

GONIO WAY

The NB gonio way is a curved cross roller slide way. It is a curved motion bearing utilizing low-friction, non-recirculating precision rollers. It is used when there is a need to change the gradient or obtain an accurate gradient angle without changing the center of rotation in high-precision optical and measurement equipment.

STRUCTURE AND ADVANTAGES

The NB gonio way RVF type consists of curved tracking bases with precisely ground V-grooves and flat installation surfaces, as well as curved roller cages. The NB gonio way RV type consists of curved rails with precisely machined V-grooves and curved roller cages. Precision rollers are employed as the rolling elements, since the rolling elements do not recirculate, the frictional resistance will not vary significantly, providing curved movement with extremely low frictional resistance.

Low Frictional Resistance and Minute Motion

The precision grinding and curved roller cage allow for extremely low frictional resistance. The negligible difference between static and dynamic frictions allows the gonio way to follow minute movements accurately, realizing curved movement of high accuracy.

Low Noise

Since NB gonio way employs a non-recirculating design, there is no noise from the circulating area. In addition, the curved roller cage realizes quiet operation without contact noise between the rolling elements.

High Rigidity and High Load Capacity

The rollers provide a larger contact area and less

elastic deformation compared to the ball elements. Additionally, since the rollers do not recirculate, the effective number of rotating elements is larger, resulting in high rigidity and high load capacity.

Flat Installation Surface

The flat installation surfaces of the RVF type do not require complicated machining of tables and beds when installing the product. As a result, machining costs can be reduced greatly.

Same Rotation Center

The curved V-grooves, which are finished with a precise grinding process, provide an accurate center of rotation. Furthermore, the products are composed to provide identical rotation centers when products of each size are installed to two axes. (refer to Table G-17.)

Figure G-28 Structure of Gonio Way RVF type

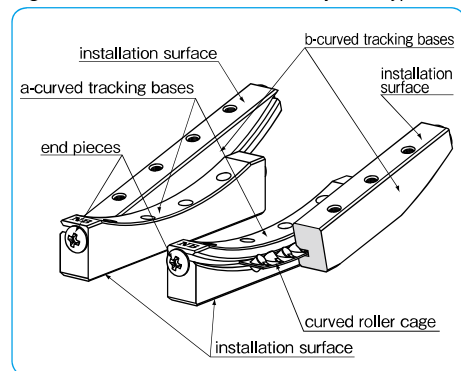
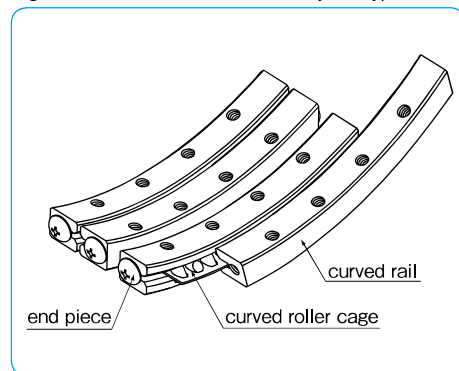


Figure G-29 Structure of Gonio Way RV type



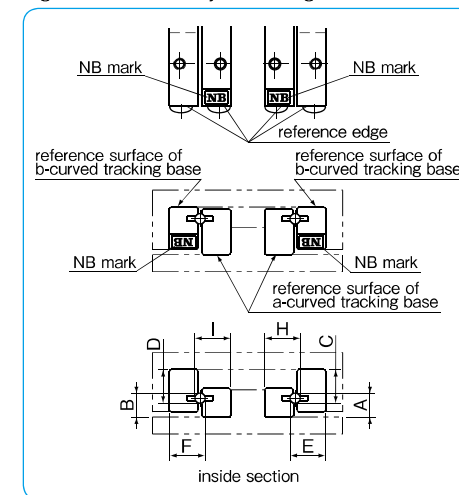
ACCURACY OF RVF TYPE

The accuracies of the gonio way RVF type are represented by mutual dimensional errors of four rails, which are measured along the overall length using the procedure as shown in Figure G-30.

