CROSSED ROLLER BEARING

THB

THB BEARINGS CO.,LTD.

THB

Have you met any following conditions regarding bearings & its neighboring parts?

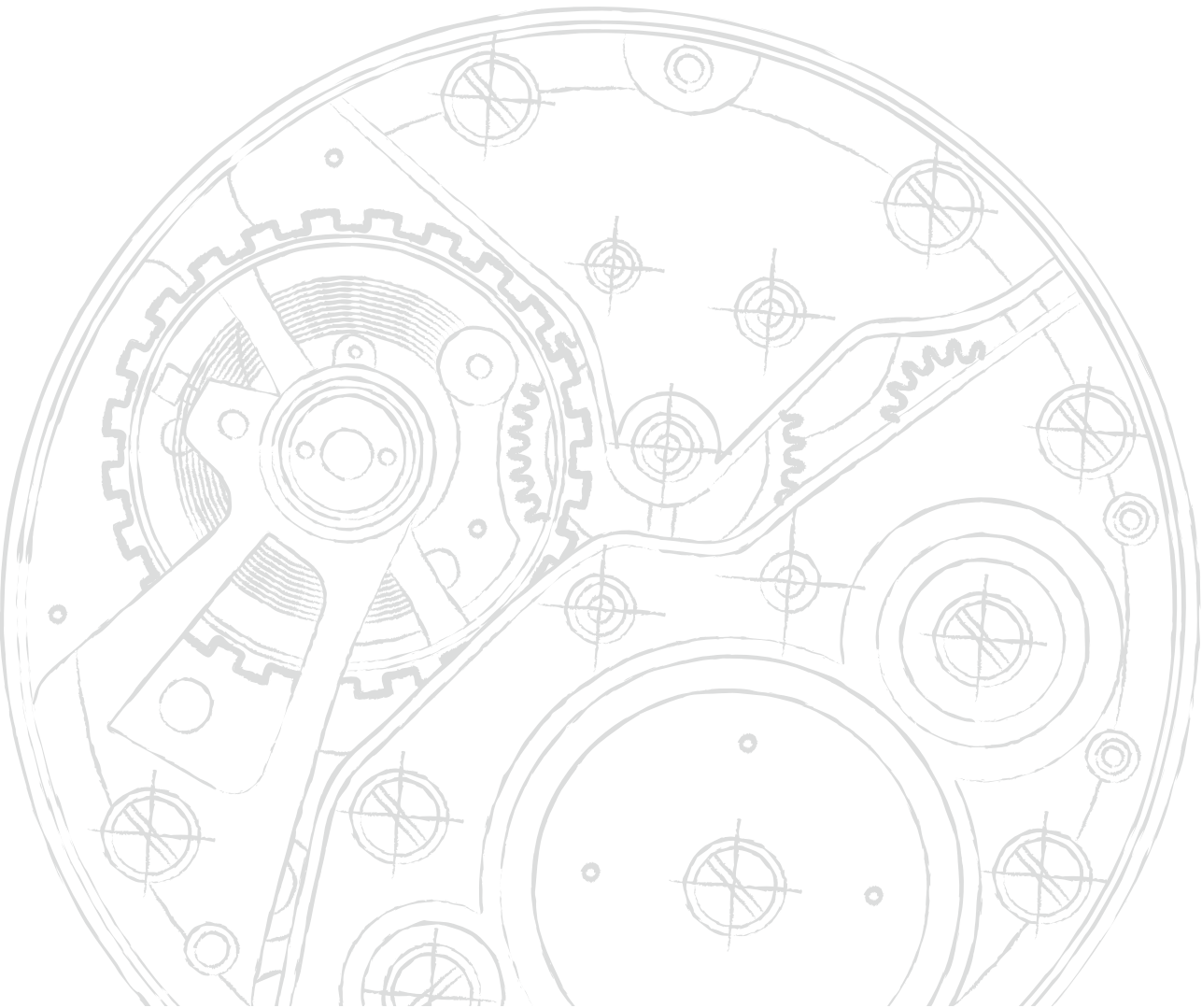Heavy noise

Frequent failures

Overheating of operation

Shorter service life

Do you want to find out the causes and get effective solutions?

THB can help you do that.

THB

THB's specialized technical services for various applications **include**

INCLUDE

DESIGN SELECTION

STATUS ANALYSIS

AFTER SALES SERVICES

Application analysis

To understand the difficulties in the transmission system; to prevent clients from potential problems in equipment design or operation.

Product selection

To provide advices for selecting optimal bearing, in order to match clients' design requirements based on application characteristics.

Application of special technologies

Depending on the application, special technologies (e.g., special coatings) will be selected to adapt to client's extreme working condition.

Customizing bearing units products

To customize the complete mechanical unit, including bearings. Which can benefit both operation precision and assembly efficiency for clients.

Optimization of design

Through analysis and optimization of the existing transmission design, enable the equipment to run faster at less energy consumption, as well as increasing reliability.
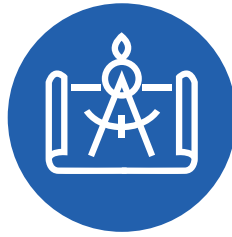
Performance Test

To use simulation software analysis and actual testing of the test machine to determine whether the bearings and its surrounding components could meet the requirements of the client (load, speed, temperature rise, noise and service life).

Failure analysis

To analyze the materials, geometrical accuracy, surface damage and microstructure to identify the cause of any failure and then to provide an effective solution timely.

Lubrication analysis and management

To analyze the equipment operation status and determine the lubrication management plan, including the selection of lubricants; lubricants application method and optimal lubrication cycle. Thus, it may help optimize the maintenance plan and improve the equipment efficiency.
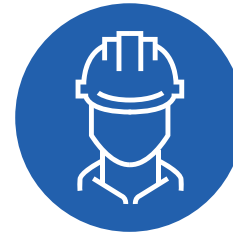
Bearing application training

To provide clients with professional training in product selection, application technologies, installation and maintenance to help them improve their competitiveness.

ndustrial bearing remanufacturing

To provide diagnostic and effective remanufacturing services for heavy-duty, high-value products with long production cycles to extend bearing life and reduce costs.

Maintenance solutions

Based on the characteristics of the industry and equipment operation, we can provide targeted maintenance and upgrade solutions to aid concern identification and improve equipment performance at an early stage.

Who is THB

THB-
a bearing technical service engineer at the R&D center who simulates the client's equipment conditions with professional design software to give professional bearing selection and design optimization advices.

THB-
a bearing application engineer with extensive experience in equipment manufactuning and operation sites, focusing on researching and solving bearing problems.

THB-
a Chinese craftsman who provides clients with high quality products, focusing on bearing manufacturing processes and bearing quality control.

THB is your technical advisor and business partner for various applications.

Contents

Overview

The crossed roller bearing is formed by arranging the appropriate rollers between the inner ring and the outer ring at 1:1. Its structure is compact and its rolling surfaces contact the rings at lines, so its rings and the rolling elements are less deformed when it is under pressure. It can bear the combined loads of the radial load, the axial load, the moment load, etc. at the same time. Such bearings are widely used in situations where high rigidity and high rotation accuracy are required and bearing size is small, such as the rotation positions of the industrial robots, the machine tools and the medical equipment. Multiple structures such as the cage, spacers and full rollers are available between the rolling elements inside the crossed cylindrical roller bearing. These structures can be selected according to the applications. The bearing with spacers is suitable for the applications with a small rotation moment and a high rotation speed, while that of a full roller structure is suitable for the applications with a low rotation speed and a heavy load.

The crossed roller bearing is sealed (uu). The sealing rings are fitted on both sides of the bearing to seal the bearing against dust and leakage of grease.

Now we can produce the crossed roller bearing product series of different structures such as those with mounting holes, those with a cage, those with spacers, those with full rollers and those with seals on both sides according to the operation requirements, and the accuracy class is up to P2.

Major Features of Precision Crossed Roller Bearings of THB

High Rigidity, High Positioning Accuracy and Smooth Rotation

The rolling elements of the cylindrical rollers are arranged perpendicular (at 90°) to each other inside the crossed roller bearing. The roller elements contact the raceway at lines, and the rings and the rolling elements are less deformed when the bearing is under pressure, so the operation rigidity of the bearing is high when it is working. The cage or spacers can be placed between the rollers to prevent the rollers from slanting or rubbing with each other to increase the smoothness of rotation and the rotation speed in the operation.

Convenient mounting

The two half outer or inner rings or the one-piece structure with a filling hole of the bearing are fixed together after the rollers are placed inside. It is very easy to mount the bearing.

High Bearing Capacity to Bear Combined Radial and Axial Load and Overturning Moment

The rollers are arranged perpendicular to each other on the rolling surface of the 90° V-shaped raceway through the spacing retainer. With such design, the crossed roller bearing can bear large loads from all directions such as the radial load, the axial load and the overturning force.

