



Cross Roller Guide/Ball Guide

THK General Catalog

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Features of the Cross Roller Guide/Ball Guide

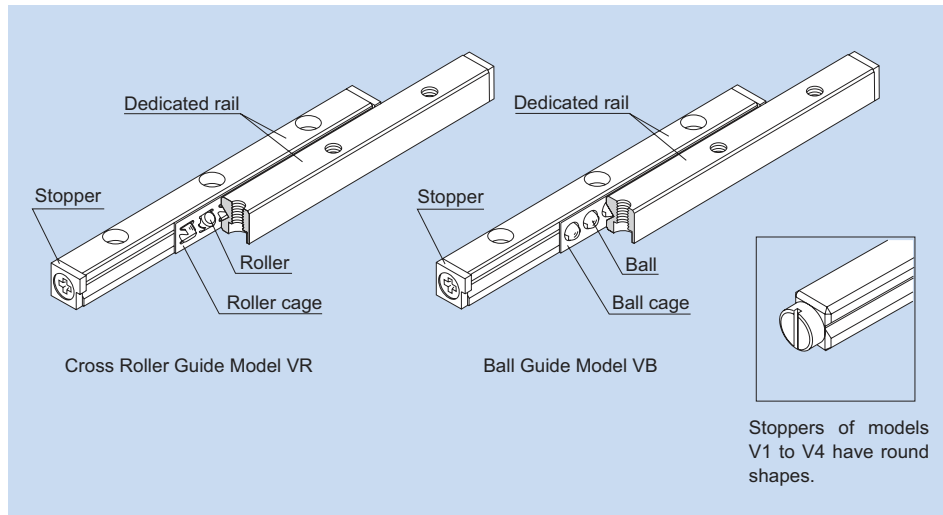


Fig.1 Structure of Cross Roller Guide Model VR and Ball Guide Model VB

Structure and Features

In model VR, precision rollers are orthogonally aligned one after another in a roller cage that is combined with a dedicated rail having a raceway cut into a V-shape groove. When two units of the Cross Roller Guide are mounted in parallel, the guide system is capable of receiving loads in the four directions. In addition, since the Cross Roller Guide can be given a preload, a clearance-free, highly rigid and smooth slide mechanism is achieved.

Model VB is a low-friction, high-accuracy, finite LM system consisting of precision steel balls, arranged in short pitches in a ball cage model B, and a dedicated rail model V.

The Cross Roller Guide and the Ball Guide are used in the slide unit of various devices such as OA equipment and its peripherals, measuring instruments, precision equipment including a printed circuit board drilling machine, optic measuring machines, optic stages, handling mechanisms and X-Ray machines.

Features and Types

Features of the Cross Roller Guide/Ball Guide

[Long Service Life, High Rigidity]

With a unique roller retaining mechanism, the effective contact length of the rollers is 1.7 times greater than the conventional type. Furthermore, the roller pitch interval is short and a sufficient number of rollers are installed, thus increasing the rigidity by two and the service life by six times greater than the conventional type. As a result, a safety-oriented design against vibrations and impact, which commonly occur in ordinary straight motion mechanisms, can be achieved.

[Smooth Motion]

With model VR, the rollers are individually held in a cage and roller pockets formed on the cage are in surface contact with the rollers to increase grease retention. Thus, smooth motion with little wear and friction is achieved.

[Highly Corrosion Resistant]

Model VR series and model VB series both include types made of stainless steel, which is highly corrosion resistant.

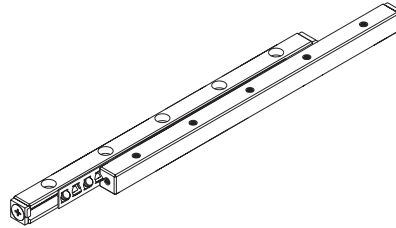
Types of the Cross Roller Guide/Ball Guide

Types and Features

Cross Roller Guide Model VR

Specification Table⇒[B-480](#)

A compact, highly rigid LM system whose roller cage holding precision rollers orthogonally aligned one after another travels by half the stroke on a V-shaped groove formed on a rail.

