

# **NSK Linear Guides** Roller Guide RA Series

Advanced analysis technology delivers super-high load capacity next-generation roller guide for machine tools





## The fruits of comprehensive technology of NSK. New-generation RA Series roller guide is ideal for machine tools

NSK sought to produce the ideal linear guide for machine tools by combining its extensive experience in roller bearings and linear guides technologies. The result is an optimal design that takes full advantage of NSK's unique know-how to realize super-high load capacity, rigidity, and motion accuracy, with smooth motion, and thereby delivering machine tools with powerful performance.

## RA Series features support high performance machine tools

#### Super-Long Life

#### • Super-high load capacity

NSK has realized super-high load capacity, now the highest performance in the world, and achieved unprecedented operating life.

#### Maintenance-free

Installing an NSK K1® lubrication unit assures long-term, maintenance-free operation.

#### • Highly dust-proof

The high performance seals as standard equipment completely block the entry of foreign matter and maintain primary performance over the long term.



#### **Contribution to High-Precision Manufacturing**

#### • Super-high rigidity

Super-high rigidity provides high-precision manufacturing.

#### • Super-high motion accuracy

Coupled with NSK's unique design approach, the vibration caused by roller passage has been substantially reduced. This will greatly contribute to improve machining quality.

#### • Smooth motion

The installation of a retaining piece achieves smooth motion, resulting in stable positioning accuracy.



Example of ball slide deformation analysis

1 NSK

## **Roller Guide RA Series**



### Optimal design through integration of NSK technologies





Balanced four-directional iso-load specifications

Smooth motion by use of retaining pieces

NSK executed a comprehensive, detailed performance simulation of roller guides by integrating its analysis technology and the tribology technology that the company had been developing over many years. Down to the dimensions and shapes of component



of roller contact surface pressure



## A variety of contributions to improve the performance of machine tools

NSK Roller Guide RA Series exhibit the world's highest load capacity and enhance the performance of machine tools through a variety of features, including super-high rigidity, super-high motion accuracy, and low friction variation.



#### Super-high load capacity

By installing rollers that are the largest possible diameter and length within the existing standard cross-section dimension in a rational layout based on analysis technology, we have realized the world's highest load capacity<sup>\*</sup>, far superior to conventional roller guides. Super-long life is achieved and impact load can be sufficiently handled.

\*Compared with products of the same size, as of September 1, 2003, researched by NSK.



The basic load rating which is shown in the figures complies with ISO standards.

#### Super-high rigidity

Using NSK's advanced analysis technology, we pursued a complete, optimal design, down to the detailed shape of roller slides and rails, thereby realizing super-high rigidity superior to that of conventional roller guides.





#### Super-high motion accuracy

Through the NSK's unique design approach, vibration caused by roller passage is effectively dampened for dramatically improved motion accuracy. RA Series significantly reduces vibration compared to conventional roller guides.



#### **Smooth motion**

Installing a retaining piece between rollers and restraining the skew peculiar to rollers, achieves smooth motion. The reduction of friction variation provides stable tracking in the complicated trajectory control.



## Highly dust-proof and maintenance-free operation

Roller slides include high performance seals as standard equipment. The seal completely blocks the entry of foreign matter into the rolling surface and prevents loss of performance. In addition, rail covers are also available for severe operating conditions. The highly regarded NSK K1<sup>®</sup> lubrication unit is also

The highly regarded NSK K1<sup>®</sup> lubrication unit is also available to satisfy customer needs for long-term, maintenance-free operation.

#### Mounting dimensions compatibility

The outer and mounting dimensions of RA Series are based on market standards. RA Series can be replaced without altering equipment design.



#### 1. Accuracy Standard and Preload

The accuracy standard of NSK Roller Guide RA Series is divided into the following four levels: Ultra precision (P3), Super precision (P4), High precision (P5), and Precision (P6).

