Cross Roller Bearing

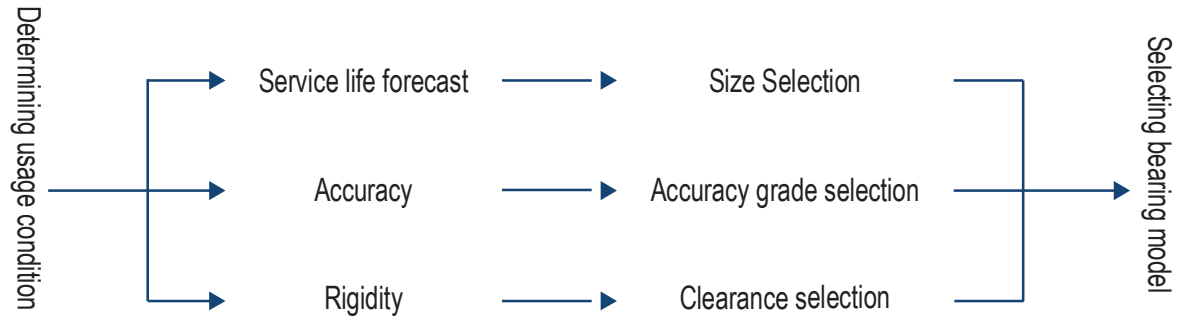
Cross roller bearings consist of inner rings, outer rings, spacer retainers and cylindrical rollers cross arranged on the V-shaped 90° groove between the inner and outer rings. This structure can withstand radial, axial and moment loads in all directions because the rollers' line contact with raceway surfaces achieve a large load-bearing area despite the minimum dimensions. Therefore these bearings are widely used on the rotating parts of industrial robots, machine tools, precision rotary tables, measuring instruments and IC manufacturing machines.

Product Features

- High rigidity
- Large load capacity
- High rotation accuracy
- Compactness
- Easy to install and handle

Cross Roller Bearing selection

The procedures for the selection and usage of cross roller bearings are based on the following figure



Models & Features

SRU Model (One-Piece Inner & Outer Ring)

The single structure with mounting holes on inner and outer rings does not require the use of flange discs or housings; therefore reduces mounting errors, achieves stable rotational accuracy and moment torque. Suitable for inner and outer ring rotation

SRB models (Split Outer Ring model for inner ring rotation)

Standard model with two split outer rings bolted together and a one-piece inner ring suitable for precision inner ring rotation.

SRBE Model (One-Piece Inner & Outer Ring)

The one-piece inner & outer ring structure provides high rigidity, high accuracy and smooth rotation; suitable for inner and outer ring rotation

SRAU Model (One-Piece Inner & Outer Ring)

Super slim type cross roller bearing with three options of bearing width: 5mm, 8mm and 13mm. Rigid and compact design is suitable for limited space and lightweight mechanism.

SRAUF(One-Piece Inner & Outer Ring)

Super slim cross roller bearing with mounting holes. Designs for easy installation that significantly reduces equipment weight and size.

SSHF Model (One-Piece Inner & Outer Ring)

Specifically designed for SHF type strain wave gears, this cross roller bearing has mounting holes for easy installation.

SCSG Model (Split outer ring)

Specifically designed for CSG type strain wave gears, this cross roller bearing has mounting holes for easy installation.

Basic Rated Life

The 90% of a group of identical Cross Roller Bearings can operate individually under the same conditions without showing material damage such as flaking caused by rolling fatigue. The basic rated life is represented by the total service hours for rotations at a constant rotational speed.

