4mm | — |

## How to mount

This bearing type can't be fixed perfectly to a housing with interference only and, therefore, it is fixed in axial direction using a snap ring. (Refer to **Fig. 1**)

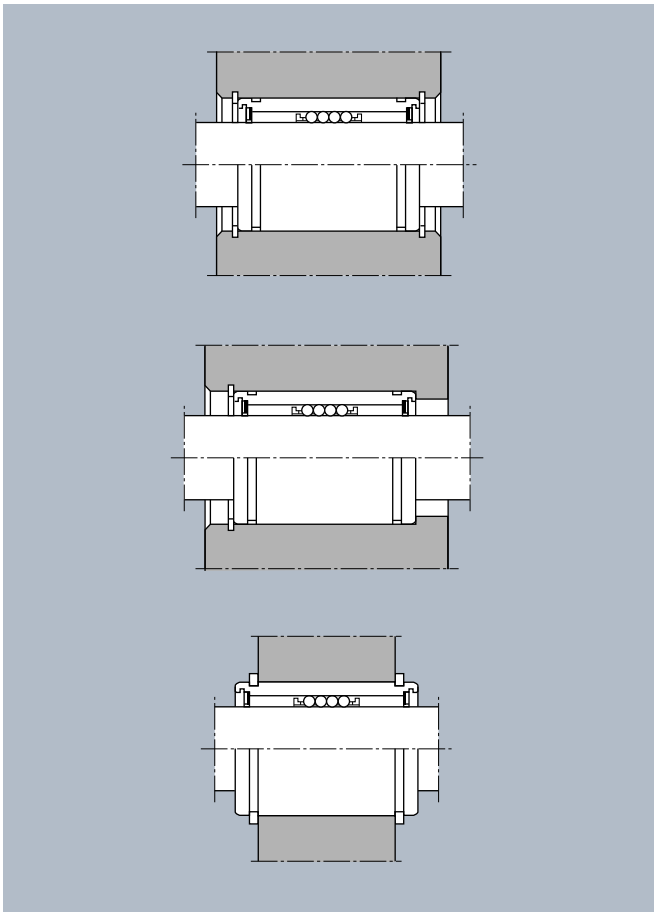


**Fig. 1 Axial fixing of bearing**

For adjusting the cage so it locates at the outer ring center after a shaft was mounted, push the cage in the arrow direction in **Fig. 2** by inserting the shaft into the outer ring that was press-fitted in the housing. (**Fig. 2**)

In this condition, insert slowly the shaft up to the center point of the reciprocating stroke and, thereafter, further push-in the shaft by 1/2 of the stroke. (**Fig. 3**) Then, return the shaft by 1/2 of the stroke to thereby locate the cage at the outer ring center and the shaft at the center point of the reciprocating stroke. (**Fig. 4**)