On preload, as a feature of roller guides, a difference in preload does not result in significant difference in rigidity and high rigidity can be stably attained. Therefore only high preload Z3 (10%C: C is basic dynamic load rating) is set up. Refer to Table 2 for running parallelism.



#### Table 1 Accuracy standards

				Unit: mm							
Accuracy Standards	Ultra super precision	Super precision	High precision	Precision							
	P3	P4	P5	P6							
Mounting height: Dimensions in mounting height H	±0.008	±0.010	±0.020	±0.040							
Mounting width: Dimensions in mounting width W <sub>2</sub> or W <sub>3</sub>	±0.010	±0.015	±0.025	±0.050							
Variation of mounting height dimension H	0.003	0.005	0.007	0.015							
Variation of mounting width dimension $W_2$ or $W_3$	0.003	0.007	0.010	0.020							
Running parallelism of face C against face A Running parallelism of face D against face B	Refer to Table 2										

#### Table 2 Running parallelism

Travel Ultra super precision Super precision High precision Precision (mm) P3 P4 P5 P6 Over - 50 or less 2 2 2 4.5 50 -80 2 2 3 5 2 80 -125 2 3.5 5.5 125 – 200 2 2 4 6 7 2 2.5 5 200 -250 250 -315 2 2.5 5 8 2 9 315 -400 3 6 400 -500 2 3 6 10 2 7 500 -630 3.5 12 630 -800 2 4 8 14 800 - 1 000 2.5 4.5 9 16 1 000 - 1 250 3 5 10 17 1 250 - 1 600 4 6 11 19 1 600 - 2 000 7 4.5 13 21 2 000 - 2 500 5 8 15 22 2 500 - 3 000 6 9.5 17 25

#### 2. Load Rating and Life

Basic dynamic load rating that indicates linear guide load capacity is the load whose direction and strength do not change at its rated fatigue life of 100 km. The basic load rating of the NSK Roller Guide RA Series is based on the ISO standards. In addition, the RA Series features four-direction iso-load with equal dynamic load rating C in horizontal and vertical directions.

Assuming only load F from above, beneath, the right or the left is applied on the roller slide, rated life L (km) can be calculated by the following formula: fw is load factor. Refer to the respective value from the following table 3 as a guideline according to potential vibration and the impact of the machine in which the linear guide is used, and select the load factor. This life formula is different from that for conventional linear guides with ball rolling elements.

$$L = 100 \times \left(\frac{C}{fw \cdot F}\right)^{\frac{10}{3}} \text{ (km)}$$

When load R in the horizontal direction and load S in the vertical direction are simultaneously applied, use the following dynamic equivalent load F for the calculation:



Table 3 Load factor fw

Impact Vibration	Load Factor
No impact and vibration from the outside	1.0 – 1.5
With impact and vibration from the outside	1.5 – 2.0
With heavy impact and vibration from the outside	2.0 - 3.0

#### 3. Dust-Proof

RA Series is equipped with side, inner and bottom seals to prevent foreign matter from entering the inside of the roller slide. Under normal applications, the RA Series can be used without modification. For severe usage conditions, optional rail covers over rails and protectors are available.

NSK K1® lubrication unit can be installed to support long-term, maintenance-free operation.



#### Table 4 Dimension of linear guides equipped with NSK K1®

Model N	lumber	Standard roller slide length	Roller slide length when attaching two NSK K1s, L	Thickness of single NSK K1, V <sub>1</sub> (Including case)	Nipple extension, N
DAGE	AN,EM	123.8	136.8	0.5	
RA35	BN,GM	152 165		6.5	11
	AN,EM	154	168	7	14
RA45	BN,GM	190	204		14
DAFE	AN,EM	184	198	7	14
RASS	BN,GM	234 248			14

Unit: mm

#### 4. Roller Slide Types and Shapes

Two types of roller slides are available in this series: one with a mounting flange, and a square type with tapped holes and no flange. On the mounting hole of the flange type, the tapped part is used to fix the roller slide from the top surface, and the minor diameter can be used as a bolt hole from the bottom. This provides mounting from both directions, top and bottom.