The service life of the cross roller bearing is calculated using the following formula:

L : basic rated life

C : basic dynamic load rating

P : dynamic-equivalent load

The number of revolutions is expressed in the unit of 10^6 (rev)

$$L = \left(\frac{C}{P} \right)^{\frac{10}{3}}$$

Dynamic Equivalent Radial Load : P

The dynamic-equivalent radial load on cross roller bearings is calculated using the following formula:

P : dynamic-equivalent radial load (kN)

Fr : radial load (kN)

Fa : axial load (kN)

M : moment (kN·mm)

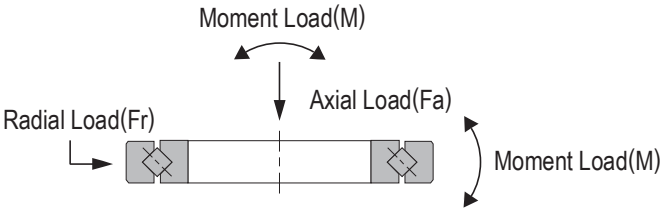
X : dynamic radial coefficient (see table1)

Y : dynamic axial coefficient (see table1)

dw : pitch circle diameter of rollers (mm)

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

Dynamic Equivalent Radial Load : P



(table 1)

Dynamic radial and axial coefficients

Categories		X	Y
$\frac{Fa}{Fr+2M/dw}$	≤ 1.5	1	0.45
$\frac{Fa}{Fr+2M/dw}$	> 1.5	0.67	0.67

An example for rated life calculation

Calculate the rated life when bearings are used under the following conditions

ID ：d=110 (mm)　W1 = 700 (N)　Fr = 2500 (N)

OD ：D=160 (mm)　W2 = 2000 (N)　L = 700 (mm)

Example: Model SRB11020

Pitch circle diameter ：dw = 135 (mm)

Basic dynamic load rating C = 34000N

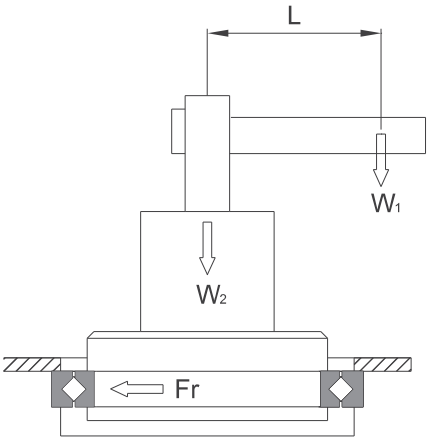
Basic static load rating C_0 =54000N

Radial load ：Fr = 2500 (N)

Axial load ：Fa = W1 + W2 = 700 + 2000 = 2700 (N)

Moment load ：M = W1 x L = 700 x 700 = 490000 (N·mm)

PCD ：dw = (d+D)/2 = (110+160)/2 = 135 (mm)



$$\frac{Fa}{Fr+2M/dw} = \frac{2700}{2500+2x490000/135} \cong 0.2766 < 1.5$$

Hence, if radial load coefficient: x=1, axial load coefficient: y=0.45, then dynamic-equivalent radial load:

$$P=X\cdot(Fr+\frac{2M}{dw})+Y\cdot Fa=1x(2500+\frac{2x490000}{135})+0.45\cdot 2700=10974(N)$$

Basic rated life ：$L=(\frac{C}{P})^{\frac{10}{3}}=(\frac{34000}{10974})^{\frac{10}{3}}=43.35^{6}(x10\ rev)$

Static safety coefficient

This coefficient is determined by the basic static rated load (Co) and static-equivalent radial load (Po). When a load is statically or dynamically applied, the static safety coefficients shown in the following figure should be considered.

fs : static safety coefficient

C_0 : basic static rated load (kN)

P_0 : static equivalent radial load (kN)

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

(fs) Static safety coefficient

Load conditions	Lower Limit of fs
Normal load	1~2
Impact load	2~3

Static equivalent radial load : P_0

The cross roller bearing's static equivalent radial load is calculated using the following formula.

P_0 : Static-equivalent radial load (kN)

Fr : radial load (kN)

Fa : axial load (kN)

M : moment (kN·mm)

X_0 : static radial coefficient (X0=1)

Y_0 : static axial coefficient (Y0=0.44)

dw : pitch circle diameter of rollers (mm)

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

Fit

Fitting of Models SRU

Fitting of Models SRU Fitting required positioning accuracy, h7 and H7 are recommended.

Fitting of Models SRAU

Fitting of Models SRAU Fitting required positioning accuracy , g5 and g6 for the shaft and H7 for the housing are recommended .

*Note: When using a Model SRAU (width 5 mm type), there is no interference on design devices.