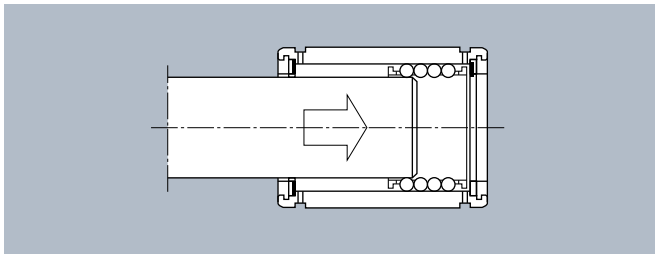


**Fig. 2**

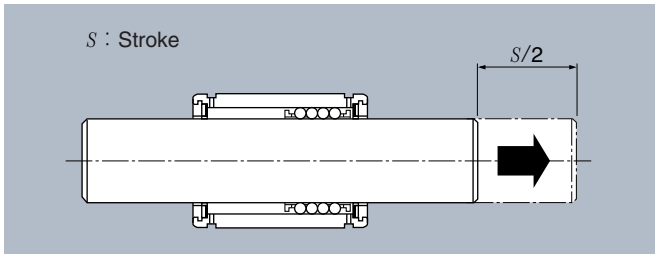



**Fig. 3**

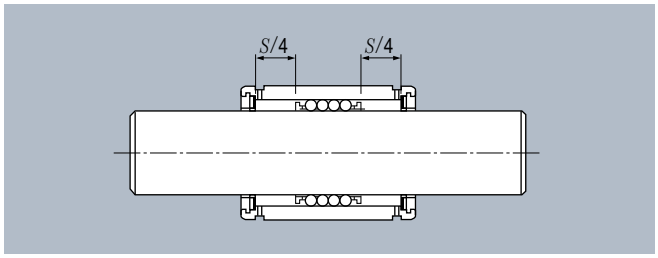
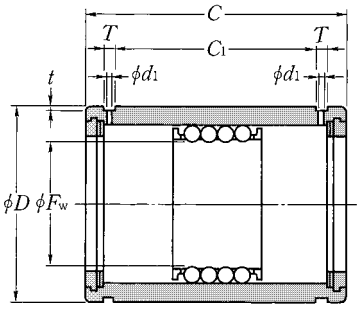



**Fig. 4**

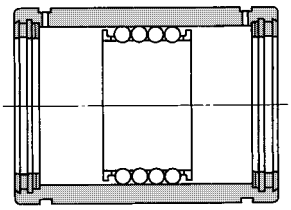
**The outer ring must be press-fitted so its grease feed hole locates at load non-acting side.**

**Where moment load acts on a bearing due to use of a vertical shaft, the load could act on the grease feed hole. Caution it.**

## Type KD
## Type KD··LL




Type KD
(Open type)



Type KD··LL
(With seal)

$F_w$ 10～80mm

| Boundary dimensions mm | | | | | | | | | | Bearing numbers | | Basic load ratings N | | | | Mass (approx.) kg | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Type KD | | Type KD··LL | | | | dynamic | static | dynamic | static | | |
| $F_w$ F6 | $D$ h5 | $C$ 1) | $T$ | $t$ | $d_1$ | $C_1$ | Max. stroke | $C_1$ | Max. stroke | Type KD | Type KD··LL | $C_r$ | $C_{or}$ | $C_r$ | $C_{or}$ | Type KD | Type KD··LL |
| **10** | 19 | 30 | 1.7 | 0.4 | 1.5 | 22.7 | 27 | 15.5 | 19 | **KD101930** | **KD101930LL/3AS** | 720 | 535 | 74 | 55 | 0.028 | 0.030 |
| **12** | 23 | 32 | 1.7 | 0.4 | 1.5 | 24.5 | 30 | 17.1 | 22 | **KD122332** | **KD122332LL/3AS** | 920 | 725 | 94 | 74 | 0.052 | 0.055 |
| **16** | 28 | 37 | 1.7 | 0.5 | 1.5 | 29.1 | 33 | 21.1 | 26 | **KD162837** | **KD162837LL/3AS** | 1 480 | 1 070 | 151 | 109 | 0.073 | 0.078 |
| **20** | 32 | 45 | 2.2 | 0.5 | 2 | 35.8 | 55 | 26.8 | 46 | **KD203245** | **KD203245LL/3AS** | 1 670 | 1 230 | 171 | 125 | 0.100 | 0.105 |
| **25** | 37 | 45 | 2.2 | 0.6 | 2 | 35.8 | 55 | 26.8 | 46 | **KD253745** | **KD253745LL/3AS** | 1 890 | 1 410 | 192 | 144 | 0.115 | 0.120 |
| **30** | 45 | 65 | 2.7 | 0.7 | 2.5 | 53.5 | 81 | 45.1 | 73 | **KD304565** | **KD304565LL/3AS** | 3 800 | 3 100 | 390 | 315 | 0.265 | 0.265 |
| **35** | 52 | 70 | 2.7 | 0.7 | 2.5 | 58.5 | 90 | 50.1 | 79 | **KD355270** | **KD355270LL/3AS** | 4 200 | 3 500 | 430 | 355 | 0.405 | 0.405 |
| **40** | 60 | 80 | 2.7 | 0.7 | 2.5 | 68.3 | 103 | 59.9 | 93 | **KD406080** | **KD406080LL/3AS** | 5 900 | 4 750 | 600 | 485 | 0.635 | 0.635 |
| **45** | 65 | 80 | 2.7 | 0.7 | 2.5 | 68.3 | 103 | 59.9 | 93 | **KD456580** | **KD456580LL/3AS** | 6 400 | 5 300 | 655 | 540 | 0.675 | 0.680 |
| **50** | 72 | 100 | 3.2 | 1 | 3 | 86.4 | 136 | 77.4 | 125 | **KD5072100** | **KD5072100LL/3AS** | 8 500 | 6 850 | 870 | 695 | 1.00 | 1.02 |
| **55** | 80 | 100 | 3.2 | 1 | 3 | 86.4 | 136 | 77.4 | 125 | **KD5580100** | **KD5580100LL/3AS** | 9 200 | 7 550 | 940 | 770 | 1.34 | 1.36 |
| **60** | 85 | 100 | 3.2 | 1 | 3 | 86.4 | 136 | 77.4 | 122 | **KD6085100** | **KD6085100LL/3AS** | 9 900 | 8 250 | 1 010 | 840 | 1.41 | 1.43 |
| **70** | 95 | 100 | 3.2 | 1 | 3 | 86.4 | 136 | 77.4 | 122 | **KD7095100** | **KD7095100LL/3AS** | 10 600 | 9 000 | 1 080 | 920 | 1.61 | 1.63 |
| **80** | 110 | 100 | 3.2 | 1.2 | 3 | 86 | 129 | 77 | 116 | **KD80110100** | **KD80110100LL/3AS** | 13 300 | 10 900 | 1 350 | 1 110 | 2.37 | 2.40 |