In addition, roller slide length can be specified by standard high load type or special long, super-high load type.



#### 5. Rail Length

Maximum single rail length is shown in the following table. For applications longer than the maximum, the rails must be butted.

Table 5 Maximum rail length of RA Series         Unit: mm												
Туре	RA35	RA45	RA55									
P3-P6	3 000	3 000	3 000									

Note: Consult with NSK if rails cannot be butted and a length over the above maximum is required.

#### 6. Reference Number

The number assigned to each roller guide and which is written into the specification drawing. Indicate the reference number for orders.



\*Please note that the appropriate design number will be inserted into the reference number and the tag end code (-II) will be omitted.

#### 7. Installation

#### (1) Mounting tolerance

Mounting tolerance results in harmful effects such as shortened operating life, deterioration in motion accuracy, and friction variation. NSK particularly focuses on operating life, and sets an operating life value of more than 20,000 km calculated under the following conditions as mounting tolerance:

- The load per roller slide is 10% of basic dynamic load rating C.
- The rigidity of machine is infinite.

The tolerance in Figure 6 is shown in the Table 6 as typical tolerance.





Unit: µm

Table 6 Mounting tolerance of RA Series

	RA35	RA45	RA55
Parallelism Tolerance of Two Axes e <sub>1</sub>	6	9	10
Height Tolerance of Two Axes $e_2$		70µm / 500mm	

#### (2) Shoulder height and corner radius of mounting surface

If rails or roller slides are pushed on the shoulders (rising edge of mounting surface) which are installed in a bed or a table to fix in the vertical direction, use shoulder height and corner radius dimensions shown in the following figure 7 and table 7.



of att	achment	
	Shoulder Height	Corner Badi

Table 7 Shoulder height and corner radius

Madal Cada	Shoulde	er Height	Corner Radius (maximum)						
Model Code	Η´	Н″	r <sub>a</sub>	r <sub>b</sub>					
RA35	5	6	0.5	0.5					
RA45	6	8	0.7	0.7					
RA55	7	10	0.7	0.7					

Fig. 7 Attachment of reference plane

#### Handling Precautions

① If oil lubrication is used, the oil may not pervade the rolling surface according to the roller slide mounting conditions such as upside down mounting and wall mounting. In these situations, consult with NSK.

<sup>(2)</sup> Operating temperature limits should normally be less than 80°C.

Unit: mm

Example of Specification Number: RA 35 1000 AN	<b>2 - ** P4 3 - Ⅱ</b>
Series code	*I: two rails per axis No code: single-rail
Size No. 35, 45, 55	Preload code Z3: Medium preload
Rail length (mm)	Accuracy grade (Without NSK K1): P3, P4, P5, P6 (With NSK K1): K3, K4, K5, K6
Roller slide shape code AN, BN, EM, GM	Design number
Material and surface treatment code, C: Special carbon steel (NSK standard)	Number of roller slides per rail

\*Please note that the appropriate design number will be inserted into the reference number and the tag end code (-II) will be omitted.