Small Mounting Space and Highly Economic

The dimensions of the inner and outer rings of the crossed roller bearing is minimized. Especially, the bearing with a super-thin structure has an overall size close to the limit. However, the bearing remains highly rigid. It is suitable for a lot of applications such as the joints or rotating parts of the industrial robots, the rotating working table of the mechanical machining centers, the rotating parts of the manipulators, the rotating precision working tables, the medical equipment, the measuring equipment and the manufacturing device for ICs.

Classification of Precision Crossed Roller Bearings of THB

RB Type (Separable outer ring type for inner ring rotation)

The RB series are the basic type of the crossed cylindrical roller bearings. The dimensions of their inner and outer rings are minimized. Their outer ring is two half rings fixed with bolts or special rivets, and their inner ring is a one-piece design. They are suitable for parts which require high rotation accuracy of the inner ring, such as the rotating parts of the indexing table of machine tools.

SX Type (Separable outer ring type for inner ring rotation)

The dimensions of the inner and outer rings of the models of the SX series are minimized. Their outer ring is two half rings fixed with a radial connecting ring, and their inner ring is a one-piece design. They are suitable for parts which require high rotation accuracy of the inner ring, such as the rotating parts of the indexing table of machine tools.

RE Type (Separable outer ring type for inner ring rotation)

The models of the RE series are a new type deriving from the design concept of the RB type. Their major dimensions are the same as those of the RB type. Their inner ring is two half rings, and their outer ring is a one-piece design. They are suitable for parts which require high rotation accuracy of the outer ring.

XV Type (Separable inner ring type for outer ring rotation, both inner ring and outer ring with mounting holes)

The outer ring of the models of the XV series is a one-piece design with a filling hole, their inner ring is two half rings, and there is a dustproof fixing metal ring between their inner and outer rings to protect them from dust and ensure the integration of their inner and outer rings. It is convenient to mount them. They are suitable for parts which require high rotation accuracy of the outer ring.

CRBH Type (High rigidity type, both inner ring and outer ring are integrated)

The inner and outer rings of the models of the CRBH series are both a one-piece design with a one-piece ring raceway. There is a filling hole in their outer ring. Their rigidity is high and their rotation accuracy is good. Meanwhile, their smooth rotation is ensured as they are provided with the quality raceway and spacers.

CRBS Type (Ultra-thin wall type, both inner ring and outer ring are integrated)

The inner and outer rings of the CRBS series are both a one-piece design with a one-piece ring raceway. There is a filling hole in their outer ring. The thickness of their rings are as thin as close to the limit, so the weight of the mechanism is effectively reduced. As it is easy to mount them and as they are extremely thin, they are most suitable for the applications which require a high rigidity and high accuracy of the inner and outer rings.

RA Type (Ultra-thin wall type, separable outer ring, integrated inner ring)

The outer ring of the models of the RA series is two half rings, and their inner ring is a one-piece design. The thickness of their rings is as thin as close to the limit, so the weight of the mechanism is effectively reduced. Both their bearing housing and the side compression flange can be lightweight. They are most suitable for the rotating joints of the hands of robots.

RU Type (Integrated inner and outer ring type, with high rigidity and mounting holes)

The inner and outer rings of the RU series are a one-piece design. As there are mounting holes in their inner and outer rings, no fixing flange or supporting housing is required. In addition, as their one-piece inner and outer rings are provided with a housing, their mounting can hardly affect their performance, so the stable rotation accuracy and torque can be achieved. They are suitable for the rotating mechanisms on their outer ring or inner ring.

Precision level of Precision Crossed Roller Bearings of THB

See the data listed below for the requirements for the rotation accuracy of the precision crossed roller bearings of the THB:

Unit: μm

Rotation Accuracy of Inner Ring of RB/CRBH Type

Nominal dimension of inner diameter (d) of bearing (mm)		Radial Runout					Axial Runout				
More than	Equal to or less than	Class P0	Class P6	Class P5	Class P4	Class P2	Class P0	Class P6	Class P5	Class P4	Class 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	-	-	-	-

Unit: μm

Rotation Accuracy of Outer Ring of RE/CRBH Type

Nominal dimension of outer diameter (D) of bearing (mm)		Radial Runout					Axial Runout				
More than	Equal to or less than	Class P0	Class P6	Class P5	Class P4	Class P2	Class P0	Class P6	Class P5	Class P4	Class 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	-	-	-	-

Rotation Accuracy of Inner/Outer Ring of RU Type

Model	Radial/axial Runout of Inner Ring			Radial/axial Runout of Outer Ring		
	Class P5	Class P4	Class P2	Class P5	Class P4	Class P2
RU 42	4	3	2.5	8	5	4
RU 66	5	4	2.5	10	6	5
RU 85	5	4	2.5	10	6	5
RU124(G)	5	4	2.5	13	8	5
RU124X	5	4	2.5	13	8	5
RU148(G)	6	5	2.5	15	10	7
RU148X	6	5	2.5	15	10	7
RU178(G)	6	5	2.5	15	10	7
RU178X	6	5	2.5	15	10	7
RU228(G)	8	6	5	18	11	7
RU228X	8	6	5	18	11	7
RU297(G)	10	8	5	20	13	8
RU297X	10	8	5	20	13	8
RU445(G)	15	12	7	25	16	10
RU445X	15	12	7	25	16	10

Unit: μm

Rotation Accuracy of Inner/Outer Ring of SX Type

Model	Radial Runout	Axial Runout	Model	Radial Runout	Axial Runout
SX011814	10	10	SX011840	15	10
SX011818	10	10	SX011848	20	10
SX011820	10	10	SX011860	20	10
SX011824	10	10	SX011868	25	10
SX011828	15	10	SX011880	30	10
SX011832	15	10	SX0118/500	40	10
SX011836	15	10			

Note: As the outer ring is two half rings, its runout value is the value when the two half rings are fixed together. Please consult the THB if any accuracy higher than the listed values is required.

Unit: μm

Rotation Accuracy of Inner/Outer Ring of XV Type

Model	Radial Runout	Axial Runout	Model	Radial Runout	Axial Runout
XV30	10	10	XV80	10	10
XV40	10	10	XV90	10	10
XV50	10	10	XV100	10	10
XV60	10	10	XV110	10	10
XV70	10	10			

Note: Please consult the THB if accuracy higher than the listed values is required.

Unit: μm

Rotation Accuracy of Inner Ring of CRBS/RA Type

Nominal dimension of inner diameter of bearing (d) (mm)		Radial/axial runout	Nominal dimension of inner diameter of bearing (d) (mm)		Radial/axial runout
More than	Equal to or less than	Permissible value	More than	Equal to or less than	Permissible value
40	65	13	120	140	25
65	80	15	140	180	25
80	100	15	180	200	30
100	120	20			

Unit: μm

Rotation Accuracy of Outer Ring of CRBS/RA Type

Nominal dimension of outer diameter of bearing (d) (mm)		Radial/axial runout	Nominal dimension of outer diameter of bearing (d) (mm)		Radial/axial runout
More than	Equal to or less than	Permissible value	More than	Equal to or less than	Permissible value
65	80	13	140	180	25
80	100	15	180	200	25
100	120	15	200	250	30
120	140	20			

Note: Please consult the THB to see if any rotation accuracy of the inner ring of the CRBS/RA type higher than the listed accuracy is required.

See the data listed below for the requirements for the dimension tolerance of the precision crossed roller bearings of the THB:

Unit: μm

Dimensional Tolerance of Inner Diameter of RB/RE/CRBH Type

Nominal dimension of inner diameter of bearing (d) (mm)		Tolerance of dm							
		Class P0		Class P6		Class P5		Classes P4 and P2	
More than	Equal to or less than	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	-	-	-	-	-	-

Dimensional Tolerance of Outer Diameter of RB/RE/CRBH Type

Nominal dimension of outer diameter of bearing (D) (mm)		Tolerance of dm							
		Class P0		Class P6		Class P5		Classes P4 and P2	
More than	Equal to or less than	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	-	-	-	-	-	-

Dimensional Tolerance of Inner and Outer Diameter of SX Type

Model	Tolerance of dm		Tolerance of Dm	
	Upper	Lower	Upper	Lower
SX011814	+4	-15	0	-22
SX011818	+4	-18	0	-22
SX011820	+4	-18	0	-25
SX011824	+4	-18	0	-25
SX011828	+4	-21	0	-25
SX011832	+4	-21	0	-29
SX011836	+4	-21	0	-29
SX011840	+4	-24	0	-29
SX011848	+5	-24	0	-32
SX011860	+5	-27	0	-36
SX011868	+7	-29	0	-40
SX011880	+7	-29	0	-40
SX0118/500	+8	-32	0	-40

Note: Please consult the THB if accuracy higher than the listed values is required.