Note 1) The tolerance for dimension-$C$ is 0, -0.120 mm against $F_w \leqq 50$ mm and 0, -0.150 mm against $F_w > 50$ mm.

# Linear Flat Rollers

## Linear Flat Rollers

This bearing type composed of a needle roller and flat cage assembly (needle rollers are configured in the flat cage) ensures smooth reciprocating motion with less friction coefficient.

## Types

For **Type FF**, the polyamide resin cage has a dovetail joint groove on its both ends so that several cages can be jointed together into one unit.

For **Type FF··ZW**, two rows of needle rollers are configured in the cage and the cage has an elastic joint on its center so as to enable to bend two rows of flat rollers to any optional angle at the elastic joint by heating them in oil of 70 to 90˚C. The two roller rows bent to any optional angle can hold the bent shape unchanged, even under normal operating temperature, by being cooled down for several seconds, with the bending angle held unchanged.

For **Type BF**, the cage is press-formed from steel plate and the standard length of the bearing unit is 1000 mm. For **Type RF**, the cage is of polyamide resin and the standard length of the bearing unit is 705 mm. The both are unavailable for cage to cage inter-jointing, but a bearing unit of any desired length is offerable upon request. Feel free to contact **NTN** for the detailed information.

## Needle roller tolerance

The needle rollers contained in the flat roller cage are manufactured within the dimensional tolerance range of 0 to -2 mm against the nominal diameter ($D_w$).

## Raceway surface requirements

**Table 1** shows the requirements for raceway surface applied to the linear flat roller bearings.

**Table 1 Raceway surface requirements (recommended)**

| Characteristics | Tolerance |
|---|---|
| Surface roughness (max) | 0.2a |
| Surface hardness ❶ | HRC58～64 |
| Effective hardened layer depth (min) | 0.4mm |
| Mounting accuracy (max)❷ | 0.1 mm per 1000 mm |

❶ Where raceway surface hardening not allowed, a quenched spring plate may be used.

❷ Mounting accuracy is expressed with an inclination value in **Fig. 1.**

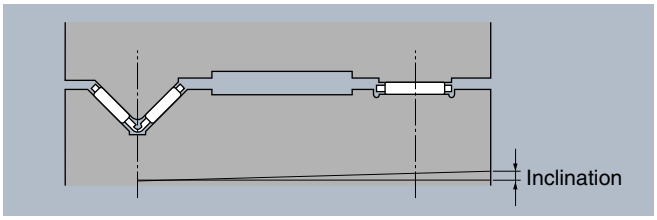



**Fig. 1**

## How to mount

Theoretically the linear flat roller bearing moves by 1/2 of table moving stroke in same direction as the table moving direction. The relationship of bed length ($L$) - stroke ($S$) - cage length ($L_1$) can be expressed in **formula (1)**. (**Fig. 2**)

$$L=S/2+L_1 \quad \cdots\cdots (1)$$

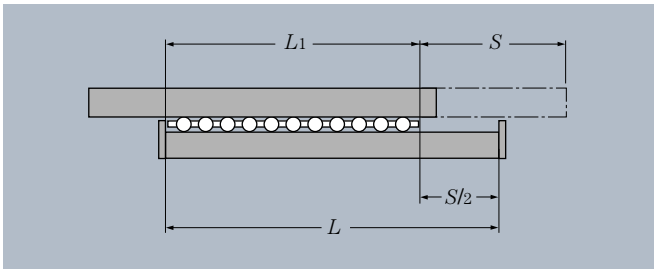



**Fig. 2**

The linear flat roller bearing results in moving deviation due to profile deviation of raceway surface, uneven load or vibration. Therefore, the table or the bed must be equipped with a stopper at its end portion to prevent over-run of the flat roller bearing. (**Fig. 5**)

**Figs. 3** and **4** illustrate application examples of the linear flat roller bearing unit.

If a separate raceway surface having undergone heat treatment and grinding is installed to a machine main body, be careful to avoid deformation of the bearing that can result from tightening.