Table G-13 Accuracy unit/μm

| part number | mutual error between A and B mutual error between C and D | mutual error between E and F mutual error between H and I |
|-------------|--|--|
| RVF2050- 70 | 10 | 10 |
| RVF2050- 87 | | |
| RVF2050-103 | | |
| RVF2050-120 | | |
| RVF3070- 85 | | |
| RVF3070-110 | | |
| RVF3100-125 | | |
| RVF3100-160 | | |

Figure G-30 Accuracy Measuring Method



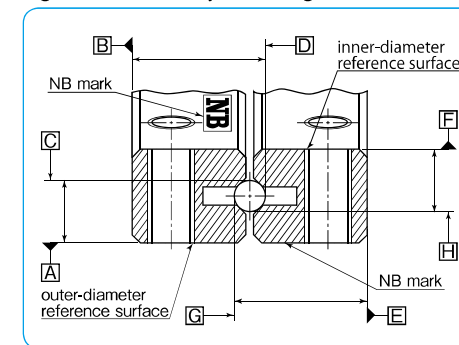
ACCURACY OF RV TYPE

The accuracies of the gonio way RV type are represented by mutual dimensional errors of four rails, which are measured along the overall length using the procedure as shown in Figure G-31.

Table G-14 Accuracy unit/μm

| part number | accuracy |
|-------------|----------|
| RV2040- 50 | 10 |
| RV2060- 60 | |
| RV3070- 90 | |
| RV3070-110 | |
| RV3100-160 | |

Figure G-31 Accuracy Measuring Method



The reference surfaces are located on the opposite side of the NB mark. There are inner reference surface and outer reference surface in one set of RV.

RATED LIFE

The life of a gonio way is obtained using the following equations.

Rated Life

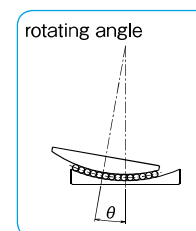
$$L = \frac{90}{\theta} \times \left(\frac{f_r}{f_w} \times \frac{C}{P} \right)^{\frac{10}{3}}$$

L: travel life (10⁶cycles) θ: rotating angle (degree)
 C: basic dynamic load rating (N) P: applied load (N)
 f_r: temperature coefficient f_w: applied load coefficient
 ※Refer to page Eng-5 for the coefficients.

Life Time

$$L_h = \frac{L \times 10^6}{60 \times n}$$

L_h: life time (hr)
 n: number of cycles per minute (cpm)



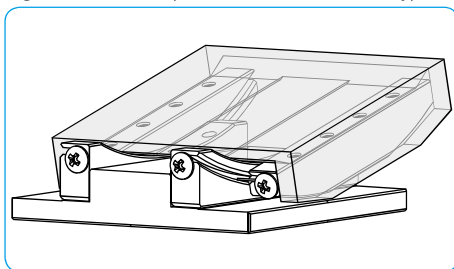
MOUNTING OF RVF TYPE

Accuracy of Mounting Surface

To maximize the performance of NB gonio way, it is important to finish the installation surface with high accuracies.

- Parallelism of surface 1 against surface A
- Perpendicularity of surface 2 against surface A
- Perpendicularity of surface 5 against surface A
- Parallelism of surface 3 against surface B
- Perpendicularity of surface 4 against surface B
- Perpendicularity of surface 6 against surface B
- Parallelism of surface 2 against surface C
- Parallelism of surface 4 against surface C

Figure G-33 Example of Installation of RVF type



Installation Procedure

Setting the curved tracking bases temporarily

- (1) Remove burrs, stains, and dust from the installation surfaces of the curved tracking bases of tables and beds. Foreign particles must be kept out of the assembly work as well.
- (2) Apply low viscosity oil to contact surfaces, check the reference edges of an a-curved tracking base and bed, and then tighten the screws temporarily. (Figure G-34a)
- (3) Align the reference edges (NB mark side) of a b-curved tracking base and an a-curved tracking base to the same orientation. Then, insert the curved roller cages between the curved tracking bases at the center area. Make sure that the curved roller cages will not interfere with the curved raceway grooves of the curved roller tracking bases. (Figure G-34b)
- (4) Check the reference edge of the table, set the table over the b-curved tracking base, and then secure the table temporarily. (Figure G-34c)