Dimensional Tolerance of Inner and Outer Diameter of XV Type

Model	Tolerance of dm		Tolerance of Dm	
	Upper	Lower	Upper	Lower
XV30	+8	-5	0	-19
XV40	+10	-6	0	-22
XV50	+10	-6	0	-22
XV60	+13	-6	0	-22
XV70	+13	-6	0	-22
XV80	+13	-6	0	-25
XV90	+16	-6	0	-25
XV100	+16	-6	0	-25
XV110	+16	-6	0	-25

Note: Please consult the THB if accuracy higher than the listed values is required.

Tolerance of Width of Inner/outer Ring of RB/RE/CRBH Type

Nominal dimension of inner diameter (d) of bearing		Tolerance of B		Tolerance of B1	
		Applicable to the inner ring of the RB type and the outer ring of the RE type		Applicable to the outer ring of the RB type and the inner ring of the RE type	
More than	Equal to or less than	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: The tolerance of the width of the CRBS and RA is both -0.120~0mm. Please consult the THB if any accuracy higher than the listed values is required.

Tolerance of Width of SX Type

Model	B		C	
	Upper	Lower	Upper	Lower
SX011814	0	-10	+100	-100
SX011818	0	-10	+120	-120
SX011820	0	-10	+120	-120
SX011824	0	-10	+120	-120
SX011828	0	-10	+120	-120
SX011832	0	-25	+130	-130
SX011836	0	-25	+130	-130
SX011840	0	-25	+130	-130
SX011848	0	-25	+130	-130
SX011860	0	-50	+140	-140
SX011868	0	-50	+140	-140
SX011880	0	-50	+150	-150
SX0118/500	0	-50	+160	-160

Note: Please consult the THB if accuracy higher than the listed values is required.

Tolerance of Width of XV Type

Model	C		B	
	Upper	Lower	Upper	Lower
XV30	0	-100	0	-75
XV40	0	-100	0	-75
XV50	0	-100	0	-75
XV60	0	-100	0	-75
XV70	0	-100	0	-75
XV80	0	-100	0	-75
XV90	0	-100	0	-75
XV100	0	-100	0	-75
XV110	0	-100	0	-75

Note: Please consult the THB if accuracy higher than the listed values is required.

Tolerance of Width of Inner/outer Ring of RU Type

Model	B/C	
	Upper	Lower
RU42	0	-75
RU66	0	-75
RU85	0	-75
RU124(G)	0	-75
RU124X	0	-75
RU148(G)	0	-75
RU148X	0	-75
RU178(G)	0	-100
RU178X	0	-100
RU228(G)	0	-100
RU228X	0	-100
RU297(G)	0	-100
RU297X	0	-100
RU445(G)	0	-100
RU445X	0	-100

Note: Please consult the THB if accuracy higher than the listed values is required.

See the data listed below for the requirements for the radial clearance of the precision crossed roller bearings of the THB:

Unit: μm

Internal Radial Clearance of RB/RE/CRBH/XV Bearings

Nominal dimension of inner diameter (d) of bearing		CC0		C0		C1	
More than	Equal to or less than	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
-	30	-10	0	0	10	10	20
30	40	-10	0	0	10	10	20
40	50	-10	0	0	10	10	25
50	65	-10	0	0	10	10	25
65	80	-10	0	0	15	15	30
80	100	-10	0	0	15	15	35
100	120	-15	0	0	15	15	35
120	140	-15	0	0	20	20	45
140	160	-15	0	0	20	20	50
160	200	-15	0	0	20	20	50
200	250	-20	0	0	25	25	60
250	315	-20	0	0	25	25	60
315	400	-25	0	0	30	30	70
400	500	-30	0	0	40	40	85
500	630	-30	0	0	50	50	100
630	710	-30	0	0	60	60	120
710	800	-40	0	0	70	70	140

Internal Radial Clearance of CRBS/RA Bearings

Nominal dimension of inner diameter (d) of bearing	CC0		C0		C1	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
50	-8	0	0	15	30	56
60	-8	0	0	15	30	56
70	-8	0	0	15	30	56
80	-8	0	0	15	41	66
90	-8	0	0	15	41	66
100	-8	0	0	15	41	66
110	-8	0	0	15	41	66
120	-8	0	0	15	51	76
130	-8	0	0	15	51	76
140	-8	0	0	15	51	76
150	-8	0	0	15	51	76
160	-10	0	0	20	51	76
170	-10	0	0	20	51	76
180	-10	0	0	20	61	86
190	-10	0	0	20	61	86
200	-10	0	0	20	61	86

Internal Radial Clearance of RU Bearings

Model	CC0		C0	
	Minimum	Maximum	Minimum	Maximum
RU42	-10	0	0	25
RU66	-10	0	0	30
RU85	-10	0	0	40
RU124(G/X)	-15	0	0	40
RU148(G/X)	-15	0	0	40
RU178(G/X)	-15	0	0	50
RU228(G/X)	-15	0	0	60
RU297(G/X)	-20	0	0	70
RU445(G/X)	-25	0	0	100

Internal Radial Clearance of SX Bearings

Model	CC0		C0		C1	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
SX011814	-15	-3	-6	3	0	10
SX011818	-15	-3	-6	3	0	10
SX011820	-20	-5	-8	4	0	20
SX011824	-20	-5	-8	4	0	20
SX011828	-20	-5	-8	4	0	20
SX011832	-20	-5	-8	4	0	20
SX011836	-25	-5	-10	5	0	25
SX011840	-25	-5	-10	5	0	25
SX011848	-25	-5	-10	5	10	30
SX011860	-25	-5	-10	5	10	40
SX011868	-25	-5	-10	5	10	40
SX011880	-25	-5	-10	5	10	50
SX0118/500	-30	-5	-12	6	10	60

Selection of Precision Crossed Roller Bearings of THB

The rigidity of the precision crossed roller bearings is three to four times that of the common angular contact ball bearings. The precision crossed cylindrical roller bearings do not need to be mounted together with the thin-wall angular contact ball bearings. A set of crossed roller bearings can bear the force from all the directions and their rigidity have tripled or quadrupled.

The following requirements shall be determined when you select a precision crossed roller bearing:

Determination of Operation Mode of Bearing	The method and speed of rotation of the inner ring or outer ring
	The range of allowed dimensions of the mechanism
Dimensions, Accuracy and Operation Characteristics of Bearing	The appropriate dimensions of the bearing shall be selected according to its required life.
	Operation rigidity - Determine the requirements for the clearance, rigidity and mounting position of the bearing.
	Rotation accuracy - Determine the accuracy class of the bearing.
Requirements for Rotation Moment	
Method of Oiling or Lubrication	Please contact the technical department of the THB if you are not sure during your selection of a bearing.

Basic Rated Dynamic Load and Life of Precision Crossed Roller Bearings of THB

Rated Life L

The basic dynamic load (C) of the crossed roller bearing refers to the radial load of constant value and direction of a batch of same crossed bearings operating one after another at their rated life L = 10⁶. See the dimension table for the parameters of the basic rated dynamic load (C).

The life of the crossed roller bearings is calculated according to the following formula.

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

L = Rated life
(10⁶ revolutions)

(The total number of revolutions achieved by 90% of a batch of same crossed bearings operating one after another under the same condition without surface peeling caused by the rotation fatigue)

[Figure 1 Temperature Factor Diagram]
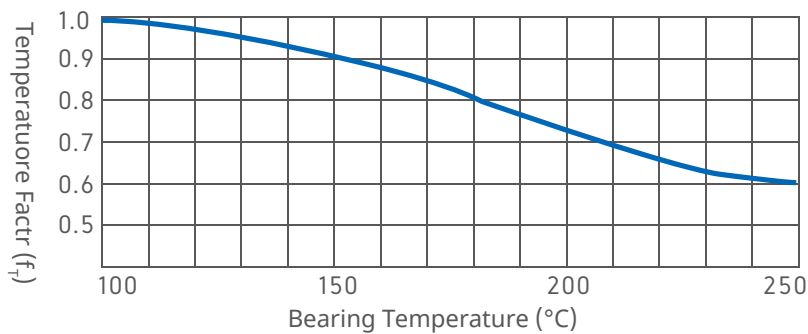
C: Basic rated dynamic load (kN) P_c: Equivalent dynamic radial Load (kN)

f_T: Temperature factor (see figure 1) f_w: Load factor (see table 1)

The usual operating temperature shall be 80°C or below. Please contact the THB if the operating temperature exceeds 80°C.