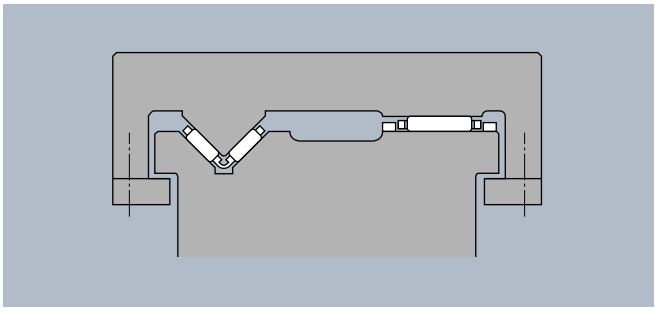


**Fig. 3 General application**

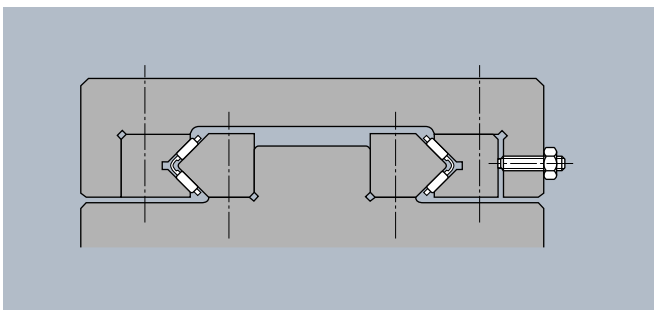


**Fig. 4 When overhung load acts on**

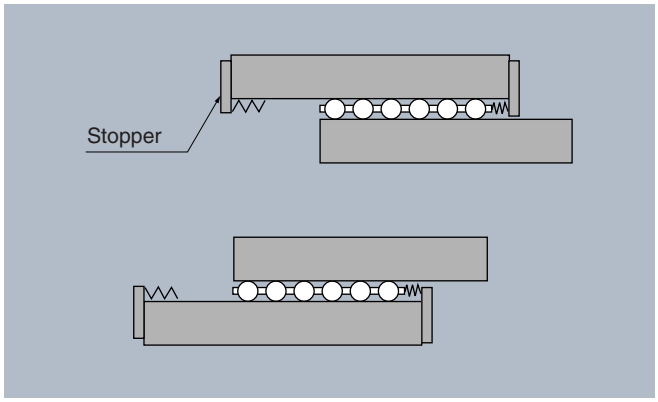
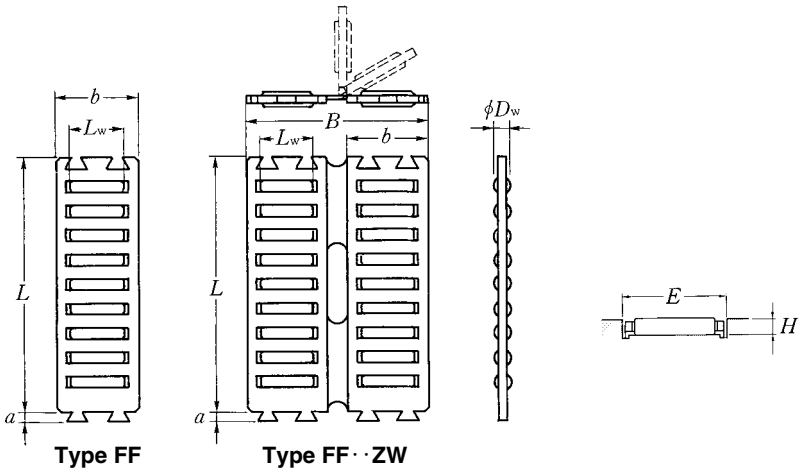



Fig. 5

## Type FF
## Type FF··ZW



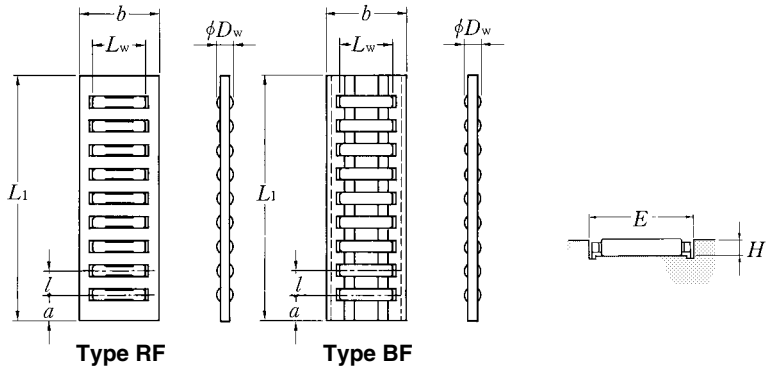

Type FF　　Type FF··ZW

$D_w$ 2～3.5mm

| Boundary dimensions mm | | | | | | Basic load ratings N dynamic | static | kgf dynamic | static | Bearing numbers | Number of rolls | Abutment dimensions mm | | Mass kg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $D_w$[1)] | $b$ | $B$ | $L$ | $L_w$ | $a$ | $C_r$ | $C_{or}$ | $C_r$ | $C_{or}$ | | | $E$ | $H$ | (approx.) |
| **2** | 10 | — | 32 | 6.8 | 2 | 8 500 | 19 700 | 865 | 2 010 | **FF2010** | 7 | $10.3^{+0.1}_{0}$ | $1.7^{0}_{-0.2}$ | 0.0020 |
| **2** | 10 | 25 | 32 | 6.8 | 2 | 15 500 | 39 500 | 1 580 | 4 000 | **FF2025ZW** | 14 | $25.3^{+0.1}_{0}$ | $1.7^{0}_{-0.2}$ | 0.0043 |
| **2.5** | 15 | — | 45 | 9.8 | 2.4 | 17 100 | 41 400 | 1 740 | 4 200 | **FF2515** | 8 | $15.3^{+0.1}_{0}$ | $2.2^{0}_{-0.2}$ | 0.0038 |
| **2.5** | 15 | 35 | 45 | 9.8 | 2.4 | 29 300 | 82 500 | 2 980 | 8 450 | **FF2535ZW** | 16 | $35.3^{+0.1}_{0}$ | $2.2^{0}_{-0.2}$ | 0.0082 |
| **3** | 20 | — | 60 | 13.8 | 3 | 31 000 | 79 500 | 3 150 | 8 100 | **FF3020** | 9 | $20.4^{+0.1}_{0}$ | $2.7^{0}_{-0.2}$ | 0.0089 |
| **3** | 20 | 45 | 60 | 13.8 | 3 | 53 500 | 159 000 | 5 450 | 16 200 | **FF3045ZW** | 18 | $45.4^{+0.1}_{0}$ | $2.7^{0}_{-0.2}$ | 0.019 |
| **3.5** | 25 | — | 75 | 17.8 | 3.2 | 50 000 | 132 000 | 5 100 | 13 500 | **FF3525** | 10 | $25.4^{+0.1}_{0}$ | $3.2^{0}_{-0.2}$ | 0.017 |
| **3.5** | 25 | 55 | 75 | 17.8 | 3.2 | 86 000 | 265 000 | 8 800 | 27 000 | **FF3555ZW** | 20 | $55.4^{+0.1}_{0}$ | $3.2^{0}_{-0.2}$ | 0.035 |