## Square type

## RA-AN (High load type), RA-BN (Super-high load type)





	Assembly Roller slide													Rail								Bas		Weight								
Model No.	Height			Width	Length		Тарр	ed hole						Grease nipple F		Grease nipple		Grease nipple F		Rail height	Bolt pitch	Bolt hole		G	Maximum	Dynamic	Static	Statio	c moment (N	l∙m)	Bearing	Rail
	Н	E	$W_2$	W	L	В	J	M×Pitch×ℓ	<i>B</i> <sub>1</sub>	$L_1$	$J_1$	K	Т	Mounting hole	<i>T</i> <sub>1</sub>	Ν	$W_1$	H <sub>1</sub>	F	$d \times D \times h$	B <sub>3</sub>	(recommended)	L <sub>0max</sub>	C (N)	C <sub>0</sub> (N)	$M_{\rm R0}$	$M_{\rm P0}$	$M_{ m Y0}$	(kg)	(kg/m)		
RA35AN RA35BN	55	6.5	18	70	123.8 152	50	50 72	M8×1.25×12	10	83.2 111.4	16.6 19.7	48.5	15	<i>M</i> 6×0.75	15	11	34	31	40	9×14×12	17	20	3 000	53 300 67 400	129 000 175 000	2 810 3 810	1 800 3 250	1 800 3 250	1.6 2.1	6.8		
RA45AN RA45BN	70	8	20.5	86	154 190	60	60 80	M10×1.5×17	13	105.4 141.4	22.7 30.7	62	17	R <sub>C</sub> 1/8	20	14	45	38	52.5	14×20×17	22.5	22.5	3 000	92 800 116 000	229 000 305 000	6 180 8 240	4 080 7 150	4 080 7 150	3.0 4.1	10.9		
RA55AN RA55BN	80	9	23.5	100	184 234	75	75 95	M12×1.75×18	12.5	128 178	26.5 41.5	71	18	R <sub>C</sub> 1/8	21	14	53	43.5	60	16×23×20	26.5	30	3 000	129 000 168 000	330 000 462 000	10 200 14 300	7 060 13 600	7 060 13 600	4.9 6.7	14.6		

Assembly Roller slide																			Rail							Basic load rating					Weight	
Model No	o Height Width Length Tapped hole, Fixing bolt		ength Tapped hole, Fixing bolt G		Grease nip	ople	Rail width Rail height Bolt pitch			Bolt hole		G Maximum		Dynamic	ic Static Stat		atic moment (N·m)		Bearing	Rail												
	Н	Ε	W2	W	L	В	J	J <sub>2</sub>	$M \times Pitch \times \ell_1(\ell_2)$	$Q \times l_{1}(l_{2})$	B <sub>1</sub>	L <sub>1</sub>	$J_1$	$J_3$	K	Т	Mounting hole	$T_1$	N W <sub>1</sub>	$H_1$	F	d×D×h	B <sub>3</sub>	(recommended)	L <sub>Omax</sub>	C (N)	$C_0(N)$	M <sub>R0</sub>	M <sub>P0</sub>	M <sub>Y0</sub>	(kg)	(kg/m)
RA35EM RA35GM	48	6.5	33	100	123.8 152	82	62	52	M10×1.5×13 (7)	8.6×13 (7)	9	83.2 111.4	10.6 24.7	15.6 29.7	41.5	12	<i>M</i> 6×0.75	8 1	1 34	31	40	9×14×12	17	20	3 000	53 300 67 400	129 000 175 000	2 810 3 810	1 800 3 250	1 800 3 250	1.7 2.3	6.8
RA45EM RA45GM	60	8	37.5	120	154 190	100	80	60	M12×1.75×15 (10.5)	10.5×15 (10.5)	10	105.4 141.4	12.7 30.7	22.7 40.7	52	13	<i>R</i> <sub>C</sub> 1/8	10 1	4 45	38	52.5	14×20×17	22.5	22.5	3 000	92 800 116 000	229 000 305 000	6 180 8 240	4 080 7 150	4 080 7 150	3.2 4.3	10.9
RA55EM RA55GM	70	9	43.5	140	184 234	116	95	70	M14×2×18 (13)	12.5×18 (13)	12	128 178	16.5 41.5	29 54	61	15	R <sub>C</sub> 1/8	11 1	4 53	43.5	60	16×23×20	26.5	30	3 000	129 000 168 000	330 000 462 000	10 200 14 300 1	7 060 13 600 1	7 060 13 600	5.4 7.5	14.6

If the above basic dynamic load rating (100 km rating) is converted into 50 km rating, use the following formula: