Cross-Roller Ring

THK General Catalog

A Technical Descriptions of the Products

B Product Specifications (Separate)

* Please see the separate "B Product Specifications".

Features of the Cross-Roller Ring

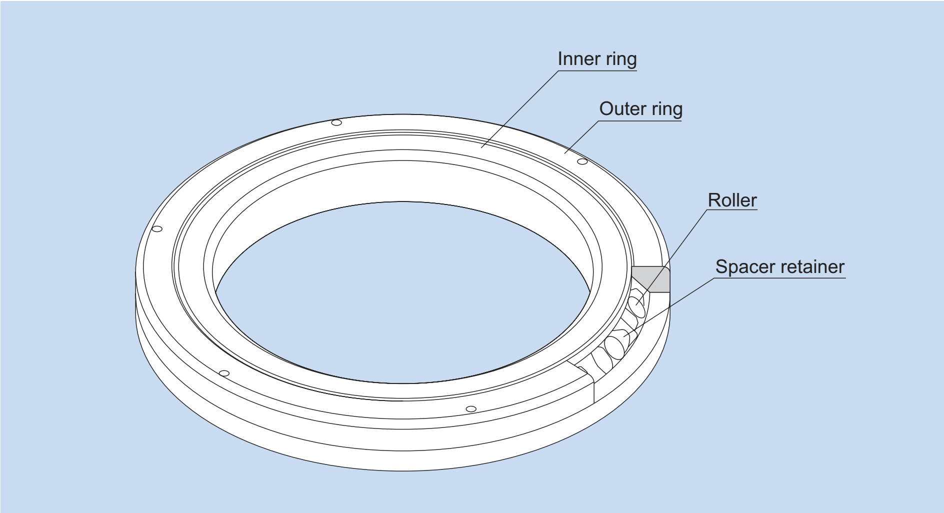


Fig.1 Structure of Cross Roller-Ring Model RB

Structure and Features

With the Cross-Roller Ring, cylindrical rollers are arranged with each roller perpendicular to the adjacent roller, in a 90° V groove, separated from each other by a spacer retainer. This design allows just one bearing to receive loads in all directions including radial, axial and moment loads.
Since the Cross-Roller Ring achieves high rigidity despite the minimum possible dimensions of the inner and outer rings, it is optimal for applications such as joints and swiveling units of industrial robots, swiveling tables of machining centers, rotary units of manipulators, precision rotary tables, medical equipment, measuring instruments and IC manufacturing machines.

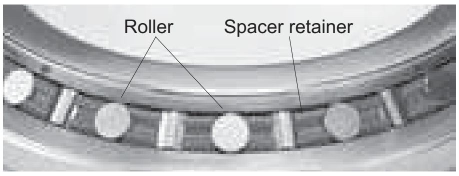
[High Rotation Accuracy]
The spacer retainer fitting among cross-arrayed rollers prevents rollers from skewing and the rotational torque from increasing due to friction between rollers. Unlike conventional types using steel sheet retainers, the Cross-Roller Ring does not cause unilateral contact of roller or seize. Thus, even under a preload, the Cross-Roller Ring provides stable rotation.
Since the inner and outer rings are designed to be separable, the bearing clearance can be adjusted. In addition, a preload can be applied. These features enable accurate rotation.

[Easy Handling]

The inner and outer rings, which are separable, are secured to the Cross-Roller Ring body after being installed with rollers and spacer retainers in order to prevent the rings from separating from each other. Thus, it is easy to handle the rings when installing the Cross-Roller Ring.

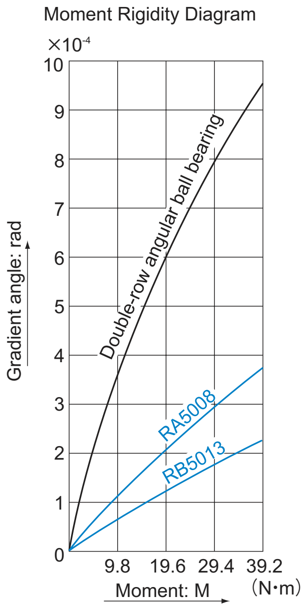
[Skewing Prevention]

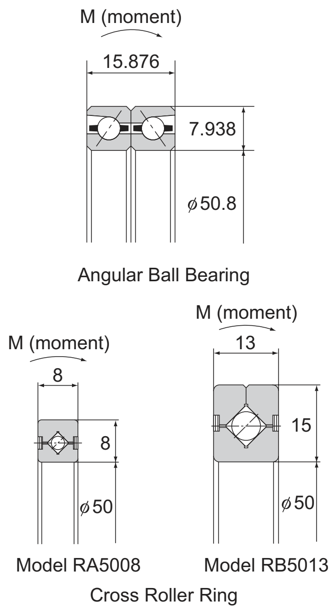
The spacer retainer keeps rollers in their proper position, thereby preventing them from skewing (tilted rollers). This eliminates friction between rollers, and therefore secures a stable rotational torque.



[Increased Rigidity (Three to Four Times Greater than the Conventional Type)]

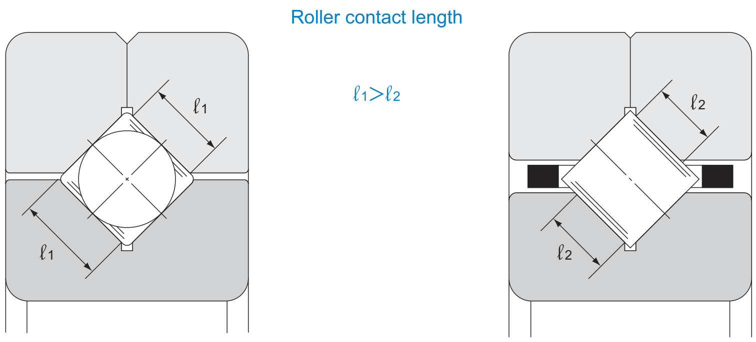
Unlike the thin angular ball bearings installed in double rows, the cross array of rollers allows a single Cross-Roller Ring unit to receive loads in all directions, increasing the rigidity to three to four times greater than the conventional type.





[Large Load Capacity]

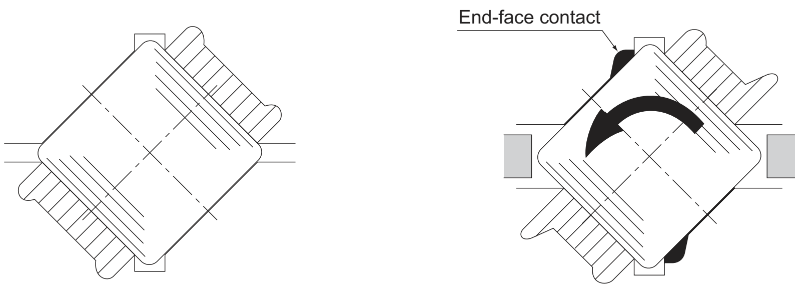
(1) Compared with conventional steel sheet retainers, the spacer retainer allows a longer effective contact length of each roller, thus significantly increasing the load capacity.
The spacer retainer guides rollers by supporting them over the entire length of each roller, whereas the conventional type of retainer supports them only at a point at the center of each roller. Such one-point contact cannot sufficiently prevent skewing.



With a spacer retainer

With a steel sheet retainer (conventional type)

(2) In conventional types, the loaded areas are asymmetrical between the outer ring and the inner ring sides around the roller longitudinal axis. The greater the applied load is, the greater the moment becomes, leading end-face contact to occur. This causes frictional resistance, which hinders smooth rotation and quickens wear.



Loaded areas symmetrical
With a spacer retainer

Loaded areas asymmetrical
With a steel sheet retainer (conventional type)

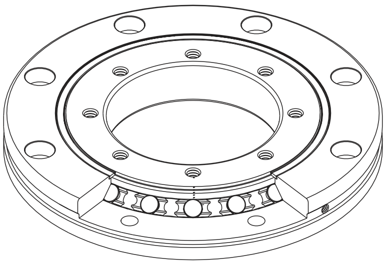
Types of the Cross-Roller Ring

Types and Features

Model RU (Integrated Inner/Outer Ring Type)

Specification Table⇒B-796

Since holes are drilled for mounting, the need for a presser flange and a housing is eliminated.Also, owing to the integrated inner/outer ring type stryucture with washer, there is almost no effect from installation on performance, allowing stable rotational accuracy and torque to be obtained.
Can be used for both outer and inner ring rotation.

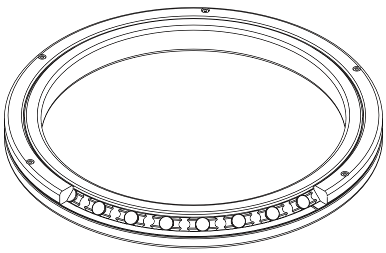


Model RU

Model RB (Separable Outer Ring Type for Inner Ring Rotation)

Specification Table⇒B-798

Cross-Roller Ring basic type, with a separable outer ring, and an inner ring integrated with the main body.It is used in locations where the rotational accuracy of the inner ring is required.
It is used, for example, in the swivel portions of index tables of machine tools.

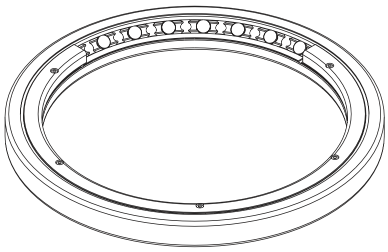


Model RB

Model RE (Two-piece Inner Ring Type for Outer Ring Rotation)

Specification Table⇒B-801

Main dimensions are the same as model RB. This model is used in locations where the rotational accuracy of the outer ring is required.



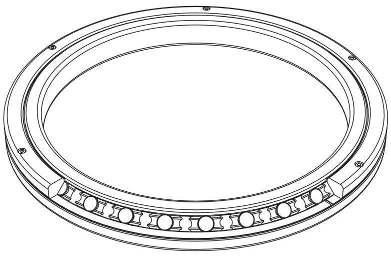
Model RE

Cross-Roller Ring

USP-Grade Series of Models RB and RE

Specification Table⇒B-804

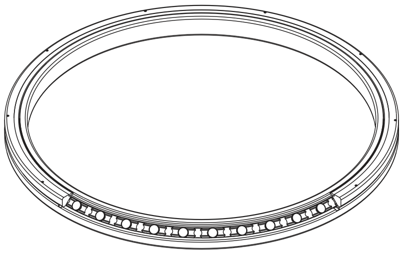
The rotation accuracy of the USP-Grade Series achieves the ultra precision grade that surpasses the world's highest accuracy standards such as JIS Class 2, ISO Class 2, DIN P2 and AFBMA ABCE9.



Model RA (Separable Outer Ring Type for Inner Ring Rotation)

Specification Table⇒B-805

A compact type similar to model RB with the thinnest possible inner and outer rings.
Optimal for locations requiring a light-weight and compact design such as the swivel portions of robots and manipulators.

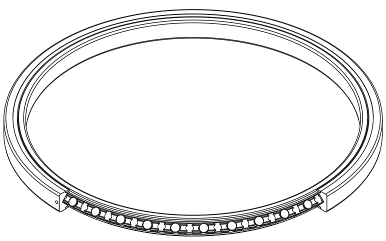


Model RA

Model RA-C (Singe-Split Type)

Specification Table⇒B-806

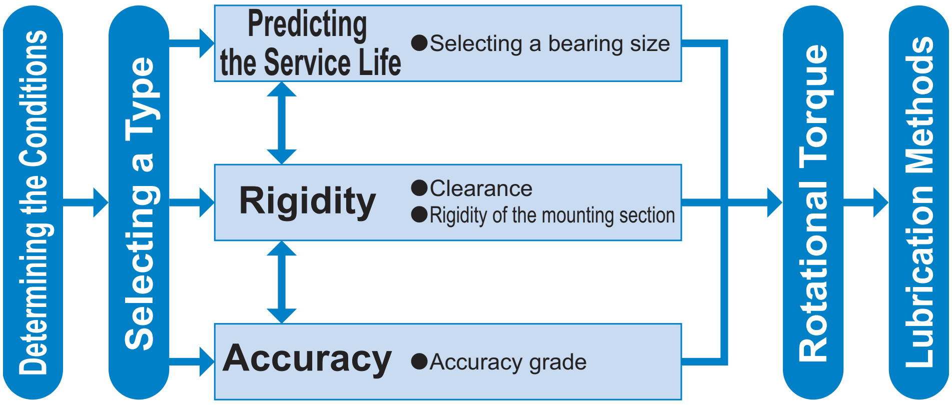
The main dimensions are the same as that of model RA.Owing to its Single-split Outer Ring structure with a highly rigid outer ring, this model can be used for outer ring rotation.



Model RA-C

Selecting a Cross-Roller Ring

The following diagram shows a typical procedure for selecting a Cross-Roller Ring.



- Inner ring rotating······Model RB
- Outer ring rotating······Model RE
- Mounting space···Models RA-C and RA

Nominal Life

The service life of the Cross-Roller Ring is obtained from the following equation.

$$L = \left(\frac{f_T \cdot C}{f_W \cdot P_C} \right)^{\frac{10}{3}} \times 10^6$$

L : Nominal life
(The total number of revolutions that 90% of a group of identical Cross-Roller Ring units independently operating under the same conditions can achieve without showing flaking from rolling fatigue)

C : Basic dynamic load rating* (N)

P_C : Dynamic equivalent radial load (N)

f_T : Temperature factor (see Fig.1)

f_W : Load factor (see Table1)

* The basic dynamic load rating (C) of the Cross-Roller Ring shows the radial load with interlocked direction and magnitude, under which the nominal life (L) is 1 million revolutions when a group of identical Cross-Roller Ring units independently operate under the same conditions. The basic dynamic load rating (C) is indicated in the specification tables.

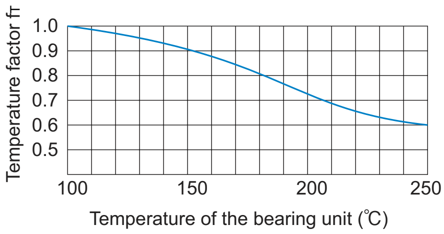


Fig.1 Temperature Factor (f_T)

Note) The normal service temperature is 80 ℃ or below. If the product is to be used at a higher temperature, contact THK.

Table1 Load Factor (f_W)

Service condition	f_W
Smooth motion without impact	1 to 1.2
Normal motion	1.2 to 1.5
Motion with severe impact	1.5 to 3

[Dynamic Equivalent Radial Load P_C]

The dynamic equivalent radial load of the Cross-Roller Ring is obtained from the following equation.

$$P_C = X \cdot \left(Fr + \frac{2M}{dp} \right) + Y \cdot Fa$$

P_C : Dynamic equivalent radial load (N)

Fr : Radial load (N)

Fa : Axial load (N)

M : Moment (N-mm)

X : Dynamic radial facto (see Table2)

Y : Dynamic axial factor (see Table2)

dp : Roller pitch circle diameter (mm)

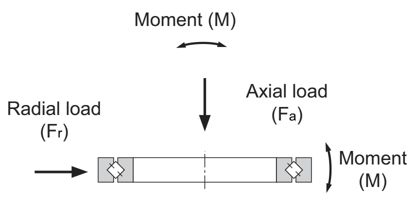


Fig.2

Table2 Dynamic Radial Factor and Dynamic Axial Factor

Classification	X	Y
$\frac{Fa}{Fr + 2M/dp} \leqq 1.5$	1	0.45
$\frac{Fa}{Fr + 2M/dp} > 1.5$	0.67	0.67

- If Fr = 0N and M = 0 N-mm, perform calculation while assuming that X = 0.67 and Y = 0.67.
- For service life calculation with a preload taken into account, contact THK.

[Example of Calculating the Nominal Life]

Assuming that model RB25025 is used under the following conditions, calculate its nominal life (L).

m_1 =100 kg
m_2 =200 kg
m_3 =300 kg
D_1 =300 mm
D_2 =150 mm
H =200 mm
C =69.3 kN
C_0 =150 kN
dp =277.5 mm
F =100 N
ω =2 rad/s(ω: angular velocity)

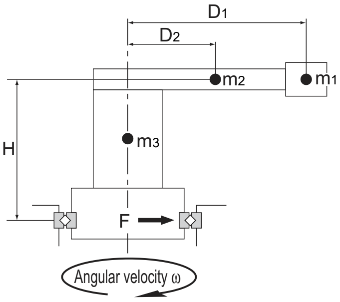


Fig.3

Radial load : Fr $=F+m_1 \cdot D_1 \times 10^{-3} \cdot \omega^2 + m_2 \cdot D_2 \times 10^{-3} \cdot \omega^2$
$= 100+100 \cdot 300 \times 10^{-3} \cdot 2^2 + 200 \cdot 150 \times 10^{-3} \cdot 2^2$
$=340$ N

Axial load : Fa $=(m_1+m_2+m_3) \times g$
$=(100+200+300) \times 9.807$
$=5884.2$ N

Moment :M $=m_1 \cdot g \times D_1 + m_2 \cdot g \times D_2 + (m_1 \cdot D_1 \times 10^{-3} \cdot \omega^2 + m_2 \cdot D_2 \times 10^{-3} \cdot \omega^2) \times H$
$=100 \cdot 9.807 \times 300 + 200 \cdot 9.807 \times 150 +$
$(100 \cdot 300 \times 10^{-3} \cdot 2^2 + 200 \cdot 150 \times 10^{-3} \cdot 2^2) \times 200$
$=636420$ N·mm

$$\frac{Fa}{Fr + 2M/dp} = \frac{5884.2}{340 + 2 \times 636420/277.5} = 1.19 \leqq 1.5$$

$\therefore X = 1$, $Y = 0.45$

Therefore, the dynamic equivalent radial load (P_c) is obtained as follows.

$$P_C = X\left(Fr + \frac{2M}{dp}\right) + Y \cdot Fa = 1 \times \left(340 + \frac{2 \cdot 636420}{277.5}\right) + 0.45 \times 5884.2 = 7574.7 \text{ N}$$

If f_W = 1.2, the nominal life is calculated as follows.Thus, the nominal life (L) is 8.7×10^8 revolutions.

$$L = \left(\frac{f_T \cdot C}{f_W \cdot P_C}\right)^{\frac{10}{3}} = \left(\frac{1 \times 69.3 \times 10^3}{1.2 \times 7574.7}\right)^{\frac{10}{3}} \times 10^6 = 8.7 \times 10^8 \quad \text{Rotation}$$

Static Safety Factor

The basic static load rating C_0 refers to the static load with constant direction and magnitude, under which the calculated contact stress in the center of the contact area between the roller and the raceway under the maximum load is 4000 MPa. (If the contact stress exceeds this level, it will affect the rotation.) This value is indicated as "C_0" in the specification tables. When a load is statically or dynamically applied, it is necessary to consider the static safety factor as shown below.

$$\frac{C_0}{P_0} = f_S$$

f_S	: Static safety factor	(see Table3)
C_0	: Basic static load rating	(N)
P_0	: Static equivalent radial load	(N)

Table3 Static Safety Factor (f_S)

Load conditions	Lower limit of f_S
Normal load	1 to 2
Impact load	2 to 3

[Static Equivalent Radial Load P_0]

The static equivalent radial load of the Cross-Roller Ring is obtained from the following equation.

$$P_0 = X_0 \cdot \left(Fr + \frac{2M}{dp} \right) + Y_0 \cdot Fa$$

P_0	: Static equivalent radial load	(N)
Fr	: Radial load	(N)
Fa	: Axial load	(N)
M	: Moment	(N-mm)
X_0	: Static radial factor	(X_0=1)
Y_0	: Static axial factor	(Y_0=0.44)
dp	: Roller pitch circle diameter	(mm)

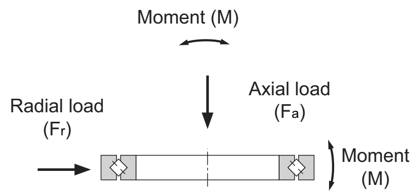


Fig.4

[Example of Calculating a Static Safety Factor]

Assuming that model RB25025 is used under the following conditions, calculate its static safety factor (f_s).

m_1 =100 kg
m_2 =200 kg
m_3 =300 kg
D_1 =300 mm
D_2 =150 mm
H =200 mm
C =69.3 kN
C_0 =150 kN
dp =277.5 mm
F =100 N
ω =2 rad/s(ω: angular velocity)

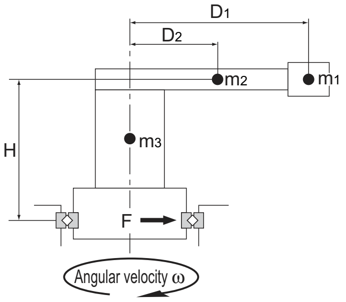


Fig.5

Radial load : Fr $=F+m_1 \cdot D_1 \times 10^{-3} \cdot \omega^2 + m_2 \cdot D_2 \times 10^{-3} \cdot \omega^2$
$= 100+100 \cdot 300 \times 10^{-3} \cdot 2^2 + 200 \cdot 150 \times 10^{-3} \cdot 2^2$
$=340$ N

Axial load : Fa $=(m_1+m_2+m_3) \times g$
$= (100+200+300) \times 9.807$
$=5884.2$ N

Moment :M $=m_1 \cdot g \times D_1 + m_2 \cdot g \times D_2 + (m_1 \cdot D_1 \times 10^{-3} \cdot \omega^2 + m_2 \cdot D_2 \times 10^{-3} \cdot \omega^2) \times H$
$= 100 \cdot 9.807 \times 300 + 200 \cdot 9.807 \times 150 +$
$(100 \cdot 300 \times 10^{-3} \cdot 2^2 + 200 \cdot 150 \times 10^{-3} \cdot 2^2) \times 200$
$=636420$ N·mm

Therefore, the static equivalent radial load (P_0) is obtained as follows.

$$P_0 = X\left(Fr + \frac{2M}{dp}\right) + Y \cdot Fa = 1 \times \left(340 + \frac{2 \cdot 636420}{277.5}\right) + 0.44 \times 5884.2 = 7515.8\ \text{N}$$

$$\therefore f_s = \frac{150 \times 10^3}{7515.8} = 20$$

Thus, the static safety factor (f_s) is 20.

Static Permissible Moment

The static permissible moment (M_0) of the Cross-Roller Ring is obtained from the following equation.

$$M_0 = C_0 \cdot \frac{dp}{2} \times 10^{-3}$$

M_0	: Static permissible moment	(kN-m)
C_0	: Basic static load rating	(kN)
dp	: Roller pitch circle diameter	(mm)

[Example of Calculating a Static Permissible Moment]

Model No. RB25025
C =69.3 kN
C_0 =150 kN
dp =277.5 mm
The static permissible moment is calculated as follows.

$$M_0 = C_0 \cdot \frac{dp}{2} \times 10^{-3} = 150 \cdot \frac{277.5}{2} \times 10^{-3} = 20.8 \text{ kN} \cdot \text{m}$$

Static Permissible Axial Load

The static permissible axial load (Fa_0) of the Cross-Roller Ring is obtained from the following equation.

$$Fa_0 = \frac{C_0}{Y_0}$$

Fa_0	: Static permissible axial load	(kN)
Y_0	: Static axial factor	(Y_0=0.44)

[Example of Calculating a Static Permissible Axial Load]

Model No. RB25025
C =69.3 kN
C_0 =150 kN
The static permissible axial load (Fa_0) is calculated as follows.

$$Fa_0 = \frac{C_0}{Y_0} = \frac{150}{0.44} = 340.9 \text{ kN}$$

Accuracy Standards

The Cross-Roller Ring is manufactured with the accuracy and the dimensional tolerance according to Table4 to Table13.

Table4 Rotational Accuracy of the Inner Ring of Model RU

Unit: µm

Model No.	Radial runout tolerance of the inner ring			Axial runout tolerance of the inner ring		
	Grade P5	Grade P4	Grade P2	Grade P5	Grade P4	Grade P2
RU42	4	3	2.5	4	3	2.5
RU66	5	4	2.5	5	4	2.5
RU85	5	4	2.5	5	4	2.5
RU124	5	4	2.5	5	4	2.5
RU148	6	5	2.5	6	5	2.5
RU178	6	5	2.5	6	5	2.5
RU228	8	6	5	8	6	5
RU297	10	8	5	10	8	5
RU445	15	12	7	15	12	7

Note) For model RU, grade P5 is standard rotational accuracy.(Not indicated in model number.)

Table5 Rotational Accuracy of the Outer Ring of Model RU

Unit: µm

Model No.	Radial runout tolerance of the outer ring			Axial runout tolerance of the outer ring		
	Grade P5	Grade P4	Grade P2	Grade P5	Grade P4	Grade P2
RU42	8	5	4	8	5	4
RU66	10	6	5	10	6	5
RU85	10	6	5	10	6	5
RU124	13	8	5	13	8	5
RU148	15	10	7	15	10	7
RU178	15	10	7	15	10	7
RU228	18	11	7	18	11	7
RU297	20	13	8	20	13	8
RU445	25	16	10	25	16	10

Note) For model RU, grade P5 is standard rotational accuracy.(Not indicated in model number.)

Table6 Rotational Accuracy of the Inner Ring of Model RB

Unit: µm

Nominal dimension of the bearing inner diameter (d) (mm)		Radial runout tolerance of the inner ring					Axial runout tolerance of the inner ring				
		Grade 0	Grade PE6	Grade PE5	Grade PE4	Grade PE2	Grade 0	Grade PE6	Grade PE5	Grade PE4	Grade PE2
Above	Or less		Grade P6	Grade P5	Grade P4	Grade P2		Grade P6	Grade P5	Grade P4	Grade P2
18	30	13	8	4	3	2.5	13	8	4	3	2.5
30	50	15	10	5	4	2.5	15	10	5	4	2.5
50	80	20	10	5	4	2.5	20	10	5	4	2.5
80	120	25	13	6	5	2.5	25	13	6	5	2.5
120	150	30	18	8	6	2.5	30	18	8	6	2.5
150	180	30	18	8	6	5	30	18	8	6	5
180	250	40	20	10	8	5	40	20	10	8	5
250	315	50	25	13	10	—	50	25	13	10	—
315	400	60	30	15	12	—	60	30	15	12	—
400	500	65	35	18	14	—	65	35	18	14	—
500	630	70	40	20	16	—	70	40	20	16	—
630	800	80	—	—	—	—	80	—	—	—	—
800	1000	90	—	—	—	—	90	—	—	—	—
1000	1250	100	—	—	—	—	100	—	—	—	—

Table7 Rotational Accuracy of the Outer Ring of Model RE

Unit: µm

Nominal dimension of the bearing outer diameter (D) (mm)		Radial runout tolerance of the outer ring					Axial runout tolerance of the outer ring				
		Grade 0	Grade PE6	Grade PE5	Grade PE4	Grade PE2	Grade 0	Grade PE6	Grade PE5	Grade PE4	Grade PE2
Above	Or less		Grade P6	Grade P5	Grade P4	Grade P2		Grade P6	Grade P5	Grade P4	Grade P2
30	50	20	10	7	5	2.5	20	10	7	5	2.5
50	80	25	13	8	5	4	25	13	8	5	4
80	120	35	18	10	6	5	35	18	10	6	5
120	150	40	20	11	7	5	40	20	11	7	5
150	180	45	23	13	8	5	45	23	13	8	5
180	250	50	25	15	10	7	50	25	15	10	7
250	315	60	30	18	11	7	60	30	18	11	7
315	400	70	35	20	13	8	70	35	20	13	8
400	500	80	40	23	15	—	80	40	23	15	—
500	630	100	50	25	16	—	100	50	25	16	—
630	800	120	60	30	20	—	120	60	30	20	—
800	1000	120	75	—	—	—	120	75	—	—	—
1000	1250	120	—	—	—	—	120	—	—	—	—
1250	1600	120	—	—	—	—	120	—	—	—	—

Table8 Rotational Accuracy of the Inner Ring of Model RA and RA-C

Unit: µm

Nominal dimension of the bearing inner diameter (d) (mm)		Tolerance in radial runout and axial runout
Above	Or less	
40	65	13
65	80	15
80	100	15
100	120	20
120	140	25
140	180	25
180	200	30

Note) If higher accuracy than the above values is required for the inner ring in rotational accuracy for models RA and RA-C, contact THK.

Table9 Rotational Accuracy of the Outer Ring of Model RA-C

Unit: µm

Nominal dimension of the bearing outer diameter (D) (mm)		Tolerance in radial runout and axial runout
Above	Or less	
65	80	13
80	100	15
100	120	15
120	140	20
140	180	25
180	200	25
200	250	30

Note) The rotational accuracy of the outer ring for model RA-C indicates the value before separation.

Table10 Dimensional Tolerance of the Bearing Inner Diameter Unit: µm

Nominal dimension of the bearing inner diameter (d) (mm)		Tolerance of dm(note 2)							
		Grades 0, P6, P5, P4 and P2		Grade PE6		Grade PE5		Grade PE4 and PE2	
Above	Or less	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
18	30	0	−10	0	−8	0	−6	0	−5
30	50	0	−12	0	−10	0	−8	0	−6
50	80	0	−15	0	−12	0	−9	0	−7
80	120	0	−20	0	−15	0	−10	0	−8
120	150	0	−25	0	−18	0	−13	0	−10
150	180	0	−25	0	−18	0	−13	0	−10
180	250	0	−30	0	−22	0	−15	0	−12
250	315	0	−35	0	−25	0	−18	—	—
315	400	0	−40	0	−30	0	−23	—	—
400	500	0	−45	0	−35	—	—	—	—
500	630	0	−50	0	−40	—	—	—	—
630	800	0	−75	—	—	—	—	—	—
800	1000	0	−100	—	—	—	—	—	—
1000	1250	0	−125	—	—	—	—	—	—

Note1) Standard inner diameter accuracy of models RA, RA-C and RU is 0. For higher accuracy than 0, contact THK.
Note2) "dm" represents the arithmetic average of the maximum and minimum diameters obtained in measuring the bearing inner diameter at two points.
Note3) For accuracy grades in bearing inner diameter with no values indicated in the table, the highest value among low accuracy grades applies.

Table11 Dimensional Tolerance of the Bearing Outer Diameter Unit: µm

Nominal dimension of the bearing outer diameter (D) (mm)		Tolerance of Dm(note 2)							
		Grades 0, P6, P5, P4 and P2		Grade PE6		Grade PE5		Grade PE4 and PE2	
Above	Or less	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
30	50	0	−11	0	−9	0	−7	0	−6
50	80	0	−13	0	−11	0	−9	0	−7
80	120	0	−15	0	−13	0	−10	0	−8
120	150	0	−18	0	−15	0	−11	0	−9
150	180	0	−25	0	−18	0	−13	0	−10
180	250	0	−30	0	−20	0	−15	0	−11
250	315	0	−35	0	−25	0	−18	0	−13
315	400	0	−40	0	−28	0	−20	0	−15
400	500	0	−45	0	−33	0	−23	—	—
500	630	0	−50	0	−38	0	−28	—	—
630	800	0	−75	0	−45	0	−35	—	—
800	1000	0	−100	—	—	—	—	—	—
1000	1250	0	−125	—	—	—	—	—	—
1250	1600	0	−160	—	—	—	—	—	—

Note1) Standard outer diameter accuracy of models RA, RA-C and RU is 0. For higher accuracy than 0, contact THK.
Note2) "Dm" represents the arithmetic average of the maximum and minimum diameters obtained in measuring the bearing outer diameter at two points.
Note3) For accuracy grades in bearing outer diameter with no values indicated in the table, the highest value among low accuracy grades applies.

Table12 Tolerance in the Width of the Inner and Outer Rings for Models RU

Unit: µm

Model No.	Tolerrance of B	
	Upper	Lower
RU42	0	−75
RU66	0	−75
RU85	0	−75
RU124	0	−75
RU148	0	−75
RU178	0	−100
RU228	0	−100
RU297	0	−100
RU445	0	−100

Table13 Tolerance in the Width of the Inner and Outer Rings (Common to All Grades) for Models RB and RE

Unit: µm

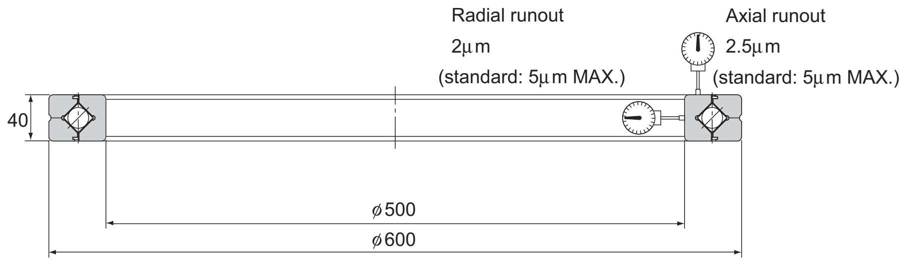
Nominal dimension of the bearing inner diameter (d) (mm)		Tolerrance of B Applied to the inner ring of RB and the outer ring of RE		Tolerrance of B1 Applied to the outer ring of RB and the inner ring of RE	
Above	Or less	Upper	Lower	Upper	Lower
18	30	0	−75	0	−100
30	50	0	−75	0	−100
50	80	0	−75	0	−100
80	120	0	−75	0	−100
120	150	0	−100	0	−120
150	180	0	−100	0	−120
180	250	0	−100	0	−120
250	315	0	−120	0	−150
315	400	0	−150	0	−200
400	500	0	−150	0	−200
500	630	0	−150	0	−200
630	800	0	−150	0	−200
800	1000	0	−300	0	−400
1000	1250	0	−300	0	−400

Note) All B and B1 types of models RA and RA-C are manufactured with tolerance between -0.120 and 0.