Fitting of Models SRB&SRBE

Radial Clearance	Service Conditions		Shaft	Housing
S1	Inner ring rotational load	Normal Load	g5	H7
		Large impact and moment		
	Outer ring rotational load	Normal Load		
		Large impact and moment		
C1	Inner ring rotational load	Normal Load	h5	H7
		Large impact and moment		
	Outer ring rotational load	Normal Load	g5	Js7
		Large impact and moment		

*Note: For the fitting for clearance S1, please avoid interference because it will cause an excessive preload. In addition, if higher rigidity is required, we recommend measuring the inner and outer diameters of the bearing and applying a slight interference fit to match the diameters.

Methods and design of the housing and flange disc

Due to the thin wall structure of the cross roller bearings, full consideration must be given to the rigidity of the housing and flange discs. With split type bearings, if the housing or flange disc is not rigid enough, the inner ring or outer ring cannot be evenly held, resulting bearing deformation when moment load is applied. Therefore, the contact area of the rollers will become uneven, causing significant decrease in bearing performance.

To prevent this from occurring, it is recommended to design the housing and flange discs by the following methods:

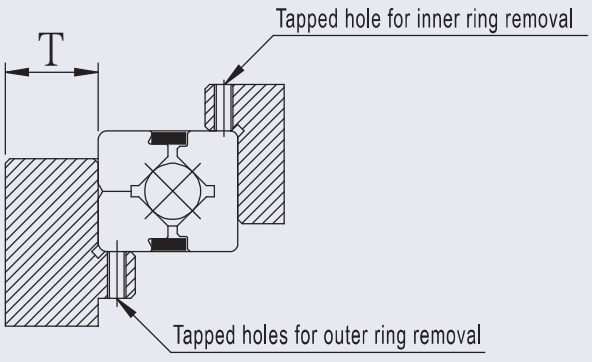
Housing: at least 60% of the sectional height of the cross roller bearing

Housing wall thickness : $$T = \frac{(D-d)}{2} \times 0.6$$ or greater

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

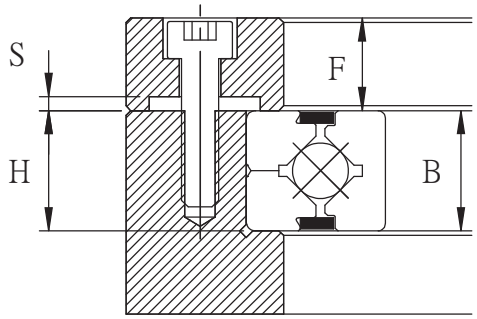
Tapped hole for bearing removal

Alternatively, tapped holes for removing bearings may be set up on the housing; when it is necessary to remove the bearings from housing, the screws may be locked into the tapped holes to push the bearing out without incurring any damage.



Flange discs and locking screws

The values of the wall thickness (F) or the clearance (S) of the flange discs may be designed per the following formula. As for the quantity of locking screws, it may be configured at equal intervals by using the quantity shown in table (1).



$F = B \times 0.5 \sim B \times 1.2$

$H = B^{0}_{-01}$

$S = 0.5$ mm

It is recommended to secure the flange discs using materials made of iron. It is advised to firmly lock the screws using torque wrenches. See table (2) for the locking torques of supporting seats or supported flange discs which are made of medium hardness steel.

Table 1. Number of locking screws and size.

Unit : mm

Outer diameter of the outer ring (D)		Number of screws	Screw size (base value)
Above	Below		
-	100	8 or more	M3~M5
100	200	12 or more	M4~M8
200	500	16 or more	M5~M12
500	-	24 or more	M12 or thicker

Table 2. Screw locking torque

Unit : N-m

Screw model	Locking torque	Screw model	Locking torque
M3	2.1	M10	72
M4	3.9	M12	122
M5	9	M16	201
M6	13	M20	392
M8	31	M22	531

Installation steps

Please follow below steps when installing cross roller bearings:

1. Checking each part and component before installing

Clean the housing and other installation components, remove dirt and make sure there are no burrs.