Figure G-32 Accuracy of Mounting Surface

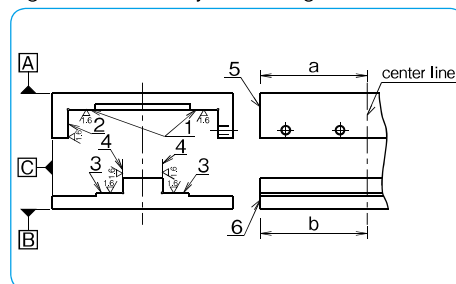
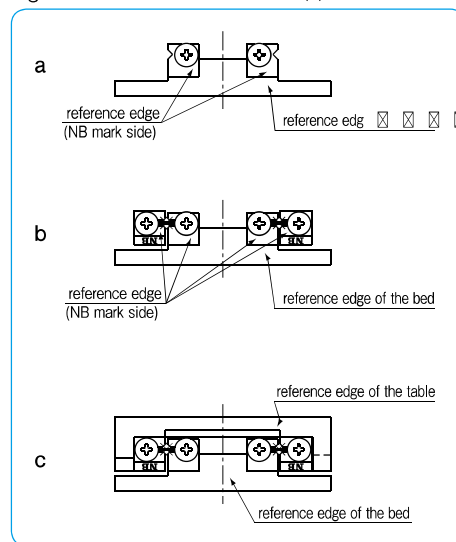


Figure G-34 Installation Method (1)



Setting four curved tracking bases in parallel position

- (5) Move the table to the maximum stroke ends of both sides and adjust the setting so that the curved roller cage is positioned at the center of the curved tracking base.
- (6) Move the table to the center position and tighten the adjustment screws with ※slightly strong torque by using a torque wrench. (Figure G-35d)
 ※"Slightly strong torque" here means slightly stronger than the torque at which the oscillation of the dial indicator is stabilized at the minimum value when the table is moved right and left, or when pressure is applied to the rolling direction while the dial indicator is attached to the side face (reference side) of the table. (Figure G-35i)
- (7) Move the table to the maximum stroke end of one side and tighten the adjustment screws on the curved roller cage with the same torque as in step (6). (Figure G-35e)
- (8) Move the table to the maximum stroke end of the other side and tighten the adjustment screws with a torque wrench by repeating the procedure above. (Figure G-35f)

Securing the curved tracking bases

- (9) Mount an edge reference plate between the reference edge of the a-curved tracking base and end piece, press it against the reference edge of the bed, and then tighten only the mounting screws in the middle. (Figure G-35g)
- (10) Repeat the procedure above to mount an edge reference plate between the reference edge of the b-curved tracking base and the end piece. Press it against the reference edge of the bed, and then tighten only the mounting screws in the middle. (Figure G-35h) In order to maintain parallelism of curved tracking bases, do not cycle the table during this process and make sure that there is no clearance between the edge of the table and the edge reference plate.
- (11) Secure the rest of the mounting screws on the curved roller cage one by one by moving the table as instructed in steps (7) and (8).

Adjusting the preload

- (12) Move the table to the right and left with the test indicator attached to the side face of the table (reference side). Or, apply pressure in the rolling direction and confirm that the oscillation of the indicator is stabilized at the minimum level. (Figure G-35i)
- (13) Return the mounting screws on the b-curved tracking base at the adjustment screw side to the temporary setting.
- (14) Return the table to the center position, slightly loosen the adjustment screws in the middle, and then gradually loosen the adjustment screws on the curved roller cage while moving the table as instructed in steps (7) and (8). Make sure not to reduce the preload too much.
- (15) Finally, secure the b-curved tracking base at the adjustment screw side, which has been installed temporarily. Secure the mounting screws on the curved roller cage one by one by moving the table as instructed above.

Figure G-35 Installation Method (2)

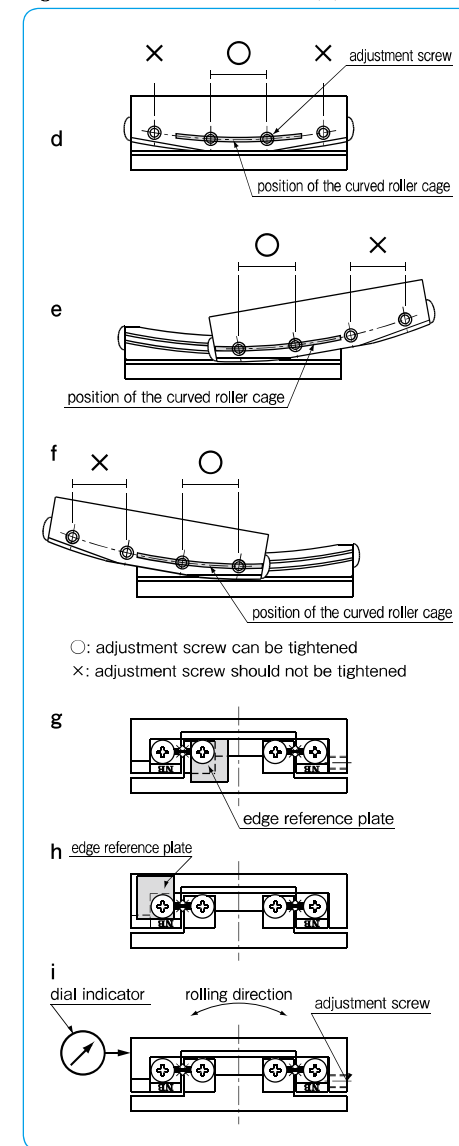


Table G-15 Recommended Torque for Mounting Screw

| size | tightening torque |
|------|-------------------|
| M2.5 | 0.5 |
| M3 | 1.1 |

(for stainless steel screw A2-70)

MOUNTING OF RV TYPE

Accuracy of Mounting Surface

The accuracy of surfaces 1, 2, 3, and 4 (Figure G-36) directly affect the motion accuracy. To maximize the performance of NB gonio way, it is important to finish the installation surface with high accuracies.

Figure G-36 Accuracy of Mounting Surface

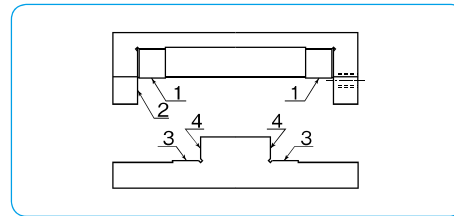
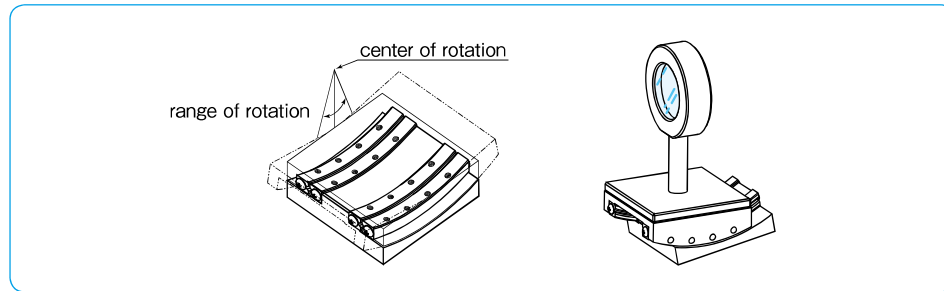


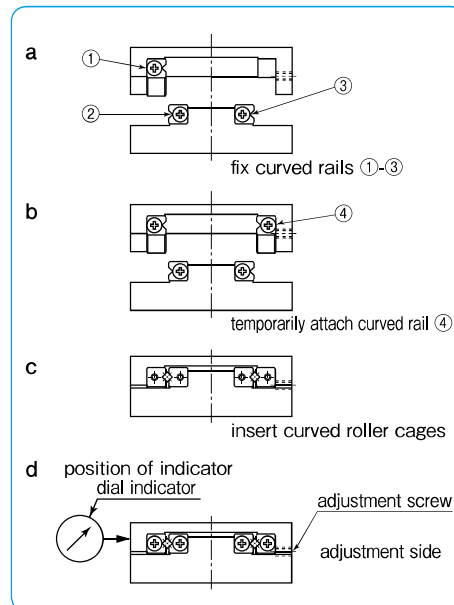
Figure G-37 Example of Installation



Installation Procedure

- (1) Remove burrs, dirt, dust, etc. from the table and the installation surfaces of the bed.
- (2) Apply a low viscosity oil to contact surfaces. Fix the rail ①inner-diameter reference surface, ②outer-diameter reference surface and ③outer-diameter reference surface by tightening screws to the specified torque. (Table G-16, Figure G-38a)
- (3) Temporarily attach the rail ④inner-diameter reference surface on curved rail to the adjustment side. (Figure G-38b)
- (4) Remove the end pieces on one side of the rails and insert roller cages to the center. (Figure G-38c)
- (5) Re-attach end pieces.
- (6) Move the table to the right and left (in the direction of the stroke) to position roller cages at the center of the curved rails.
- (7) Set an indicator at the side of the table on the reference surface. (Figure G-38d)
- (8) Move the table to one of the stroke ends and tighten the adjustment screws slightly. (Figure G-39e)

Figure G-38 Installation Method (1)