[Table 1 Load Factor (f_w)]

| Operating condition	f_w
Smooth motion without impacts	1-1.2
Normal motion	1.2-1.5
Motion with severe impacts	1.5-3

Equivalent Radial Dynamic Load

The equivalent radial dynamic load of the crossed roller bearings shall be calculated according to the following formula.

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

P_c: Equivalent dynamic radial Load

Fr: Radial load (kN)

F_a: Axial load (kN)

M: Moment (kN.mm)

X: Dynamic radial factor (see table 2)

Y: Dynamic axial factor (see table 2)

dp: Pitch circle diameter of roller (mm)

[Figure 2 Dynamic Free Body Diagram of Bearing]
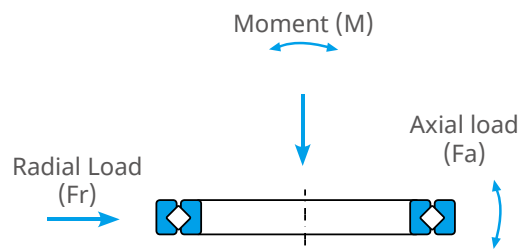
[Table 2 Dynamic Radial Factor and Dynamic Axial Factor]

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

Please do the calculation with X = 0.67 and Y = 0.67 if Fr = 0kN and if M = 0kN.mm.

Basic Rated Static Load and Static Safety Factor of Precision Crossed Roller Bearings of THB

The basic rated static load C_0 refers to the static load of a fixed direction and value on the contact area bearing the maximum stress when the sum of the amount of permanent deformation of the roller and that of the rolling surface reaches 0.0001 times the diameter of the roller. If the sum of the amount of permanent deformation exceeds 0.0001 times the diameter of the roller, the bearing will fail in its operation. See the dimension table for the parameters of this basic rated static load C_0. It is necessary to consider the following static safety factor for the static or dynamic load.

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

f_s: Static safety factor (see table 3)

C_0: Basic rated static load (kN)

P_0: Equivalent radial static load (kN)

[Table 3 Static Safety Factor (f_s)]

Load Condition	Lower Limit of f_s
Normal load	1~2
Impact load	2~3

Equivalent radial static load: P_0

The equivalent radial static load of the crossed roller bearing shall be calculated according to the following formula:

$$P_C = X_0 \cdot (F_r + \frac{2M}{dp}) + Y_0 \cdot F_a$$

P_0: Equivalent radial static load (kN) X_0: Static radial factor (X_0 = 1)

F_r: Radial load (kN) Y_0: Static axial factor (Y_0 = 0.44)

F_a: Axial load (kN)   dp: Pitch circle diameter of roller (mm)

M: Moment (kN.mm)

[Figure 3 Static Free Body Diagram of Bearing]

Moment (M)

Axial load
(Fa)

Radial Load
(Fr)

Permissible Moment: M_0
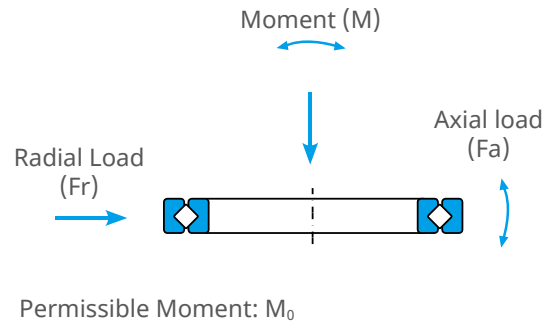
The permissible moment of the crossed roller bearing shall be calculated according to the following formula.

$$M_0 = C_0 \cdot d_p / 2$$

M_0: Permissible moment (kN.mm) C_0: Basic rated static load (kN)
d_p: Pitch circle diameter of roller (mm)

Permissible Axial load: Fa_0

The permissible axial load of the crossed roller bearing shall be calculated according to the following formula.

$$Fa_0 = C_0 / Y_0$$

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

Design of Parts Mating with Precision Crossed Roller Bearings of THB

As the crossed roller bearing has a compact structure and thin walls, pay special attention to the following factors when design its mating mechanisms and compression flange: If the rigidity of the holes of the bearing housing for the bearing with double outer rings or double inner rings is not enough, the flange or the compression bolts will cause unsmooth operation of the bearing or even sticking of the inner or outer rings and, when the mechanisms bear the load, the bearing will deform and its performance and life will be severely affected.
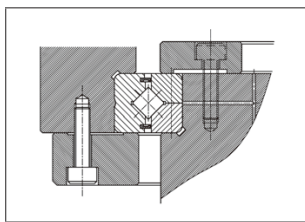
Recommended Structure Arrangement

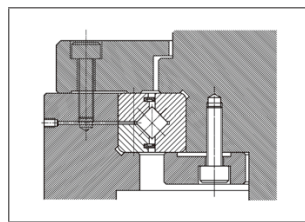Figure 4 Recommended structure form for rotating outer ring

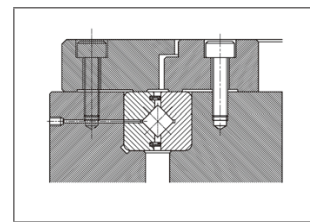Figure 5 Recommended structure form for rotating inner ring

Figure 6 Method of fixing in the same direction for rotating inner and outer rings

Requirements for Structures Mating with Bearing

The inner ring of the bearing with threaded mounting holes

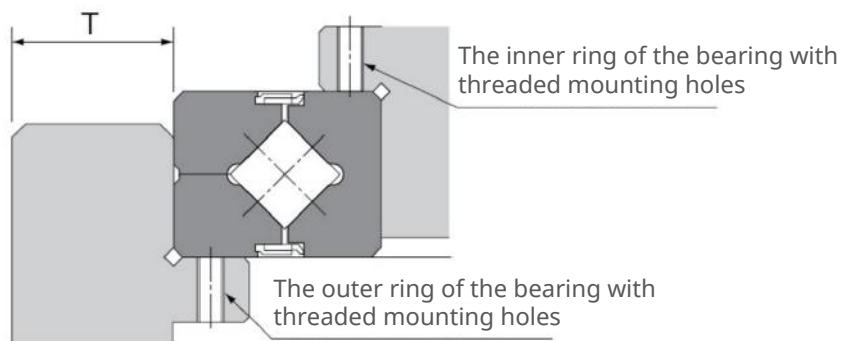The outer ring of the bearing with threaded mounting holes

Figure 7

The related structures mating with the precision crossed roller bearing shall have enough rigidity. The thickness T of the housing for the outer ring of the normal crossed roller bearing as shown in the above figure shall be:

$T \geq (D-d)/2 \times 0.6$

D - Nominal dimension of the outer diameter of the bearing

d - Nominal dimension of the inner diameter of the bearing

If there are mounting holes in both inner and outer rings of the bearing, the rigidity of the bearing shall be better than that of the common crossed roller bearings so that such structure will not cause the deformation of the bearing or affect the bearing otherwise. If the outer ring rotates, the inner ring shall not bear force, and vice versa.
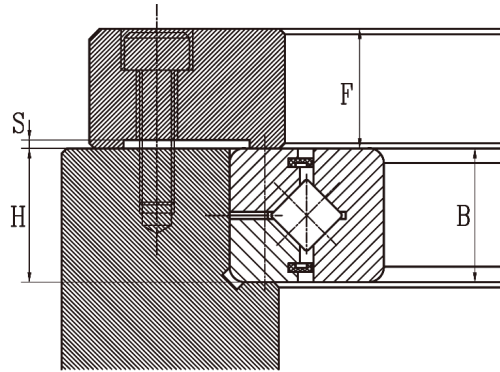

Figure 8

The requirements for the upper/lower fixing flange for the end face of the bearing are shown in the above figure, in which

F = Bx0.5~Bxl.2	Thickness of the flange
$H = B_{-0.1}^{0}$	Height of the bearing housing
S = 0.5mm	The reserved compression gap between the compression surface of the flange and the end faces of the bearing and the supporting housing.

The thickness (F) of the compression flange and the gap (S) between the flange and the mating surfaces shall be calculated according to the above formula in the design. As for the quantity of the bolts, the more the bolts, the stabler the mechanism by principle. Usually, the quantity of the bolts indicated in the following section shall be equally spaced.

The bearing housing and the shaft shall be made of lightweight aluminum, and the steel flange is recommended.

The parts mating with the bearing shall be rigid enough and the surface of the compression flange shall be separated from the contact surfaces of the end face of the supporting housing and the bearing with a certain gap S so that the deformation caused by insufficient rigidity of part structure, which would affect the rotation accuracy and smoothness of the bearing, will not happen after the end face of the bearing is compressed.

Fit Tolerance of Precision Crossed Roller Bearings of THB

There are no very strict requirements for the fit dimensions of the crossed roller bearing series with mounting holes. The shaft tolerance h7 and the housing hole tolerance H7 shall be used as the fit accuracy for mounting.

Please see the parameters in table 4 for the fit tolerance of the common crossed roller bearing series.

[Table 4 Radial Clearance Table for Common Bearing Series]

Clearance	Application		Fit tolerance	
			Shaft	Housing hole
C0	Inner ring rotation load	Normal load	h5	H7
		Large impact and overturning moment	h5	H7
	Outer ring rotation load	Normal load	g5	Js7
		Large impact and overturning moment	g5	Js7
C1	Inner ring rotation load	Normal load	j5	H7
		Large impact and overturning moment	k5	Js7
	Outer ring rotation load	Normal load	g6	Js7
		Large impact and overturning moment	h6	k7

Note: Please avoid repeated preload for the fit with the CC0 clearance. Therefore, please use the tolerance of g5 and H7 for the joints of robots or rotary mechanisms with the clearance of the CC0 group.

See table 5 for the recommended quantity of bolts used and the required preload for the mounting of the bearing.

Meanwhile, it is recommended that the side compression flange should be made of iron again even if the shaft or the bearing housing are made of light alloy. To tighten the compression bolts, please use a torque spanner to tighten them firmly.

[Table 5 Recommended Quantity and Dimensions of
Bolts for tightening the Bearings]

Outer diameter of bearing (mm)		Recommended quantity of bolts	Recommended diameter of bolts
More than	equal to or less than		
--	100	≥8	M3-M5
100	200	≥12	M4-M8
200	500	≥16	M5-M12
500	--	≥24	M12~

The tightening torque for the bearing housing or side compression flange made of common steel of medium hardness shall be as shown in the table.

[Table 6 Recommended Preload for Tightening the Bearings]

Diameter of bolt	Torque	Diameter of bolt	Torque
M3	2	M10	70
M4	4	M12	120
M5	9	M16	200
M6	14	M20	390
M8	30	M22	530

Mounting of Precision Crossed Roller Bearings of THB

Please mount the crossed roller bearing according to the following procedure.

1. Inspection of Parts Before Mounting	Wash the bearing housing and other mounting parts to remove the dirt, and confirm if the burrs have been removed from each part.

2. Proper Mounting	The thin-wall bearing tends to slant when it is being mounted. Please use a plastic hammer or the like to align it, and at the same time hit its periphery evenly to mount it little by little until it is confirmed through the sound that it tightly contacts the contact surface.
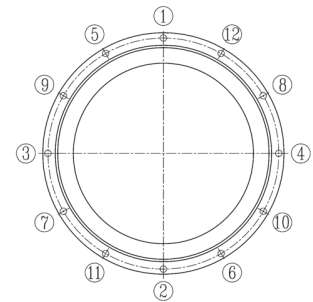
Figure 9 Tighten the bolts in the above order in the cross way in 2-3 cycles

3. Tightening of Bearing

1) Place the side compression flange properly, and shake it by turning it clockwise and counterclockwise for several times to adjust its position for mounting the bolts.

2) Mount the compression bolts When tightening the bolts with your hand, confirm they are not put in in a difficult way due to the misalignment of the bolt holes.

3) First tighten the compression bolts tentatively, and then tighten them properly. Complete the whole process in 3-4 stages. Tighten them repeatedly in the diagonal order. To tighten the compression bolts to fix the two-half inner/outer rings, frequently turn the one-piece inner/outer ring slightly while tightening them so that the misalignment of the two half rings can be corrected.

Lubrication of Precision Crossed Roller Bearings of THB

All the crossed roller bearings have been filled with No. 2 lithium-based grease of high quality, so they can be directly used once received. However, as their internal space is small compared with the space of the common roller bearings, and as adequate lubricant is vital to their structure where the rollers contact the surface of the raceway closely, they shall be lubricated with additional grease periodically.

The lubrication with additional grease is done through the lubricant hole in the inner/outer ring which is connected to the lubricant groove. The interval for the lubrication with additional grease shall usually be 6 to 12 months even if the rotation frequency is low. Please put additional grease of the same type to every place inside the bearing in such lubrication. The relubrication interval for the applications with high-frequency rotation shall be shortened according to the operation requirements.

Meanwhile, the torque of the bearing will increase for a short time when it rotates in the early period after it is filled with grease due to the resistance of the grease. After the unnecessary grease overflows from the seal, it will return to its normal torque. Besides, there is no lubricant groove in the super-thin bearings. Please provide an appropriate lubricant groove in the part mating with the bearing for timely lubrication with additional grease.

Precautions in Use of Precision Crossed Roller Bearings of THB

The half inner/outer rings are fixed with special rivets or bolts and nuts, and they cannot be separated after fixed. Directly insert them into the bearing housing to use them.

Meanwhile, any error in reassembly of the spacing retainer will significantly affect the rotation performance of the bearings. Therefore, the users are requested not to disassemble the bearings arbitrarily.

1) Sometimes, the joint of the inner or outer ring may be misaligned more or less. Before inserting the bearing into the bearing housing, please loosen the bolts of the inner or outer ring and align it with a plastic hammer. (The fixed rivets will deform with the bearing housing.)

2) Please do not apply external force to the fixing rivets or bolts during mounting or removal.

3) Please pay attention to the dimensional tolerance of the mounting parts so that the side compression flange can firmly compress the inner or outer ring from the side.

Parameter Table

RB Type (with two half outer rings and a one-piece inner ring)

RB...

RB...UU
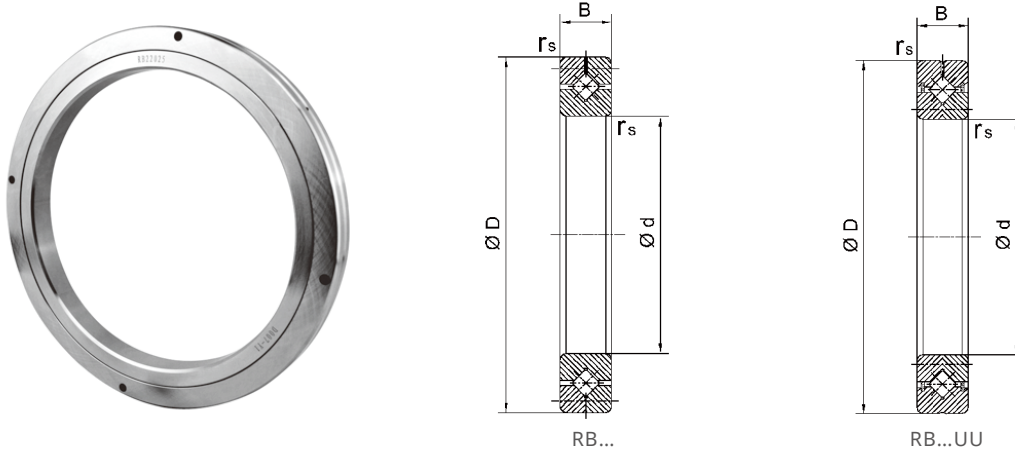
Model of bearing	Overall dimensions (mm)				Rated load (KN)		Weight
	d	D	B	r_{smin}	C_r	C_{or}	kg
RB 2008	20	36	8	0.5	3.23	3.1	0.04
RB 2508	25	41	8	0.5	3.63	3.83	0.05
RB 3010	30	55	10	0.6	7.35	8.36	0.12
RB 3510	35	60	10	0.6	7.64	9.12	0.13
RB 4010	40	65	10	0.6	8.33	10.6	0.15
RB 4510	45	70	10	0.6	8.62	11.3	0.17
RB 5013	50	80	13	0.6	16.7	20.9	0.29
RB 6013	60	90	13	0.6	18	24.3	0.33
RB 7013	70	100	13	0.6	19.4	27.7	0.38
RB 8016	80	120	16	0.6	30.1	42.1	0.74
RB 9016	90	130	16	1	31.4	45.3	0.81
RB 10016	100	140	16	1	31.7	48.6	0.83
RB 10020	100	150	20	1	33.1	50.9	1.42
RB 11012	110	135	12	0.6	12.5	24.1	0.4
RB 11015	110	145	15	0.6	23.7	41.5	0.75
RB 11020	110	160	20	1	34	54	1.56
RB 12016	120	150	16	0.6	24.2	43.2	0.72
RB 12025	120	180	25	1.5	66.9	100	2.62
RB 13015	130	160	15	0.6	25	46.7	0.72
RB 13025	130	190	25	1.5	69.5	107	2.82
RB 14016	140	175	16	1	25.9	50.1	1
RB 14025	140	200	25	1.5	74.8	121	2.96

Parameter Table

RB Type (with two half outer rings and a one-piece inner ring)

RB...

RB...UU
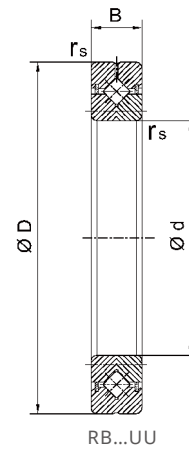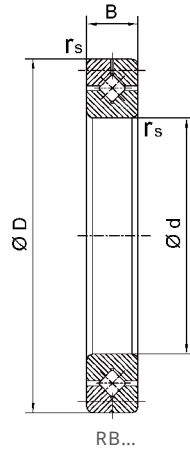
Model of bearing	Overall dimensions (mm)				Rated load (KN)		Weight
	d	D	B	r_{smin}	C_r	C_{or}	kg
RB 15013	150	180	13	0.6	27	53.5	0.68
RB 15025	150	210	25	1.5	76.8	128	3.16
RB 15030	150	230	30	1.5	100	156	5.3
RB 16025	160	220	25	1.5	81.7	135	3.14
RB 17020	170	220	20	1.5	29	62.1	2.21
RB 18025	180	240	25	1.5	84	143	3.44
RB 19025	190	240	25	1	41.7	82.9	2.99
RB 20025	200	260	25	2	84.2	157	4
RB 20030	200	280	30	2	114	200	6.7
RB 20035	200	295	35	2	151	252	9.58
RB 22025	220	280	25	2	92.3	171	4.1
RB 24025	240	300	25	2.5	68.3	145	4.5
RB 25025	250	310	25	2.5	69.3	150	4.97
RB 25030	250	330	30	2.5	126	244	8.1
RB 25040	250	355	40	2.5	195	348	14.8
RB 30025	300	360	25	2.5	76.3	178	5.88
RB 30035	300	395	35	2.5	183	367	13.4
RB 30040	300	405	40	2.5	212	409	17.2

Parameter Table

RB Type (with two half outer rings and a one-piece inner ring)

RB...

RB...UU
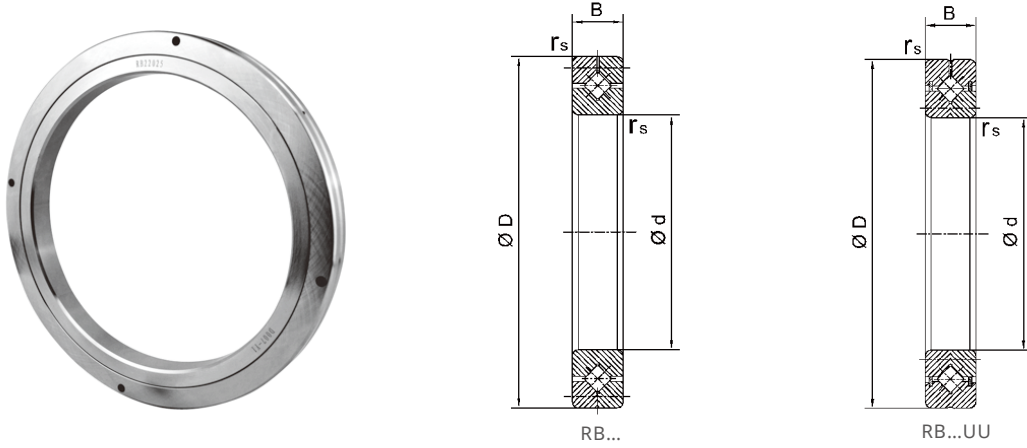
Model of bearing	Overall dimensions (mm)				Rated load (KN)		Weight
	d	D	B	r_{smin}	C_r	C_{or}	kg
RB 35020	350	A00	20	2.5	54.1	145	3.9
RB 40035	400	480	35	2.5	156	370	14.5
RB 40040	400	510	40	2.5	241	531	23.5
RB 40070	400	580	70	2.5	470	811	72.4
RB 45025	450	500	25	1	61.7	182	6.6
RB 50025	500	550	25	1	65.5	201	7.3
RB 50040	500	600	40	2.5	239	607	26
RB 50050	500	625	50	2.5	267	653	41.7
RB 50070	500	680	70	2.5	536	1020	86.1
RB 60040	600	700	40	3	264	721	30.6
RB 60070	600	780	70	3	591	1230	102
RB 600120	600	870	120	3	1250	227.	274
RB 70045	700	815	45	3	281	836	56.5
RB 70070	700	880	70	3	630	1390	115
RB 700150	700	1020	150	3	1660	3010	478
RB 80070	800	950	70	4	468	1330	109
RB 800100	800	1030	100	4	936	2040	247
RB 90070	900	1050	70	4	494	1490	120
RB 1000110	1000	1250	110	5	1220	3220	360
RB 1250110	1250	1500	110	5	1350	3970	440

Parameter Table

SX Type (with two half outer rings and a one-piece inner ring)

SX...
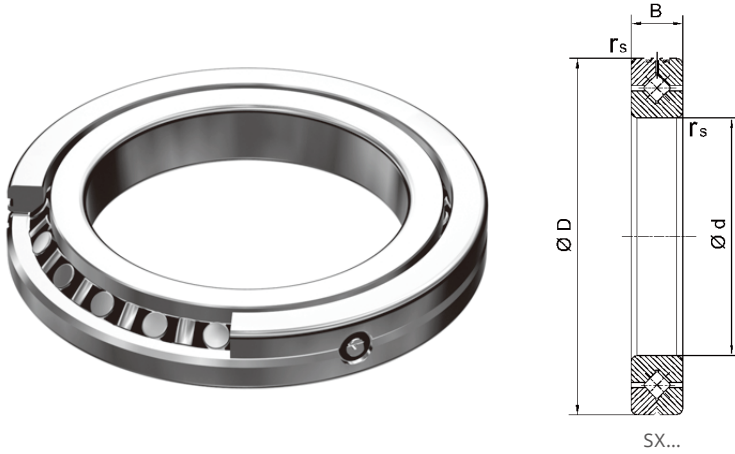
Model of bearing	Overall dimensions (mm)				Rated load (KN)		Weight
	d	D	B	r_{smin}	C_r	C_{or}	kg
SX 011814	70	90	10	0.6	11	20.4	0.3
SX 011818	90	115	13	1	18.3	36.5	0.4
SX 011820	100	125	13	1	19.4	40.5	0.5
SX 011824	120	150	16	1	27	59	0.8
SX 011828	140	175	18	1.1	45	96	1.1
SX 011832	160	200	20	1.1	48	111	0.7
SX 011836	180	225	22	1.1	69	153	2.3
SX 011840	200	250	24	1.5	72	170	3.1
SX 011848	240	300	28	2	105	255	5.3
SX 011860	300	380	38	2.1	173	425	12
SX 011868	340	420	38	2.1	185	485	13.5
SX 011880	400	500	46	2.1	275	720	24
SX 0118/500	500	620	56	3	395	1100	44

Parameter Table

RE Type (with two half outer rings and a one-piece inner ring)

RE...

RE...UU
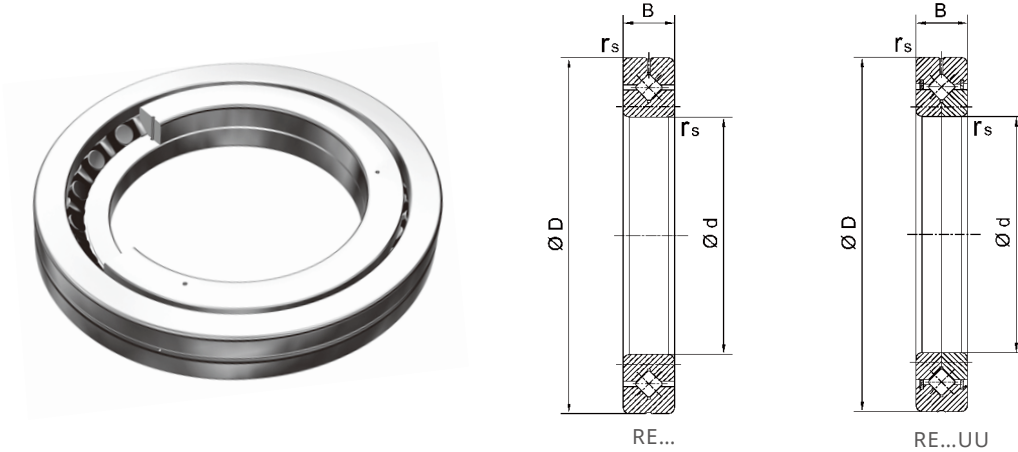
Model of bearing	Overall dimensions (mm)				Rated load (KN)		Weight
	d	D	B	r_{smin}	C_r	C_{or}	kg
RE 2008	20	36	8	0.5	3.23	3.1	0.04
RE 2508	25	41	8	0.5	3.63	3.83	0.05
RE 3010	30	55	10	0.6	7.35	8.36	0.12
RE 3510	35	60	10	0.6	3.64	9.12	0.13
RE 4010	40	65	10	0.6	8.33	10.6	0.15
RE 4510	45	70	10	0.6	8.62	11.3	0.17
RE 5013	50	80	13	0.6	16.7	20.9	0.29
RE 6013	60	90	13	0.6	18	24.3	0.33
RE 7013	70	100	13	0.6	19.4	27.7	0.38
RE 8016	80	120	16	0.6	30.1	42.1	0.74

Parameter Table

RE Type (with two half outer rings and a one-piece inner ring)

RE...