2. Installing the cross roller bearings into housing or onto shaft

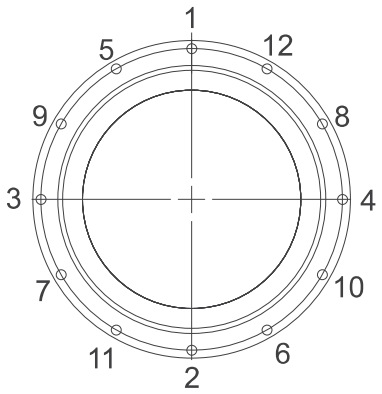
The cross roller bearing is easily tilted due to its thin wall structure. To install, level one side, and gradually insert the bearing by evenly and cautiously hammering along the perimeter using a rubber hammer or similar tool until the sound of the ring come in full contact with the mounting surface.

3. Installing the flange disc

(1) Place the disc into position, shake it along its circumference back and forth several times to match the bolt holes.

(2) Install screws. When manually turning the screws, make sure that the screw is fully aligned with the screw hole.

(3) Tighten the screws in the order on the diagonal repeatedly as shown in the following figure, and fasten the disc from loose to tighten in three to four steps. When tightening the split type inner or outer rings, slightly turn the one-piece inner or outer rings to correct the misalignment between the ring and body.



Other precautions

Instructions on lubrication

(1) Each cross roller bearings are pre-lubricated with high quality lithium soap grease No. 2. However, the bearings need lubricating on a regular basis and users are required to reapply same type of grease at a minimum interval ranging from 6 to 12 months to enable the distribution of grease within the entire internal structure of the bearing; the actual interval depends on the machine or usage.

(2) Avoid mixing various kinds of lubrication grease.

(3) When the bearings are used under such special conditions as high vibration, clean rooms, vacuum, low and high temperature, it may be impossible to use general-purpose lubrication grease and please contact us before using special type grease.

Precautions on use

(1) Foreign objects entering the interior of the bearings may damage the revolution path of the rollers or disable their functions; take caution to prevent foreign objects entering the bearing.

(2) If bearings are used at an ambient temperature above 80℃, contact us first.

(3) When foreign objects enter the interior of bearings, apply lube oil again after cleaning the product.

(4) Do not attempt to remove the screws and nuts on the split type bearings.

Accuracy Standards

SRU、SRB、SRBE inner diameter dimensional accuracy

Unit : μm

Inner ring diameter (d) Nominal dimension (mm)		Tolerance dm					
		0、P5、P4、P2		PS5		PS4、PS2	
Above	Below	Above	Below	Above	Below	Above	Below
18	30	0	-10	0	-6	0	-5
30	50	0	-12	0	-8	0	-6
50	80	0	-15	0	-9	0	-7
80	120	0	-20	0	-10	0	-8
120	150	0	-24	0	-12	0	-9
150	180	0	-24	0	-12	0	-10
180	250	0	-30	0	-14	0	-12
250	315	0	-34	0	-17	-	-

SRU、SRB、SRBE outer diameter dimensional accuracy

Unit : μm

Outer ring diameter (D) Nominal dimension (mm)		Tolerance dm					
		0、P5、P4、P2		PS5		PS4、PS2	
Above	Below	Above	Below	Above	Below	Above	Below
30	50	0	-11	0	-7	0	-6
50	80	0	-13	0	-9	0	-7
80	120	0	-15	0	-10	0	-8
120	150	0	-18	0	-10	0	-9
150	180	0	-24	0	-12	0	-9
180	250	0	-30	0	-15	0	-10
250	315	0	-34	0	-18	0	-12

SRAU ID and OD dimensional accuracy

Unit : μm

Inner ring diameter (d) Nominal dimension (mm)		SRAU Inner Ring		SRAU Outer Ring	
Above	Below	Above	Below	Above	Below
-	18	0	-8	-	-
18	30	0	-10	0	-9
30	50	0	-12	0	-11
50	80	0	-15	0	-13
80	120	0	-20	0	-15
120	150	0	-25	0	-18
150	180	0	-25	0	-25
180	315	0	-30	0	-30

SRU inner ring rotational accuracy

Unit : μm

Model	Inner ring radial/axial run-out tolerance		
	P5	P4	P2
SRU42	4	3	2.5
SRU66	5	4	2.5
SRU85	5	4	2.5
SRU124	5	4	2.5
SRU148	6	5	2.5
SRU178	6	5	2.5
SRU228	8	6	5