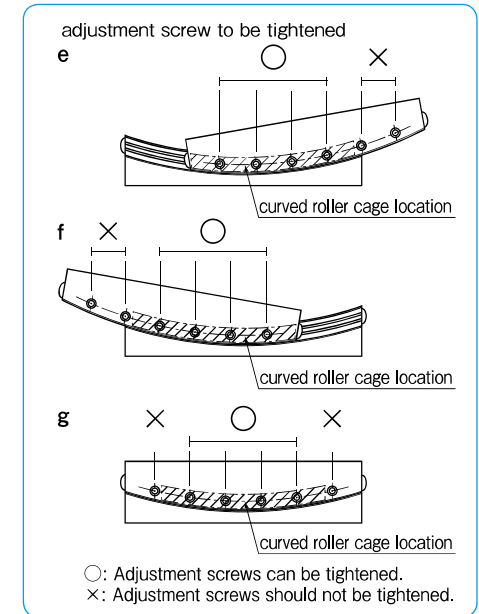
- (9) Move the table fully to the other stroke end and tighten the adjustment screws slightly. (Figure G-39f)
- (10) Move the table to the center and lightly tighten adjustment screws. (Figure G-39g)
- (11) Repeat steps (8)~(10) until there is no clearance around the table. If there is no clearance, the indicator will show a minimum fluctuation value when the table is moved to the right and left. Exercise care so as not to apply an excessive preload.
- (12) Repeat steps (8)~(10) and tighten the adjustment screws uniformly by using a torque wrench.
- (13) Fix the rail ④inner-diameter reference surface. Tighten the mounting screws sequentially by moving the table in the same manner as with the adjustment screws.

Table G-16 Recommended Torque for Mounting Screw

| size | torque |
|------|--------|
| M3 | 1 |

(for stainless steel screw A2-70)

Figure G-39 Installation Method (2)



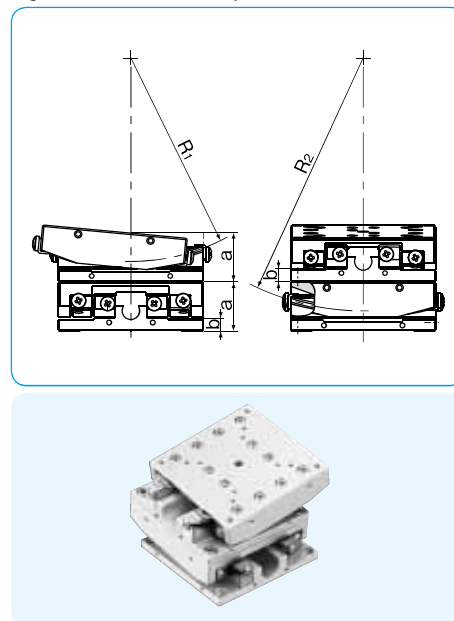
RVF TYPE 2 AXES AND SPECIAL SPECIFICATIONS

When incorporating RVF type units onto two axes as illustrated in Figure G-40, adjust the height of one lifting axis as instructed in Table G-17. Then, adjust dimension b (the height of the installation surface of the a-curved tracking base) in Figure G-40 according to the table in order to obtain the identical rotation center for the two axes. In addition, requests can be made for custom specifications including table units fitted for two axes, non-standard lengths for curved tracking bases, the radius of rotation, the rotation range, and the number of rollers. Contact NB for further information.

Table G-17 Two Axes Specification unit/mm

| part number combination | a | R ₁ | R ₂ |
|----------------------------|----|----------------|----------------|
| RVF2050- 70 RVF2050- 87 | 17 | 70 | 87 |
| RVF2050-103 RVF2050-120 | 17 | 103 | 120 |
| RVF3070- 85 RVF3070-110 | 25 | 85 | 110 |
| RVF3100-125 RVF3100-160 | 35 | 125 | 160 |

Figure G-40 Two Axes Specification



USE AND HANDLING PRECAUTIONS

Lubrication

NB gonio ways are lubricated using lithium soap based grease prior to shipment, so they can be used immediately. Make sure to relubricate with a similar type of grease periodically according to the operating conditions. NB also provides low dust generation grease for the linear system. Please refer to page Eng-39 for further details.

Dust Prevention

If a foreign matter, such as dust and dirt, enters the inside of the NB gonio way, it will deteriorate the accuracy and life of the system. A gonio way used in a harsh environment should be protected with a cover.