RE...UU
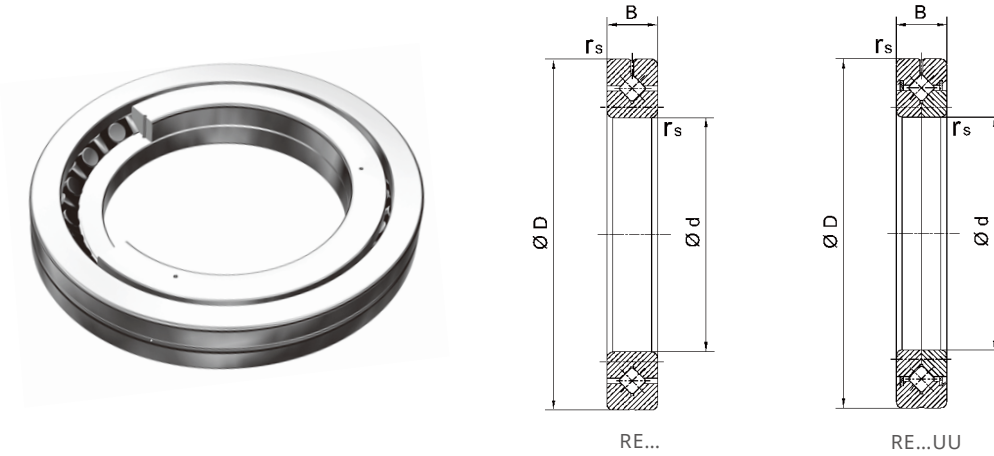
Model of bearing	Overall dimensions (mm)				Rated load (KN)		Weight
	d	D	B	r_{smin}	C_r	C_{or}	kg
RE 9016	90	130	16	1	31.4	45.3	0.81
RE 10016	100	140	16	1	31.7	48.6	0.83
RE 10020	100	150	20	1	33.1	50.9	1.45
RE 11012	110	135	12	0.6	12.5	24.1	0.4
RE 11015	110	145	15	0.6	23.7	41.5	0.75
RE 11020	110	160	20	1	34	54	1.56
RE 12016	120	150	16	0.6	24.2	43.2	0.72
RE 12025	120	180	25	1.5	66.9	100	2.62
RE 13015	130	160	15	0.6	25	46.7	0.72
RE 13025	130	190	25	1.5	69.5	107	2.82
RE 14016	140	175	16	1	25.9	50.1	1
RE 14025	140	200	25	1.5	74.8	121	2.96
RE 15013	150	180	13	0.6	27	53.5	0.68
RE 15025	150	210	25	1.5	76.8	128	3.16
RE 15030	150	230	30	1.5	100	156	5.3
RE 16025	160	220	25	1.5	81.7	135	3.14
RE 17020	170	220	20	1.5	29	62.1	2.21
RE 18025	180	240	25	1.5	84	143	3.44
RE 19025	190	240	25	1	41.7	82.9	2.99

Parameter Table

RE Type (with two half outer rings and a one-piece inner ring)

RE...

RE...UU
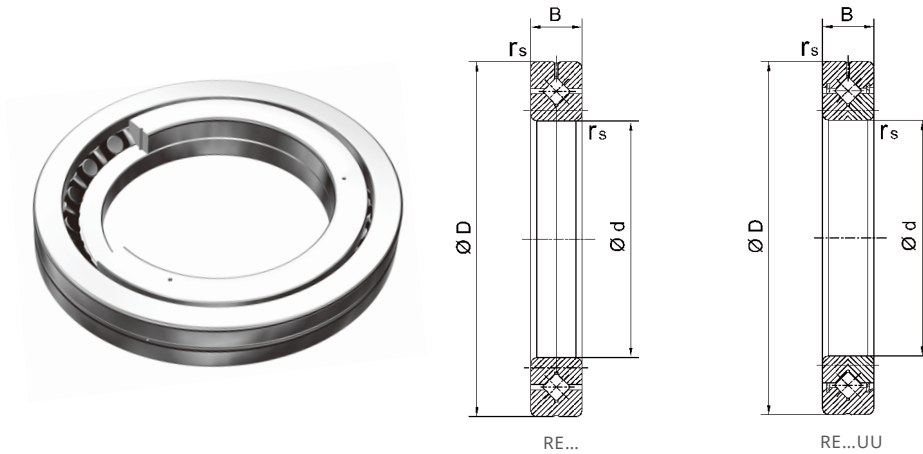
Model of bearing	Overall dimensions (mm)				Rated load (KN)		Weight
	d	D	B	r_{smin}	C_r	C_{or}	kg
RE 20025	200	260	25	2	84.7	157	4
RE 20030	200	280	30	2	114	200	6.7
RE 20035	200	295	35	2	151	252	9.58
RE 20025	220	280	25	2	92.3	171	4.1
RE 24025	240	300	25	2.5	68.3	145	4.5
RE 25025	250	310	25	2.5	69.3	150	4.97
RE 25030	250	330	30	2.5	126	244	8.1
RE 25040	250	355	40	2.5	195	348	14.8
RE 30025	300	360	25	2.5	76.3	178	5.88
RE 30035	300	395	35	2.5	183	367	13.4
RE 30040	300	405	40	2.5	212	409	17.2
RE 35020	350	400	20	2.5	54.1	143	3.9
RE 40035	400	480	35	2.5	156	370	14.5
RE 40040	400	510	40	2.5	241	531	23.5
RE 45025	450	500	25	1	61.7	182	6.6
RE 50025	500	550	25	1	65.5	201	7.3
RE 50040	500	600	40	2.5	239	607	26
RE 50050	500	625	50	2.5	267	653	41.7
RE 60040	600	700	40	3	264	721	30.6

Parameter Table

## XV Type (with two half inner rings and a one-piece outer ring with mounting holes)

XV…

Model of bearing	Overall dimensions (mm)										Rated load (KN)		Weight
	d	D	B	C	D_1	n_1	d_1	d_{11}	t_1		C_r	C_{or}	kg
XV 30	30	75	15	14	60	12	4.6	8	4.6	2x20°	7.4	10.4	0.37
XV 40	40	85	15	14	70	12	4.6	8	4.6	2x20°	8.7	13.8	0.44
XV 50	50	100	17	16	85	12	5.6	10	5.4	2x20°	13.1	21.5	0.67
XV 60	60	110	19	16	95	16	5.6	10	5.4	2x20°	14.4	25.5	0.75
XV 70	70	120	17	16	105	16	5.6	10	5.4	2x20°	15.1	28	0.84
XV 80	80	135	19	18	120	16	6.6	11	6.4	2x20°	21.4	40.5	1.18
XV 90	90	145	19	18	130	16	6.6	11	6.4	2x20°	22.3	44.5	1.29
XV 100	100	170	23	22	150	16	9	15	8.5	2x20°	34.4	65	2.31
XV 110	110	180	23	22	160	16	9	15	8.5	2x20°	36.2	72	2.48

Parameter Table

CRBH Type (with one-piece inner and outer rings of high rigidity)

CRBH...