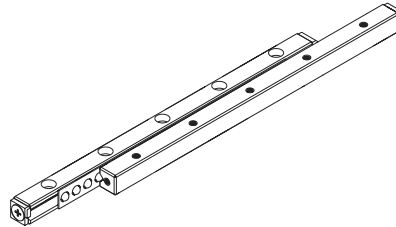


Model VR

Ball Guide Model VB

Specification Table⇒[B-498](#)

A low-friction, highly accurate LM system whose ball cage holding precision balls in short pitches travels by half the stroke on a V-shaped groove formed on a rail.



Model VB

Rated Load and Nominal Life

[Rated Loads in All Directions]

The basic load ratings (C_z and C_{0z}) in the specification table indicate the values per rolling element in the directions shown in Fig.1. When obtaining the nominal life, calculate the basic load ratings (C and C_0) of the actually used rolling elements from the equation below.

● For Model VR

$$C = C_L = \left(\frac{Z}{2}\right)^3 \times C_z, \quad C_T = 2C$$

$$C_0 = C_{0L} = \frac{Z}{2} \times C_{0z}, \quad C_{0T} = 2C_0$$

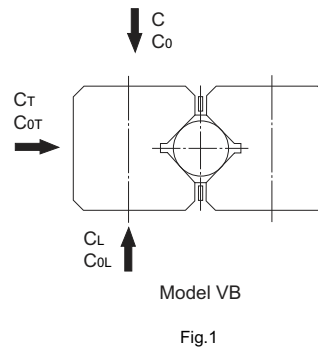
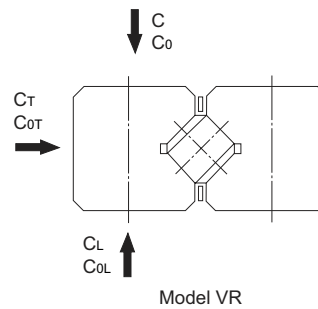
(For $\frac{Z}{2}$, truncate the decimals.)

● For Model VB

$$C = C_L = Z^{\frac{2}{3}} \times C_z, \quad C_T = 2C$$

$$C_0 = C_{0L} = Z \times C_{0z}, \quad C_{0T} = 2C_0$$

- C : Basic dynamic load rating (kN)
- C_0 : Basic static load rating (kN)
- C_z : Basic dynamic load rating in the specification table (kN)
- C_{0z} : Basic static load rating in the specification table (kN)
- Z : Number of rolling elements used (number of rolling elements within the effective load range) (kN)



[Static Safety Factor f_s]

Models VR and VB may receive an unexpected external force while it is stationary or operative due to the generation of an inertia caused by vibrations and impact or start and stop. It is necessary to consider a static safety factor against such a working load.

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

f_s : Static safety factor (see Table1)
 C_0 : Basic static load rating (kN)
 P_c : Calculated load (kN)

Table1 Reference Values of Static Safety Factor (f_s)

Machine using the LM system	Basic dynamic load rating	Lower limit of f_s
General industrial machinery	Without vibration or impact	1 to 1.3
	With vibration or impact	2 to 3

[Nominal Life]

When the basic dynamic load ratings have been obtained, the rated lives of model VR and model VB are obtained using the following equations.

● For Model VR

$$L = \left(\frac{f_r}{f_w} \cdot \frac{C}{P_c} \right)^{\frac{10}{3}} \times 100$$

● For Model VB

$$L = \left(\frac{f_r}{f_w} \cdot \frac{C}{P_c} \right)^3 \times 50$$

L : Nominal life (km)
 (The total number of revolutions that 90% of a group of identical VR (VB) units independently operating under the same conditions can achieve without showing flaking)
 C : Basic dynamic load rating (kN)
 P_c : Calculated load (kN)
 f_r : Temperature factor (see Fig.2 on A-577)
 f_w : Load factor (see Table2 on A-577)

[Calculating the Service Life Time]

When the nominal life (L) has been obtained, if the stroke length and the number of reciprocations per minute are constant, the service life time is obtained using the following equation.

$$L_h = \frac{L \times 10^6}{2 \times \ell_s \times n_1 \times 60}$$

L_h : Service life time (h)
 ℓ_s : Stroke length (mm)
 n_1 : Number of reciprocations per minute (min^{-1})

Point of Selection

Rated Load and Nominal Life

● f_t : Temperature Factor

If the temperature of the environment surrounding the operating model VR or VB exceeds 100 °C, take into account the adverse effect of the high temperature and multiply the basic load ratings by the temperature factor indicated in Fig.2.

Note) If the environment temperature exceeds 100 °C, contact THK.

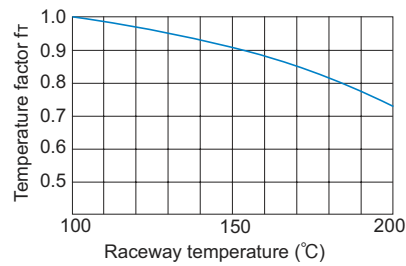


Fig.2 Temperature Factor (f_t)

● f_w : Load Factor

In general, reciprocating machines tend to involve vibrations or impact during operation. It is extremely difficult to accurately determine vibrations generated during high-speed operation and impact during frequent start and stop. Therefore, when the actual load applied on model VR or VB cannot be obtained, or when speed and vibrations have a significant influence, divide the basic load rating (C or C_0), by the corresponding load factor in Table2 of empirically obtained data.

Table2 Load Factor (f_w)

Vibrations/ impact	Speed(V)	f_w
Faint	Very low $V \leq 0.25\text{m/s}$	1 to 1.2
Weak	Slow $0.25 < V \leq 1\text{m/s}$	1.2 to 1.5

Accuracy Standards

The accuracy of the dedicated rail for the Cross Roller Guide is classified into high accuracy grade (H) and precision grade (P) as shown in Table3.

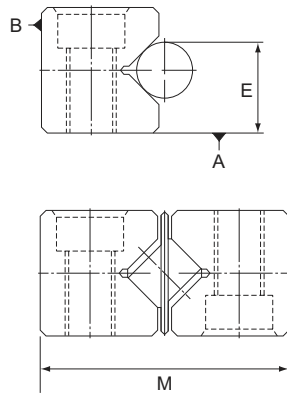


Fig.3

Table3 Accuracy Standards for Dedicated Rail Model V
Unit: mm

Accuracy grades	High-accuracy grade	Precision grade
Symbol	H	P
Item	As per Fig.4	
Parallelism of the raceway against surfaces A and B	As per Fig.4	
Dimensional tolerance in height E	± 0.02	± 0.01
Difference in height E (note)	0.01	0.005
Dimensional tolerance in width M	$\begin{matrix} 0 \\ -0.2 \end{matrix}$	$\begin{matrix} 0 \\ -0.1 \end{matrix}$

Note) The difference in height E applies to four rails used on the same plane.

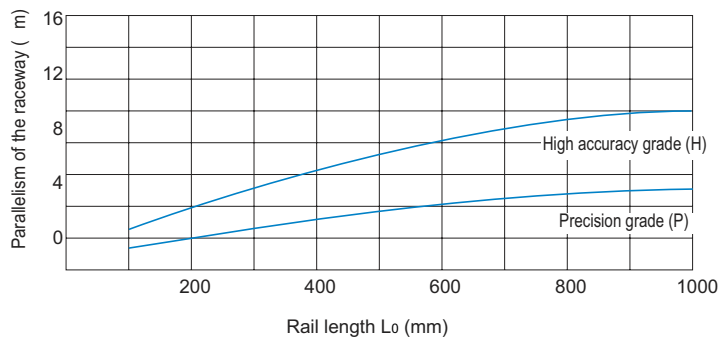


Fig.4 Rail Length and Parallelism of the Raceway

Installation Procedure

When using clearance adjustment bolts:

- (1) Closely contact rails 2 and 3 onto the base, and rail 1 onto the table, and then firmly tighten the rail mounting bolts.

- (2) Temporarily fasten rail 4 to the table.

Note) The rail mounting bolts must be designed so that they can be fully fastened while maintaining the rail installed.

- (3) Place the base and the tables as shown in Fig.1, and then insert the roller cage from the end. If the cage does not enter because there is no clearance, slide rail 4 toward the adjustment bolt first, and then insert the cage again.

- (4) Place a dial gauge as shown in Fig.1. Then, lightly screw all adjustment bolts evenly until the clearance is almost eliminated while gently pressing the table sideways.

- (5) Attach the stopper to the rail end.

- (6) Slide the table and adjust the cage position so as to achieve the required stroke.

- (7) Position the roller cage in the center of the rail as shown in Fig.2-1. Then, evenly tighten the adjustment bolts (b, c and d) that are within the area where the roller is present until the dial gauge indicates the required displacement. Fully fasten the mounting bolts where adjustment was performed.

Note) The displacement indicated on the gauge represents the preload per roller cage.

- (8) Slide the table as shown in Fig.2-2, and adjust the remaining adjustment bolts (a and e) in the same manner.

Note) When installing two or more units, first measure the tightening torque of the adjustment bolts for the first unit or the sliding resistance of the first unit. Then, install the second (and later) unit so that its/their tightening torque(s) or sliding resistance(s) equal(s) that of the first unit. In this way, almost uniform preloads can be provided.

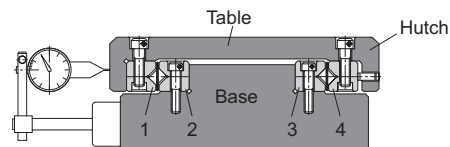


Fig.1 Installation of the Cross Roller Guide

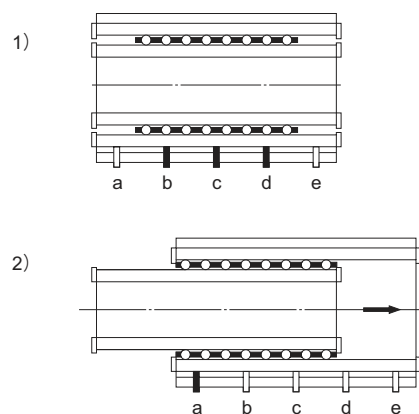
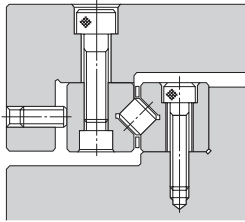


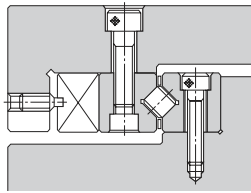
Fig.2 Sequence of Tightening the Adjustment Bolts

Example of Clearance Adjustment

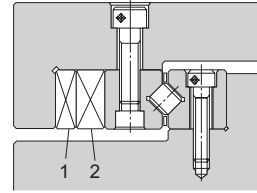
Design the adjustment bolt so that it presses the rail on the same level as the roller.



Normally, press the rail with the adjustment bolt.



When a certain level of accuracy and rigidity is required, use a presser plate.



When high accuracy and high rigidity are required, use tapered gibs 1 and 2.

Fig.3 Example of Clearance Adjustment

Preload

An excessive preload may cause indentation, shorten the service life or cause trouble. The permissible preload per roller cage is indicated in the specification table. Tighten the adjustment bolts while monitoring the displacement of the roller contact area.

Accuracy of the Mounting Surface

To achieve a high level of running accuracy, it is also necessary to establish a certain level of accuracy in parallelism and straightness. Preferably, the parallelism and the flatness of the rail-mounting surface should be finished by grinding or similar machining to at least the same degree as the parallelism of the rail (see A-578). Also, mount the rail so that it closely contacts the mounting surface.

Dedicated Mounting Bolt

To mount the rail where normal clearance is to be adjusted, use the screw hole drilled on the rail as shown in Fig.1. The holes of the bolt (d_1 and D_1) must be machined so that they are greater by the adjustment allowance.

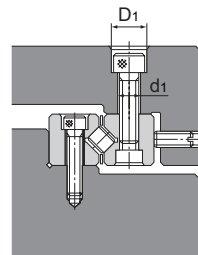


Fig.1

If it is inevitable to adopt a mounting method like the one shown in Fig.2 for a structural reason, use the dedicated mounting bolt (S) indicated in Fig.3.

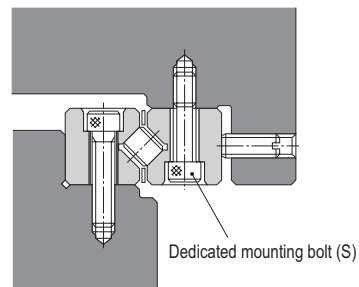


Fig.2

Table1 Dedicated Mounting Bolt

Unit: mm

Model No.	S	d	D	H	L	B	Supported rail
S 3	M3	2.3	5	3	12	2.5	V3
S 4	M4	3.1	5.8	4	15	3	V4
S 6	M5	3.9	8	5	20	4	V6
S 9	M6	4.6	8.5	6	30	5	V9
S 12	M8	6.25	11.3	8	40	6	V12
S 15	M10	7.9	13.9	10	45	8	V15
S 18	M12	9.6	15.8	12	50	10	V18

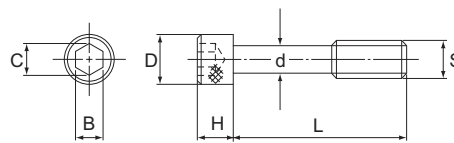


Fig.3 Dedicated Mounting Bolt

[Handling]

- (1) Disassembling components may cause dust to enter the system or degrade mounting accuracy of parts. Do not disassemble the product.
- (2) Dropping or hitting the Cross Roller Guide/Ball Guide may damage it. Giving an impact to it could also cause damage to its function even if the product looks intact.

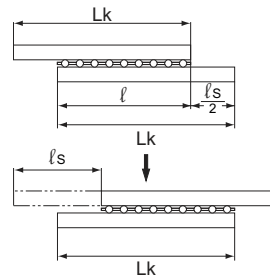
[Lubrication]

- (1) Thoroughly remove anti-rust oil and feed lubricant before using the product.
- (2) Do not mix lubricants of 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.

[Rail Length]

The roller cage and the ball cage move half the travel distance of the table in the same direction. To prevent the cage from overhanging from the raceway base when the cage length is " l " and the stroke length is " l_s ", the rail length (L_k) must be at least the following.

$$L_k \geq l + \frac{l_s}{2}$$



[Offset of the Cage]

The cage, which retains rollers (or balls), demonstrates extremely accurate motion. However, it may be offset as affected by driving vibrations, inertia or impact.

If using the Cross Roller Guide or Ball Guide in the following conditions, contact THK.

- Vertical use
- Pneumatic cylinder drive
- Cam drive
- High speed crank drive
- Under a large moment load
- Butting the guide's external stopper with the table

Precautions on Use

[Stopper]

Stoppers are attached to the rail ends in order to prevent the cage from falling off. Note, however, that frequently colliding the cage with the stopper may cause wear of the stopper and loosening of the stopper fastening screws, and may cause the cage to fall off.

[Contamination Protection]

As a means to prevent foreign material from entering the Cross Roller Guide or the Ball Guide, contamination protection accessories for the side faces as shown in Fig.1 are available. For contamination protection in the front and rear directions, consider using a bellows or a telescopic cover.

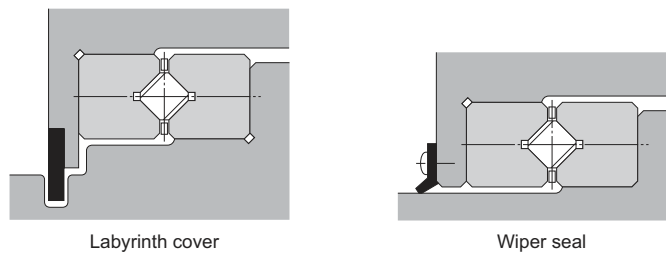


Fig.1 Contamination Protection Methods

[Precautions on Use]

- (1) If foreign material adheres to the product, replenish the lubricant after cleaning the product.
- (2) Contact THK if you desire to use the product at a temperature of 100°C or higher.
- (3) 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.

[Storage]

When storing the Cross Roller Guide/Ball Guide, enclose it in a package designated by THK and store it while avoiding high temperature, low temperature and high humidity.