Operating Environment

The recommended operating temperature range of the NB gonio way is -20°C to 110°C.

Adjustment

Inaccuracy in mounting surface or improper adjustment of preload will reduce the motion accuracy, resulting in skewing and shortening of gonio way life. The adjustment should be carried out carefully.

Cage Slippage

For the NB Gonio Way, the cage can slip under high-speed motion, vertical application, unbalanced-loading, and vibrating conditions. It is recommended that the rotation range be set with sufficient margin and an excessive preload should be avoided. It is also recommended that the rails be cycled to perform the maximum stroke several times, so that the cage returns to its central position.

End Pieces

End pieces are attached to each end of the NB gonio way to prevent removal of the curved roller cage. Do not use as a mechanical stopper.

Careful Handling

Dropping the NB gonio way causes the rolling elements to make dents in the raceway surface. This will prevent smooth motion and will also affect accuracy. Be sure to handle the product with care.

Use as a Set

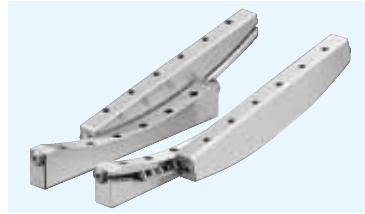
The accuracy of the rails has been matched within each set. Note that the accuracy will be affected when the rails of different sets are combined.

Allowable Load

The allowable load is a load under which the sum of elastic deformation of the rolling element and the raceway in the contact area subject to the maximum contact stress is small enough to guarantee smooth rolling movement. When very smooth and highly accurate motion is required, make sure to use the product within the allowable load.

RVF TYPE

— Gonio Way flat-installation-surface —



part number structure

example **RVF 3 100 - 125 - 16Z**

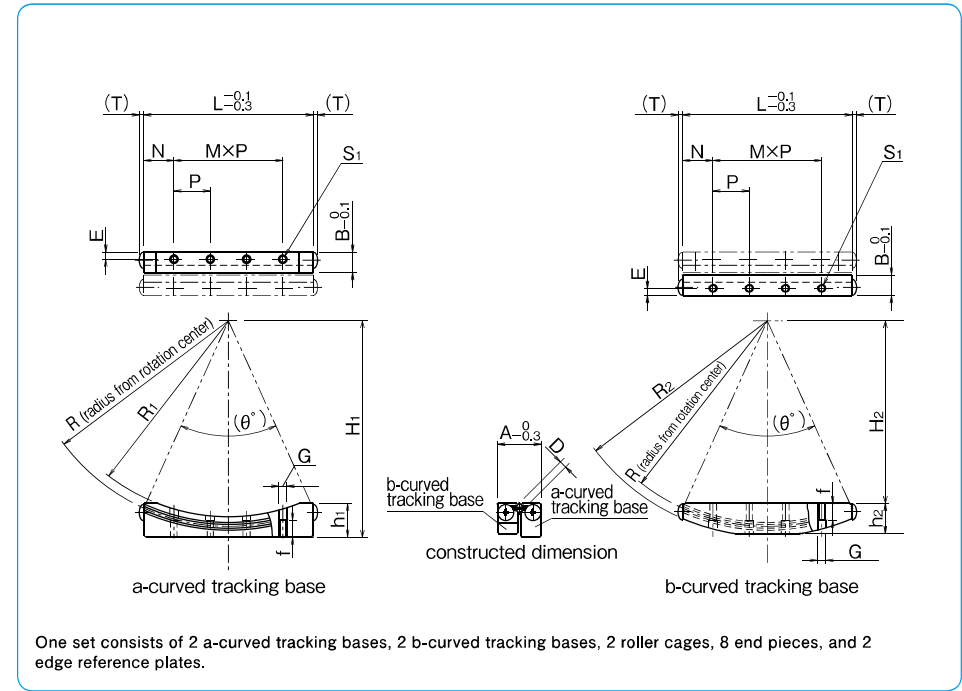
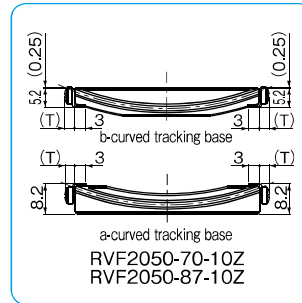
RVF type