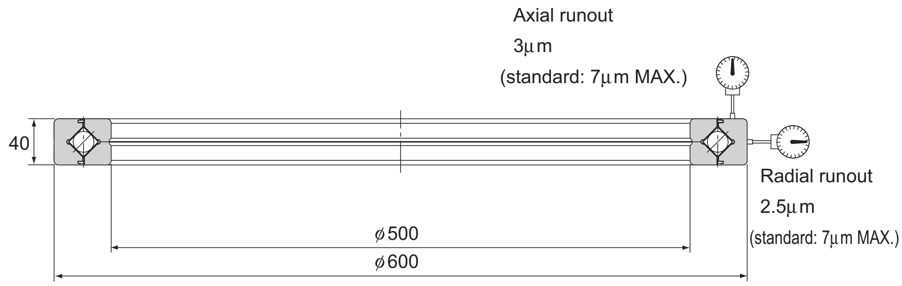
Accuracy Standard of the USP-Grade Series

[Examples of Rotational Accuracy of the USP-Grade Series Cross-Roller Rings]

The rotation accuracy of the USP-Grade Series achieves the ultra precision grade that surpasses the world's highest accuracy standards such as JIS Class 2, ISO Class 2, DIN P2 and AFBMA ABEC9.



Rotational Accuracy of the Inner Ring of Model RB50040CC0USP



Rotational Accuracy of the Outer Ring of Model RE50040CC0USP

[Accuracy Standards]

The USP-grade series of models RB and RE are manufactured with runout accuracies according to Table14.

Table14 Runout Accuracies of the USP-grade Series

Unit: μm

Nominal inner diameter (d) and outer diameter (D) (mm)		Runout accuracy of the inner ring of model RB		Runout accuracy of the outer ring of model RE	
Above	Or less	Radial runout tolerance	Axial runout tolerance	Radial runout tolerance	Axial runout tolerance
80	180	2.5	2.5	3	3
180	250	3	3	4	4
250	315	4	4	4	4
315	400	4	4	5	5
400	500	5	5	5	5
500	630	6	6	7	7
630	800	—	—	8	8

Radial Clearance

Table15 shows the radial clearance of model RU, Table16 that of the standard type of models RB and RE, Table17 that of the USP-grade series of models RB and RE, and Table18 that of the thin type of models RA and RA-C.

Table15 Radial clearance for model RU

Unit: µm

Model No.	CC0		C0	
	Starting torque (N•m)		Radial clearance (µm)	
	Min.	Max.	Min.	Max.
RU42	0.1	0.5	0	25
RU66	0.3	2.2	0	30
RU85	0.4	3	0	40
RU124	1	6	0	40
RU148	1	10	0	40
RU178	3	15	0	50
RU228	5	20	0	60
RU297	10	35	0	70
RU445	20	55	0	100

Note) Model RU clearance CC0 is controlled by starting torque.Starting torque for clearance CC0 does not include seal resistance value.

Table16 Radial Clearances of Models RB and RE

Unit: µm

Pitch circle diameter of the roller (dp) (mm)		CC0		C0		C1	
Above	Or less	Min.	Max.	Min.	Max.	Min.	Max.
18	30	−8	0	0	15	15	35
30	50	−8	0	0	25	25	50
50	80	−10	0	0	30	30	60
80	120	−10	0	0	40	40	70
120	140	−10	0	0	40	40	80
140	160	−10	0	0	40	40	90
160	180	−10	0	0	50	50	100
180	200	−10	0	0	50	50	110
200	225	−10	0	0	60	60	120
225	250	−10	0	0	60	60	130
250	280	−15	0	0	80	80	150
280	315	−15	0	30	100	100	170
315	355	−15	0	30	110	110	190
355	400	−15	0	30	120	120	210
400	450	−20	0	30	130	130	230
450	500	−20	0	30	130	130	250
500	560	−20	0	30	150	150	280
560	630	−20	0	40	170	170	310
630	710	−20	0	40	190	190	350
710	800	−30	0	40	210	210	390
800	900	−30	0	40	230	230	430
900	1000	−30	0	50	260	260	480
1000	1120	−30	0	60	290	290	530
1120	1250	−30	0	60	320	320	580
1250	1400	−30	0	70	350	350	630

Table17 Radial Clearances of USP-grade Series of Models RB and RE

Unit: µm

Pitch circle diameter of the roller (dp) (mm)		CC0		C0	
Above	Or less	Min.	Max.	Min.	Max.
120	160	−10	0	0	40
160	200	−10	0	0	50
200	250	−10	0	0	60
250	280	−15	0	0	80
280	315	−15	0	0	100
315	355	−15	0	0	110
355	400	−15	0	0	120
400	500	−20	0	0	130
500	560	−20	0	0	150
560	630	−20	0	0	170
630	710	−20	0	0	190

Table18 Radial Clearances of Models RA and RA-C

Unit: µm

Pitch circle diameter of the roller (dp) (mm)		CC0		C0	
Above	Or less	Min.	Max.	Min.	Max.
50	80	−8	0	0	15
80	120	−8	0	0	15
120	140	−8	0	0	15
140	160	−8	0	0	15
160	180	−10	0	0	20
180	200	−10	0	0	20
200	225	−10	0	0	20

Moment Rigidity

Fig.6 to Fig.9 show moment rigidity diagrams for the Cross-Roller Ring as a separate unit. Rigidity is affected by the deformation of the housing, presser flange and bolts. Therefore, the strength of these parts must be taken into account.

(Radial clearance: 0)