Note 1) The dimensional tolerance for needle roller diameter $D_w$ is 0 to -2 $\mu$m.

## Type BF
## Type RF




Type RF　　Type BF

$D_w$ 3～7mm

| Boundary dimensions mm | | | | | | Basic load ratings[3] dynamic / static N | | dynamic / static kgf | | Bearing numbers | Abutment dimensions mm | | Mass[4] kg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $D_w$[1] | $b$ | $L_1$[2] | $L_w$ | $l$ | $a$ | $C_r$ | $C_{or}$ | $C_r$ | $C_{or}$ | | $E$ | $H$ | (approx.) |
| **3** | 20 | 705 | 13.8 | 6 | 4.5 | 34 000 | 88 500 | 3 450 | 9 000 | **RF3020/705** | 20.4 $^{+0.1}_{0}$ | 2.7 $^{0}_{-0.2}$ | 0.015 |
| **3** | 20 | 1 000 | 15.8 | 6 | 5 | 38 000 | 102 000 | 3 850 | 10 400 | **BF3020/1000** | 20.4 $^{+0.1}_{0}$ | 2.7 $^{0}_{-0.2}$ | 0.037 |
| **5** | 23 | 1 000 | 19.8 | 8 | 8 | 87 000 | 211 000 | 8 850 | 21 500 | **BF5023/1000** | 23.4 $^{+0.1}_{0}$ | 4.7 $^{0}_{-0.2}$ | 0.054 |
| **5** | 32 | 1 000 | 27.8 | 8 | 8 | 114 000 | 299 000 | 11 600 | 30 500 | **BF5032/1000** | 32.4 $^{+0.1}_{0}$ | 4.7 $^{0}_{-0.2}$ | 0.073 |
| **7** | 28 | 1 000 | 24 | 11 | 10.5 | 138 000 | 305 000 | 14 000 | 31 000 | **BF7028/1000** | 28.5 $^{+0.1}_{0}$ | 6.7 $^{0}_{-0.2}$ | 0.091 |
| **7** | 35 | 1 000 | 30 | 11 | 10.5 | 185 000 | 445 000 | 18 900 | 45 500 | **BF7035/1000** | 35.5 $^{+0.1}_{0}$ | 6.7 $^{0}_{-0.2}$ | 0.110 |

Note 1) The dimensional tolerance for needle roller diameter $D_w$ is 0 to -2 $\mu$m.
2) The standard length $L_1$ of the cage shall be 1000 mm for Type BF and 705 mm for Type RF.
Where special cage length is required, the nominal bearing number is followed by the numerical length value as exemplified below.
Ex. Where $L_1$ = 500 mm is required for **BF3020**, **BF302/500**
3) The listed basic load ratings are subject to use of 10 flat rollers. Calculate the basic load ratings for any optional cage length $L_1$ by the following formula.
$C = f_1^{7/9} \cdot C_r$
$C_0 = f_1 \cdot C_{0r}$
Herein, $f_1$=0.1 $(L_1 + l - 2a) / l$
4) The listed weights are subject to $L_1$ = 100 mm.

Remarks: For **Type BF**
1. On occasion, the length of an ordered unit could be shorter by $l$ dimension shown in each Dimensions Table because the roller and cage assy is cut at the minimum unit of each pocket so as to match the required length.
2. Where this bearing unit is used frequently at various lengths, it is more economical to cut the standard bearing of 1000 mm length to each desired length at your side.

# Linear Roller Bearings

This roller bearing with cylindrical rollers having the function capable of circulating within the raceway block ensures smooth infinite linear motion on a flat surface. The cylindrical rollers are retained and guided by the cage and the ribs of the raceway block.

The cage is of such a construction as not allow adjacent rollers to contact with one another. Hence, the friction coefficient is low.

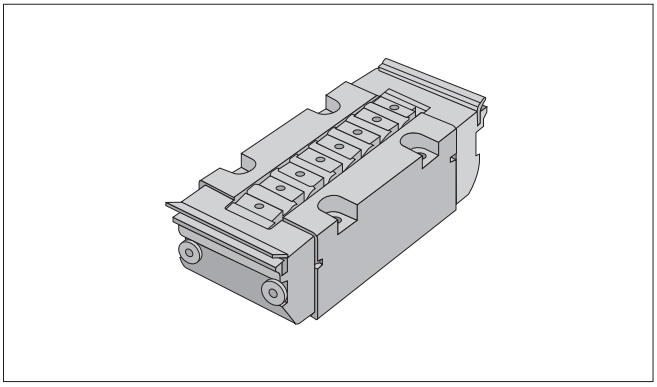


**Fig. 1**

## Bearing accuracy

All the linear roller bearings are manufactured within the dimensional tolerance range of 0 to -2.5 $\mu$m for bearing height ($H$). And these bearings are delivered classified into 5-stepped tolerance classes. (See **Table 1**)

**Table 1 Classification of bearing height $H$ by accuracy class**

Unit : $\mu$m

| Class code | Tolerance for height ($H$) |
|---|---|
| 1H | 0～－ 5 |
| 2H | － 5～－10 |
| 3H | －10～－15 |
| 4H | －15～－20 |
| 5H | －20～－25 |

## Requirements and tolerances for raceway surface and mounting surface

**Table 2** shows the requirements and tolerances for the raceway surface, on which linear roller bearing rolls, and the bearing mounting surface. Where adhesion of a hard foreign matter to the raceway surface is forecast, the raceway surface must be protected with a proper protective cover.

The reference surface for mounting is the back face and opposite face to **NTN** mark.

**Table 2 Requirements for raceway surface and mounting surface (recommended)**

| Characteristics | Allowable value or tolerance range |
|---|---|
| Raceway surface roughness (max) | 0.2a |
| Raceway surface hardness | HRC58～64 |
| Effective hardened layer depth of raceway surface (min) | as described in applicable Dimensions Table |
| Parallelism of mounting surface | |
| $\Delta x$ (See **Fig. 2**) | 0.05 mm per 100 mm |
| $\Delta y$ (See **Fig. 3**) | 0.01 mm per 100 mm |

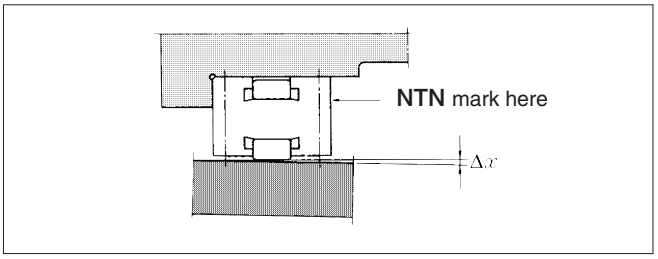



**Fig. 2**

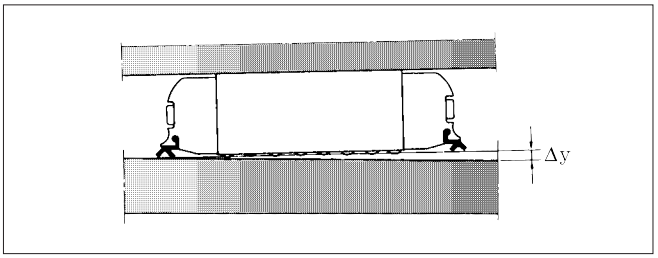



**Fig. 3**

## How to mount

Fix linear roller bearing using the tapped holes which are provided on the mounting reference surface. (See **Fig. 4**)

If a plurality of bearing units are installed on a same plane, select the units that belong to a same bearing height H dimensional accuracy class (**Table 1**) so that the load is uniformly distributed onto them.

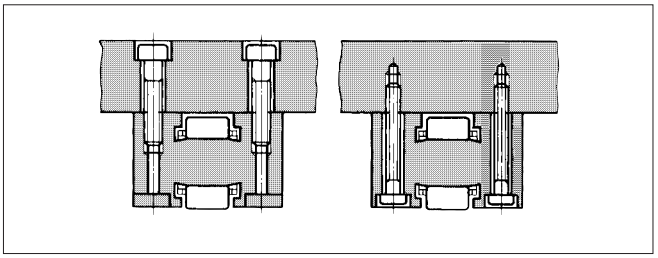
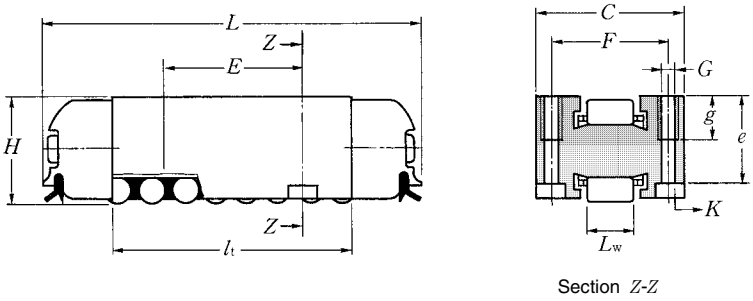


**Fig. 4**

## Type RLM




Section Z-Z

*H* 16～38mm

| Boundary dimensions mm | | | | | | | | | | | Bearing numbers | Basic load ratings dynamic static N | | Basic load ratings dynamic static kgf | | Required case depth on track (min.) | Mass kg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *H* | *C* | *L* | $L_w$ | *E* | *F* | *G* | $L_t$ | *e* | *g* | *K* | | $C_r$ | $C_{or}$ | $C_r$ | $C_{or}$ | mm | (approx.) |
| **16** | 25 | 62 | 8 | 17 | 19 | M4 | 35.5 | 12.5 | 6 | $\phi$3.2 | **RLM16× 62A** | 15 400 | 34 000 | 1 570 | 3 450 | 0.3 | 0.11 |
| **19** | 27 | 69 | 10 | 25.5 | 20.6 | M4 | 43.4 | 15.5 | 6 | $\phi$3.2 | **RLM19× 69B** | 26 100 | 58 000 | 2 660 | 5 900 | 0.3 | 0.16 |
| **26** | 40 | 86 | 14 | 28 | 30 | M6 | 52.4 | 21 | 10 | $\phi$4.5 | **RLM26× 86A** | 50 000 | 106 000 | 5 100 | 10 800 | 0.4 | 0.41 |
| **26** | 40 | 102 | 14 | 44 | 30 | M6 | 67.9 | 21 | 10 | $\phi$4.5 | **RLM26×102A** | 62 500 | 142 000 | 6 350 | 14 400 | 0.4 | 0.53 |
| **26** | 40 | 126 | 14 | 68 | 30 | M6 | 91.8 | 21 | 10 | $\phi$4.5 | **RLM26×126A** | 80 000 | 195 000 | 8 150 | 19 900 | 0.4 | 0.70 |
| **38** | 52 | 134 | 20 | 51 | 41 | M8 | 85.7 | 31 | 14 | $\phi$6.5 | **RLM38×134B** | 124 000 | 270 000 | 12 600 | 27 500 | 0.5 | 1.3 |