SRU outer ring rotational accuracy

Unit : μm

Model	Outer ring radial/axial run-out tolerance		
	P5	P4	P2
SRU42	8	5	4
SRU66	10	6	5
SRU85	10	6	5
SRU124	12	8	5
SRU148	15	10	7
SRU178	15	10	7
SRU228	18	11	7

SRB、SRBE inner ring rotational accuracy

Unit : μm

Inner ring diameter (d) Nominal dimension (mm)		Inner ring radial run-out tolerance				Inner ring axial run-out tolerance			
Above	Below	0	PS5 P5	PS4 P4	PS2 P2	0	PS5 P5	PS4 P4	PS2 P2
18	30	12	4	3	2.5	12	4	3	2.5
30	50	13	5	4	2.5	13	5	4	2.5
50	80	15	5	4	2.5	15	5	4	2.5
80	120	20	6	5	2.5	20	6	5	2.5
120	150	20	8	6	2.5	20	8	6	2.5
150	180	25	8	6	5	25	8	6	5
180	250	25	10	8	5	25	10	8	5
250	315	35	13	10	-	35	13	10	-

SRBE outer ring rotational accuracy

Unit : μm

Outer ring diameter (D) Nominal dimension (mm)		Outer ring radial run-out tolerance				Outer ring axial run-out tolerance			
		0	PS5 P5	PS4 P4	PS2 P2	0	PS5 P5	PS4 P4	PS2 P2
Above	Below	Maximum				Maximum			
30	50	20	7	5	2.5	20	7	5	2.5
50	80	25	8	5	4	25	8	5	4
80	120	35	10	6	5	35	10	6	5
120	150	40	11	7	5	40	11	7	5
150	180	45	13	8	5	45	13	8	5
180	250	50	15	10	7	50	15	10	7
250	315	60	18	11	7	60	18	11	7

SRAU inner ring rotational accuracy

Unit : μm

Inner ring diameter (d) Nominal dimension (mm)		Inner ring radial run-out tolerance				Inner ring axial run-out tolerance			
Above	Below	0	P6	P5	P4	0	P6	P5	P4
-	18	10	8	5	4	10	8	5	4
18	40	13	10	5	4	13	10	5	4
40	65	13	10	-	-	13	10	-	-
65	80	15	10	-	-	15	10	-	-
80	100	15	13	-	-	15	13	-	-
100	120	20	13	-	-	20	13	-	-
120	140	25	18	-	-	25	18	-	-
140	180	25	18	-	-	25	18	-	-
180	200	30	20	-	-	30	20	-	-

*Above rotational accuracy are for width 8mm~13mm type，If a certain level of accuracy is required, please contact with SFT。
*Note :SRAU width 5mm Type
1.Seals are not available
2.Only available with C1 radial clearance ,S1 is not available .

SRAU outer ring rotational accuracy

Unit : μm

Outer ring diameter (d) Nominal dimension (mm)		Outer ring radial run-out tolerance				Outer ring axial run-out tolerance			
Above	Below	0	P6	P5	P4	0	P6	P5	P4
-	65	13	11	-	-	13	11	-	-
65	80	13	11	-	-	13	11	-	-
80	100	15	13	-	-	15	13	-	-
100	120	15	13	-	-	15	13	-	-
120	140	20	15	-	-	20	15	-	-
140	180	25	20	-	-	25	20	-	-
180	200	25	20	-	-	25	20	-	-
200	250	30	25	-	-	30	25	-	-

*Above rotational accuracy are for width 8mm~13mm type，If a certain level of accuracy is required, please contact with SFT。
*Note :SRAU width 5mm Type
1.Seals are not available
2.Only available with C1 radial clearance ,S1 is not available .