size

rail length

radius from rotation center

number of rollers



| part number | rotation range | roller diameter D mm | number of rollers Z | major dimensions | | | | | | | | | |
|-----------------|----------------|----------------------|---------------------|------------------|------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|------|------|
| | | | | L mm | R mm | R ₁ mm | R ₂ mm | H ₁ mm | H ₂ mm | h ₁ mm | h ₂ mm | A mm | B mm |
| RVF2050- 70-10Z | ± 5° | 2 | 10 | 50 | 70 | 67 | 73 | 72.5 | 64.5 | 7.5 | 7.5 | 15 | 7.25 |
| RVF2050- 87-10Z | | | 10 | | 87 | 84 | 89.5 | 89.5 | 81.5 | 7.5 | 7.5 | | |
| RVF2050-103-10Z | | | 10 | | 103 | 100 | 106 | 105.5 | 97.5 | 7.5 | 8 | | |
| RVF2050-120- 9Z | | | 9 | | 120 | 117 | 123 | 122.5 | 114.5 | 7.5 | 8 | | |
| RVF3070- 85-10Z | ±10° | 3 | 10 | 70 | 85 | 81 | 89 | 89.5 | 75.5 | 14 | 12.5 | 18 | 8.5 |
| RVF3070-110-10Z | | | 10 | | 110 | 106 | 114 | 114.5 | 100.5 | 12.8 | 12.5 | | |
| RVF3100-125-16Z | | | 16 | | 125 | 121 | 129 | 129.5 | 110.5 | 17.5 | 18 | | |
| RVF3100-160-14Z | | | 14 | | 160 | 156 | 164 | 164.5 | 145.5 | 15 | 18 | | |

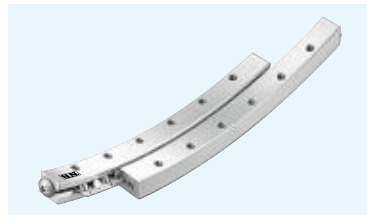
※ Please refer to page G-64 for information on cage dimensions.

| M×P mm | N mm | E mm | S ₁ | f mm | G mm | T mm | θ° | basic load rating | | | mass (one set) g | part number |
|--------|------|------|----------------|------|------|------|-------|-------------------|-------------|--------------------|------------------|-----------------|
| | | | | | | | | dynamic C N | static Co N | allowable load F N | | |
| 3×12.5 | 6.25 | 2.5 | M2.5 | 4 | 3 | 2.7 | 41.8° | 1,180 | 2,400 | 800 | 66 | RVF2050- 70-10Z |
| | | | | | | | 33.3° | 1,060 | 2,430 | 810 | 70 | RVF2050- 87-10Z |
| 3×13 | 5.5 | 2.5 | M2.5 | 4 | 3 | 1.5 | 28.0° | 998 | 2,440 | 815 | 70 | RVF2050-103-10Z |
| | | | | | | | 24.0° | 751 | 1,970 | 657 | 70 | RVF2050-120- 9Z |
| 3×15 | 12.5 | 3 | M3 | 7 | 3.5 | 1.9 | 48.6° | 2,680 | 5,530 | 1,840 | 182 | RVF3070- 85-10Z |
| | | | | | | | 37.1° | 2,440 | 5,620 | 1,870 | 182 | RVF3070-110-10Z |
| 5×15 | 12.5 | 3 | M3 | 7 | 3.5 | 1.9 | 47.1° | 3,520 | 8,850 | 2,950 | 327 | RVF3100-125-16Z |
| | | | | | | | 36.4° | 2,860 | 7,890 | 2,630 | 323 | RVF3100-160-14Z |