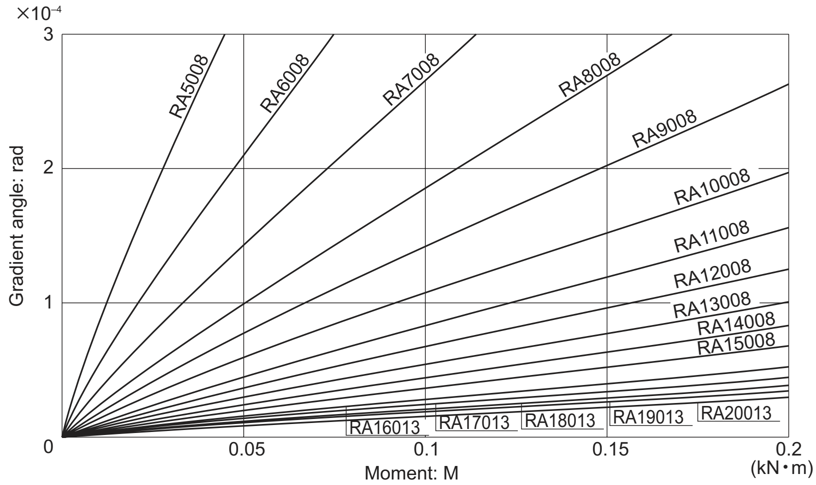


Fig.6

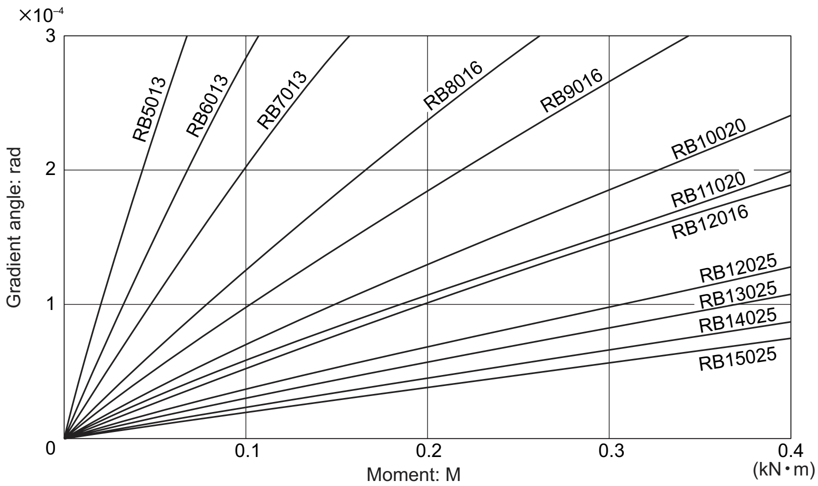


Fig.7

Cross-Roller Ring

dammy

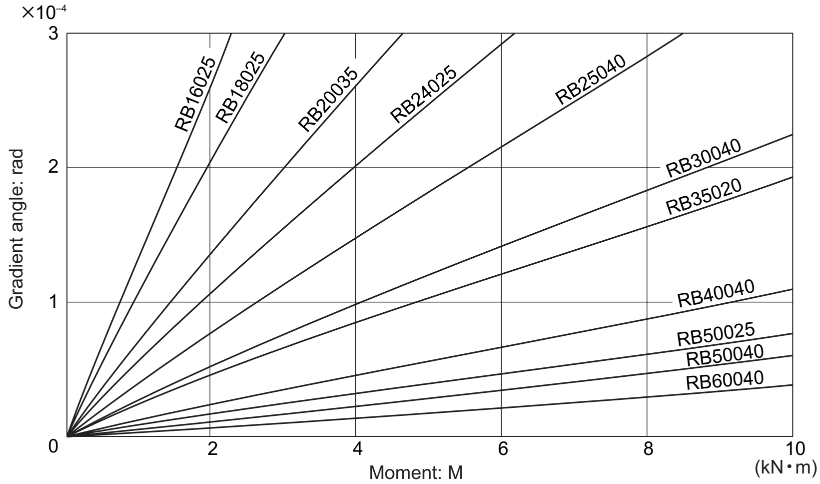


Fig.8

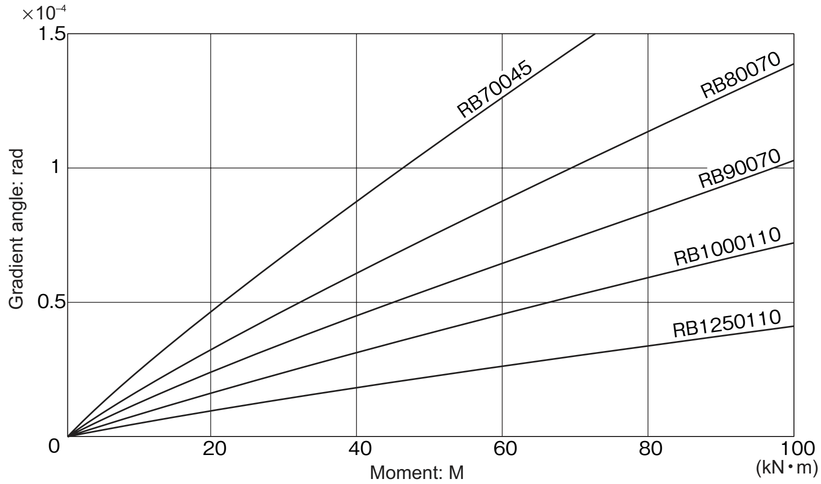


Fig.9

Fit

[Fitting of Models RU]

Fitting for model RU is basically not required. However, for fitting requiring positioning accuracy, h7 and H7 are recommended.

[Fitting of Models RB, RE and RA]

For the fitting of models RB, RE and RA, we recommend using the combinations indicated in Table1.

Table1 Fitting of Models RB, RE and RA

Radial clearance	Service condition		Shaft	Housing
C0	Inner ring rotational load	Normal load	h5	H7
		Large impact and moment	h5	H7
	Outer ring rotational load	Normal load	g5	Js7
		Large impact and moment	g5	Js7
C1	Inner ring rotational load	Normal load	j5	H7
		Large impact and moment	k5	Js7
	Outer ring rotational load	Normal load	g6	Js7
		Large impact and moment	h5	K7

Note) For the fitting for clearance CC0, avoid interference because it will cause an excessive preload. As for the fitting when you have selected clearance CC0 for the joints or swiveling unit of a robot, the combination of g5 and H7 is recommended.

[Fitting of the USP-grade]

For the fitting of the USP-grade series of models RB and RE, we recommend using the combinations indicated in Table2.

Table2 Fitting of the USP-grade

Radial clearance	Condition	Shaft	Housing
CC0	Inner ring rotational load	h5	J7
	Outer ring rotational load	g5	Js7
C0	Inner ring rotational load	j5	J7
	Outer ring rotational load	g5	K7

[Fitting for Model RA-C]

For the fitting of model RA-C, we recommend using the combinations indicated in Table3.

Table3 Fitting for Model RA-C

Radial clearance	Condition	Shaft	Housing
CC0	Inner ring rotational load	h5	J7
	Outer ring rotational load	g5	Js7
C0	Inner ring rotational load	j5	J7
	Outer ring rotational load	g5	K7

Designing the Housing and the Presser Flange

Since the Cross-Roller Ring is a compact, thin device, special consideration must be given to the rigidity of the housing and the presser flange.

With types having a separable outer ring, insufficiency in the strength of the housing, pressure flange or the presser bolt will result in the inability to evenly hold the inner or outer ring, or the deformation of the bearing when a moment load is applied. Consequently, the contact area of the rollers will become uneven, causing the bearing's performance to significantly deteriorate.

Fig.2 shows examples of installing the Cross-Roller Ring.

[Housing]

When determining the thickness of the housing, make sure it is at least 60% of the sectional height of the bearing as a guide.

$$\text{Housing thickness } T = \frac{D-d}{2} \times 0.6 \text{ or greater}$$

(D: outer diameter of the outer ring;
d: inner diameter of the inner ring)

If tapped holes for removing the inner or outer ring (Fig.1) are provided, the ring can be removed without causing damage to the bearing. When removing the outer ring, do not press the inner ring, or vise versa. For the dimensions of the presser on the side(s), see the shoulder dimensions indicated in the corresponding specification table.

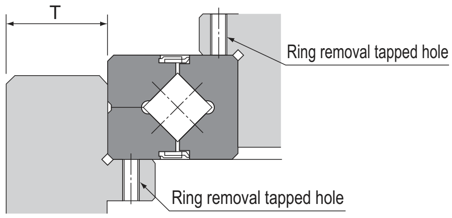


Fig.1

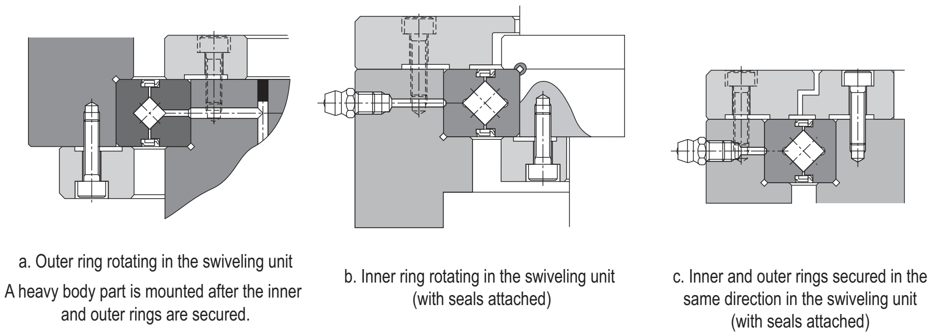


Fig.2 Example of Installation

[Presser Flange and Presser Bolt]

When determining the thickness of the presser flange (F) or the clearance of the flange section (S), refer to the dimensions indicated below as a guide.

As for the number of the presser bolts, the greater the number of the bolts, the more stable the system becomes. As a guide, however, it is normally appropriate to use the number of bolts indicated in Table4 and equidistantly arrange them.

F = B×0.5 to B×1.2

H = $B^{0}_{-0.1}$

S = 0.5 mm

Even if the shaft and the housing are made of light alloy, it is recommendable to select a steel-based material for the presser flange.

When tightening the presser bolts, firmly secure them using a torque wrench or the like so that they will not loosen. Table5 shows tightening torques for the housing and presser flanges made of typical steel materials with medium hardness.

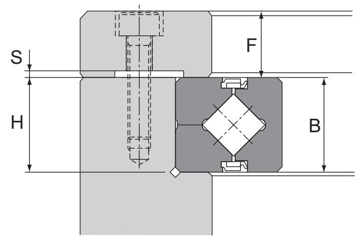


Table4 Number of Presser Bolts and Bolt Sizes

Unit: mm

Outer diameter of the outer ring (D)		No. of bolts	Bolt size (reference value)
Above	Or less		
—	100	8 or more	M3 to M5
100	200	12 or more	M4 to M8
200	500	16 or more	M5 to M12
500	—	24 or more	M12 or thicker

Table5 Bolt Tightening Torque

Unit: N-m

Screw model No.	Tightening torque	Screw model No.	Tightening torque
M3	2	M10	70
M4	4	M12	120
M5	9	M16	200
M6	14	M20	390
M8	30	M22	530

Procedure for Assembly

When assembling the Cross-Roller Ring, follow the steps below.

[Inspecting the Parts before Assembling Them]
Thoroughly clean the housing and other parts to be assembled, and check if there is no burr or knots.

[Installing the Cross-Roller Ring into the Housing or onto the Shaft]
Since the Cross-Roller Ring is a thin bearing, it tends to tilt as it is installed. To prevent it, gradually drive the Cross-Roller Ring into the housing or onto the shaft by gently hitting it with a plastic hammer while keeping it horizontal. Be sure to keep hammering it with much care until you hear it fully contact the reference surface.

[Attaching the Presser Flange]
(1) Place the presser flange onto the Cross-Roller Ring. Rock the flange several times to match the bolt holes.
(2) Insert the presser bolts into the holes. Manually turn the bolts and make sure they do not show skewing caused by misalignment of the holes.
(3) Fasten the presser bolts in three to four steps from temporary to full fastening by repeatedly securing the bolts in the diagonal order, as shown in Fig.1. When tightening the separable inner or outer ring, slightly turning the integral outer or inner ring will correct the dislocation between the ring and the body.

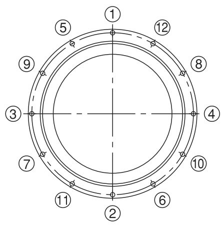


Fig.1 Tightening Sequence

[Handling]

(1) The separable inner or outer ring is fastened in place using special rivets, bolts or nuts when delivered. When installing it to the system, do not disassemble it. Also, erroneously installing the spacer retainer will significantly affect the rotational performance of the system. Do not disassemble the bearing.
(2) The matching mark of the inner or outer ring may be slightly misaligned when delivered. In that case, loosen the bolts that secure the inner or outer ring, and correct the alignment using a plastic hammer or the like, before installing it to the housing. (Let the securing rivets follow the housing.)
(3) When installing or removing the Cross-Roller Ring, do not apply force to the fixing rivets or the bolts.
(4) When mounting the presser flange, take into account the dimensional tolerances of the parts so that the flange firmly holds the inner and outer ring from the side.
(5) Dropping or hitting the Cross-Roller Ring may damage it. Giving an impact force to the bushing could also cause damage even if the product looks intact.

[Lubrication]

(1) Since each Cross-Roller Ring unit contains high-quality lithium soap group grease No. 2, you can start using the product without replenishing grease. However, the product requires regular lubrication since it has a smaller internal space than ordinary roller bearings and because the rollers need frequent lubrication due to their rolling contact structure.
To replenish grease, it is necessary to secure greasing holes that lead to the oil grooves formed on the inner and outer rings. As for the lubrication interval, normally replenish grease of the same group so that it is distributed throughout the interior of the bearing at least every six to twelve months.
When the bearing is filled up with grease, the initial rotational torque temporarily increases. However, surplus grease will run off of the seals and the torque will return to the normal level in a short period. The thin type does not have an oil groove. Secure an oil groove inside the housing for lubrication.
(2) Do not mix greases with different physical properties.
(3) In locations exposed to constant vibrations or in special environments such as clean rooms, vacuum and low/high temperature, normal lubricants may not be used. Contact THK for details.
(4) When planning to use a special lubricant, contact THK before using it.

[Precautions on Use]

(1) Entrance of foreign material may cause damage to the ball circulating path or functional loss. Prevent foreign material, such as dust or cutting chips, from entering the system.
(2) Contact THK if you desire to use the product at a temperature of 80℃ or higher.
(3) If planning to use the Cross-Roller Ring in an environment where a coolant penetrates into the product, contact THK.
(4) If foreign material adheres to the product, replenish the lubricant after cleaning the product.
(5) When using the product in locations exposed to constant vibrations or in special environments such as clean rooms, vacuum and low/high temperature, contact THK in advance.