Inner & Outer ring width tolerances

SRU Inner & Outer ring width tolerances

Unit : μm

Model	Tolerances	
	Above	Below
SRU42	0	-70
SRU66	0	-70
SRU85	0	-70
SRU124	0	-70
SRU148	0	-70
SRU178	0	-80
SRU228	0	-80

SRB Inner & Outer ring width tolerances (for all grades)

Unit : μm

Inner ring diameter (d) Nominal dimension (mm)		Tolerances		Tolerances	
		Inner Ring		Outer Ring	
Above	Below	Above	Below	Above	Below
18	30	0	-70	0	-90
30	50	0	-70	0	-90
50	80	0	-70	0	-90
80	120	0	-70	0	-90
120	150	0	-80	0	-100
150	180	0	-80	0	-100
180	250	0	-80	0	-100
250	315	0	-80	0	-130

SRBE Inner & Outer ring width tolerances

Tolerances	
Maximum	Minimum
0	-75

SRAU Inner & Outer ring width tolerances

Tolerances	
Maximum	Minimum
0	-120

SRAUF Mounting Hole Type Super Slim Cross Roller Bearing

SRAUF ID & OD dimensional accuracy

Unit : μm

Inner ring diameter (d) Nominal dimension (mm)		Inner Ring		Outer Ring	
Above	Below	Above	Below	Above	Below
10	20	0	-8	0	-9
20	30	0	-8	0	-9
30	40	0	-10	0	-13
40	50	0	-10	0	-13

SRAUF inner ring rotational accuracy

Unit : μm

Inner ring diameter (d) Nominal dimension (mm)		Inner ring radial run-out tolerance				Inner ring axial run-out tolerance			
Above	Below	0	P6	P5	P4	0	P6	P5	P4
10	20	13	8	4	3	13	8	4	3
20	30	13	8	5	4	13	8	5	4
30	40	13	10	5	4	13	10	5	4
40	50	15	10	5	4	15	10	5	4

SRAUF Outerr ring rotational accuracy

Unit : μm

Outer ring diameter (d) Nominal dimension (mm)		Outer ring radial run-out tolerance				Outer ring axial run-out tolerance			
Above	Below	0	P6	P5	P4	0	P6	P5	P4
40	50	20	10	7	5	20	10	7	5
50	60	20	13	8	5	20	13	8	5
60	70	25	13	8	5	25	13	8	5
70	80	25	13	8	5	25	13	8	5

SRAUF Inner & Outer ring width tolerances

Tolerances	
Maximum	Minimum
0	-75

SRAUF radial clearance

Unit : μm

S1 Radial Clearance		C1 Radial Clearance	
Minimum	Maximum	Minimum	Maximum
-8	0	0	15
-8	0	0	15
-8	0	0	15
-8	0	0	15

Radial Clearances

SRU model radial clearance

Unit : μm

Model	S1 Radial Clearance		C1 Radial Clearance	
	Minimum	Maximum	Minimum	Maximum
SRU42	-8	0	0	24
SRU66	-8	0	0	28
SRU85	-8	0	0	38
SRU124	-12	0	0	38
SRU148	-12	0	0	38
SRU178	-12	0	0	48
SRU228	-12	0	0	58

SRB、SRBE model radial clearance

Unit : μm

Roller Pitch Circle Diameter (dw) (mm)		S1 Radial Clearance		C1 Radial Clearance	
Above	Below	Minimum	Maximum	Minimum	Maximum
18	30	-8	0	0	14
30	50	-8	0	0	24
50	80	-8	0	0	28
80	120	-8	0	0	38
120	140	-8	0	0	38
140	160	-10	0	0	38
160	180	-10	0	0	48
180	200	-10	0	0	48
200	225	-10	0	0	58
225	250	-10	0	0	58
250	280	-14	0	0	78
280	315	-14	0	25	98
315	355	-14	0	25	108

SRAU radial clearance

Unit : μm

Roller Pitch Circle Diameter (dw) (mm)		S1 Radial Clearance		C1 Radial Clearance	
Above	Below	Minimum	Maximum	Minimum	Maximum
-	18	-	-	0	15
18	30	-	-	0	15
30	50	-	-	0	15
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

*Above radial clearance are for width 8mm~13mm type，If a certain level of accuracy is required, please contact with SFT 。

*Note :SRAU width 5mm Type

1.Seals are not available

2.Only available with C1 radial clearance ,S1 is not available .