1N=0.102kgf

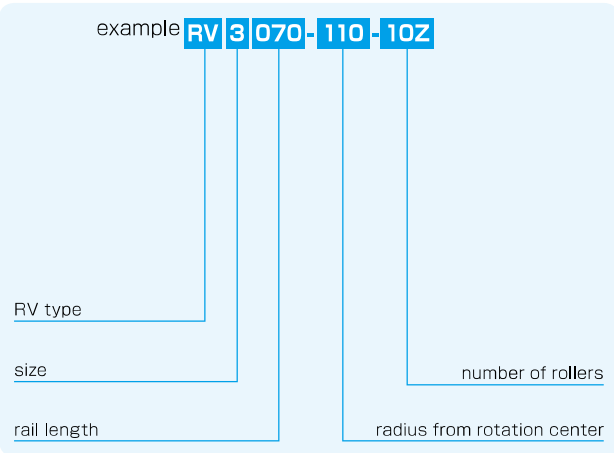
RV TYPE

— Gonio Way —



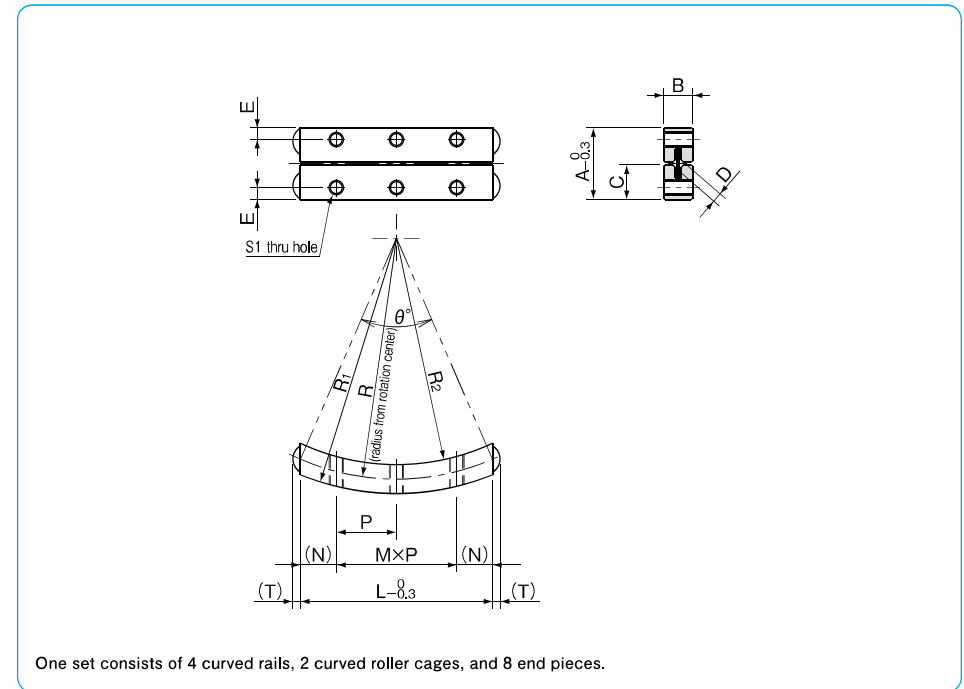
part number structure

example **RV 3 070 - 110 - 10Z**



| part number | rotation range | roller diameter D mm | number of rollers Z | major dimensions | | | | | | |
|----------------|----------------|-------------------------|---------------------|------------------|---------|----------------------|----------------------|---------|---------|---------|
| | | | | L mm | R mm | R ₁ mm | R ₂ mm | A mm | B mm | C mm |
| RV2040- 50- 7Z | ±10° | 2 | 7 | 40 | 50 | 53 | 47 | 15 | 6 | 7.25 |
| RV2060- 60-12Z | | | 12 | 60 | 60 | 63 | 57 | | | |
| RV3070- 90-11Z | ±10° | 3 | 11 | 70 | 90 | 94 | 86 | 18 | 8 | 8.5 |
| RV3070-110-10Z | | | 10 | 70 | 110 | 114 | 106 | | | |
| RV3100-160-14Z | | | 14 | 100 | 160 | 164 | 156 | | | |

※ Please refer to page G-64 for information on cage dimensions.



| M×P mm | N mm | E mm | S ₁ | T mm | θ° | basic load rating | | allowable load F N | mass (one set) g | part number |
|-----------|---------|---------|----------------|---------|-------|-------------------|----------------|-----------------------|---------------------|----------------|
| | | | | | | dynamic C N | static Co N | | | |
| 2×12.5 | 7.5 | 2.5 | M3 | 1.5 | 47.2° | 820 | 1,440 | 482 | 49 | RV2040- 50- 7Z |
| 3×12.5 | 11.25 | | | | 60.0° | 1,490 | 2,800 | 936 | 75 | RV2060- 60-12Z |
| 3×15 | 12.5 | 3 | M3 | 1.9 | 45.8° | 2,640 | 5,550 | 1,850 | 137 | RV3070- 90-11Z |
| 3×15 | | | | | 37.1° | 2,440 | 5,620 | 1,870 | 135 | RV3070-110-10Z |
| 5×15 | | | | | 36.4° | 2,860 | 7,890 | 2,630 | 193 | RV3100-160-14Z |

1N≒0.102kgf