CRBH...UU
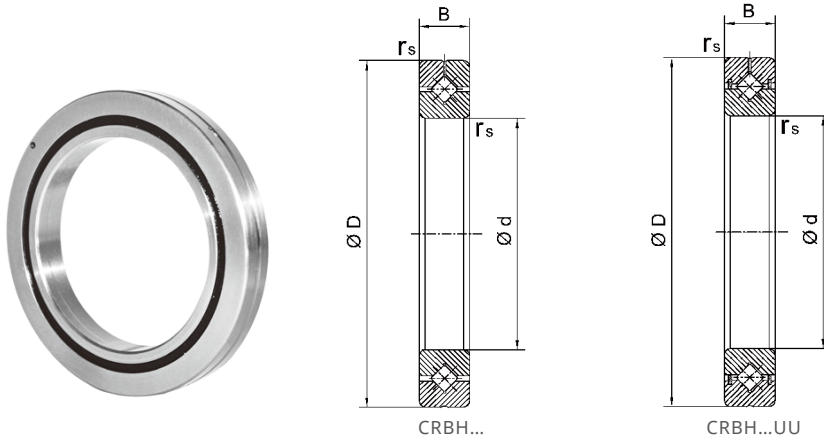
Model of bearing	Overall dimensions (mm)				Rated load (KN)		Weight
	d	D	B	r_{smin}	C_r	C_{or}	kg
CRBH 2008	20	36	8	0.3	3.23	3.1	0.04
CRBH 2508	25	41	8	0.3	3.63	3.83	0.05
CRBH 3010	30	55	10	0.3	7.35	8.36	0.12
CRBH 3510	35	60	10	0.3	7.64	9.12	0.13
CRBH 4010	40	65	10	0.3	8.33	10.6	0.15
CRBH 4510	45	70	10	0.3	8.62	11.3	0.16
CRBH 5013	50	80	13	0.6	16.7	20.9	0.29
CRBH 6013	60	90	13	0.6	18	24.3	0.33
CRBH 7013	70	100	13	0.6	19.4	27.7	0.38
CRBH 8016	80	120	16	0.6	30.1	42.1	0.74
CRBH 9016	90	130	16	0.6	31.4	45.3	0.81
CRBH 10020	100	150	20	0.6	33.1	50.9	1.45
CRBH 11020	110	160	20	0.6	34	54	1.56
CRHB 12025	120	180	25	1	66.9	100	2.62
CRHB 13025	130	190	25	1	69.5	107	2.82
CRBH 14025	140	200	25	1	74.8	121	2.96
CRHB 15025	150	210	25	1	76.8	128	3.16
CRBH 20025	200	260	25	1	84.2	157	4
CRBH 25025	250	310	25	1.5	69.3	150	4.97

Parameter Table

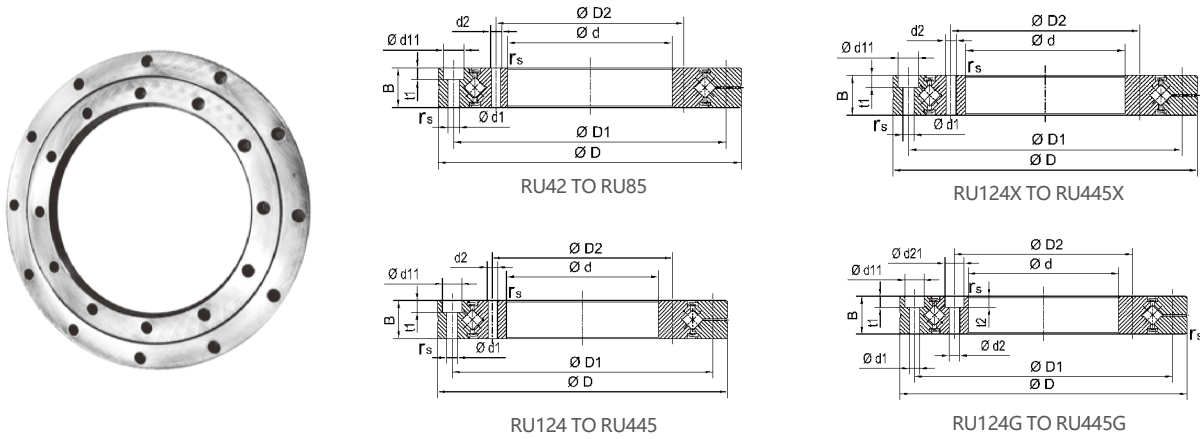**CRBS Type (with one-piece inner and outer rings with a super-thin wall)**

CRBS...   CRBS...UU
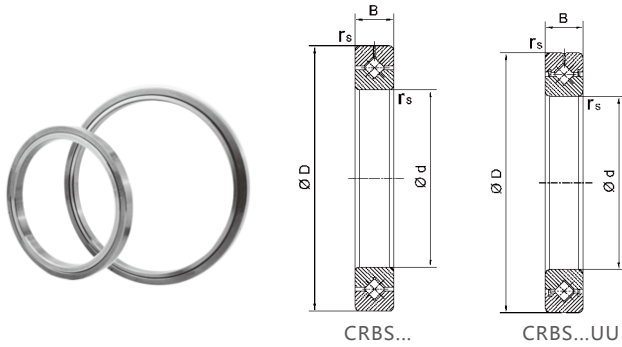
RA Type (with two half outer rings and a one-piece inner ring with a super-thin wall)

RA...   RA...UU
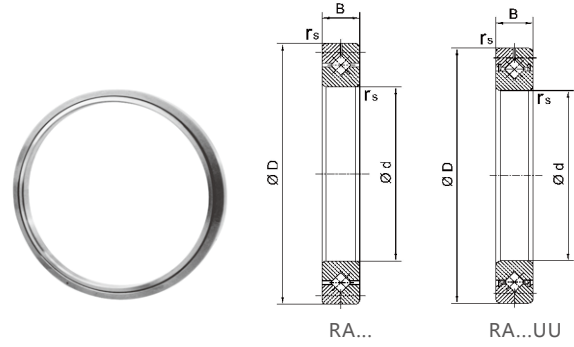
Model of bearing		Overall dimensions (mm)				Rated load (KN)		Weight
		d	D	B	r_{smin}	C_r	C_{or}	kg
CRBS 5008	RA 5008	50	66	8	0.4	4.9	6.17	0.084
CRBS 6008	RA 6008	60	76	8	0.4	5.35	7.31	0.094
CRBS 7008	RA 7008	70	86	8	0.4	5.74	8.44	0.108
CRBS 8008	RA 8008	80	96	8	0.4	6.13	9.59	0.122
CRBS 9008	RA 9008	90	106	8	0.4	6.49	10.7	0.135
CRBS 10008	RA 1008	100	116	8	0.4	6.85	11.9	0.152
CRBS 11008	RA 1108	110	126	8	0.4	7.16	13	0.163
CRBS 12008	RA 1208	120	136	8	0.4	7.53	14.1	0.184
CRBS 13008	RA 1308	130	146	8	0.4	7.86	15.3	0.199
CRBS 14008	RA 1408	140	156	8	0.4	8.06	16.4	0.205
CRBS 15008	RA 1508	150	166	8	0.4	8.35	17.5	0.22
CRBS 16013	RA 16013	160	186	13	0.6	20.3	39.9	0.62
CRBS 17013	RA 17013	170	196	13	0.6	20.9	42.2	0.675
CRBS 18013	RA 18013	180	206	13	0.6	21.5	44.6	0.71
CRBS 19013	RA 19013	190	216	13	0.6	22.1	46.9	0.74
CRBS 20013	RA 20013	200	226	13	0.6	22.5	49.3	0.78

Parameter Table

RU Type (with one-piece inner and outer rings of high rigidity and with mounting holes)

RU42 TO RU85

RU124X TO RU445X

RU124 TO RU445

RU124G TO RU445G

Model of bearing	Overall dimensions (mm)														Rated load (KN)		Weight
	d	D	B	D_1	D_2	n_1	n_2	d_1	d_{11}	t_1	d_2	d_{21}	t_2	r_{smin}	C_r	C_{or}	kg
RU42	20	70	12	57	28	6	6	3.4	6.5	3.3	M3	---	---	0.6	7.35	8.35	0.29
RU66	35	95	15	83	45	8	8	4.5	8	4.4	M4	---	---	0.6	17.5	22.3	0.62
RU85	55	120	15	105	65	8	8	5.5	9.5	5.4	M5	---	---	0.6	20.3	29.5	1
RU124(G)	80	165	22	148	97	10	10	5.5	9.5	5.4	5.5	9.5	5.4	1	33.1	50.9	2.6
RU124X	80	165	22	148	97	10	10	5.5	9.5	5.4	M5			1	33.1	50.9	2.6
RU148(G)	90	210	25	187	112	12	12	9	14	8.6	9	14	8.6	1.5	49.1	76.8	4.9
RU148X	90	210	25	187	112	12	12	9	14	8.6	M8	---	---	1.5	49.1	76.8	4.9
RU178(G)	115	240	28	217	139	12	12	9	14	8.6	9	14	8.6	1.5	80.3	135	6.8
RU178X	115	240	28	217	139	12	12	9	14	8.6	M8	---	---	1.5	80.3	135	6.8
RU228(G)	160	295	35	270	184	12	12	11	17.5	10.8	11	17.5	10.8	2	104	173	11.4
RU228X	160	295	35	270	184	12	12	11	17.5	10.8	M10	---	---	2	104	173	11.4
RU297(G)	210	380	40	350	240	16	16	14	20	13	14	20	13	2.5	156	281	21.3
RU297X	210	380	40	350	240	16	16	14	20	13	M12			2.5	156	281	21.3
RU445(G)	350	540	45	505	385	24	24	14	20	13	14	20	13	2.5	222	473	35.4
RU445X	350	540	45	505	385	24	24	14	20	13	M12	---	---	2.5	222	473	35.4

Notes

Make Transmission More Free

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