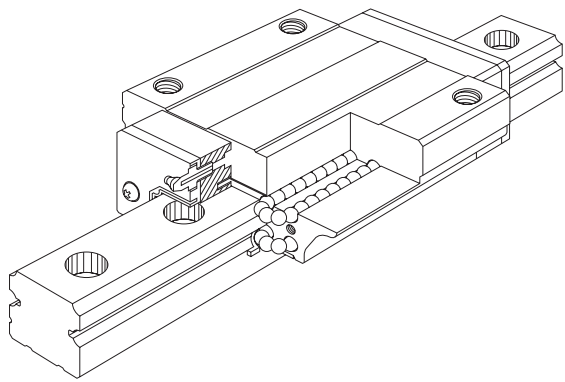
MOTION & CONTROL™

NSK

Installation of NSK Linear Guides™



NSK

NSK Linear Guides™: Handling Precautions

NSK linear guides are high quality and easy to use. NSK places importance on safety in design. For maximum safety, please follow precautions as outlined below.

(1) Lubrication

Confirm lubrication.

a. If anti-corrosive oil has been applied, thoroughly wipe the rust prevention oil and put lubricant inside slide before using. For seal lubrication products, put lubricant on the rail.

b. Do not mix greases of different brands.

c. If your linear guide has rust prevention specifications, put lubricant inside slide before using.

(2) Handling

Handle with care.

Do not disassemble.

Do not drop.

Do not impact.

a. Interchangeable slides are installed on a provisional rail when they leave the factory. Handle the slide with care during installation to the rail.

b. Do not disassemble the linear guide unless absolutely necessary. Not only does it allow dust to enter, but it lessens precision.

c. The slide may move by simply leaning the rail. Make sure that the slide does not disengage from the rail.

d. Standard end caps are made of plastic. Beating it or hitting it against an object may cause damage.

(3) Usage precautions

Avoid contamination.

Follow temperature limits.

Use care when hanging upside-down

a. Make every effort not to allow dust or foreign objects to enter.

b. Please apply splash guard or bellows to the linear guide to prevent solvents or coolant from adhering when they contain corrosive material.

c. The temperature where linear guides are used should not exceed 80°C (excluding heat-resistant linear guides). A higher temperature may damage the plastic end cap.

d. If the user cuts the rail, thoroughly remove burrs and sharp edges on the cut surface.

e. When hanging upside-down (e.g. the rail is installed upside-down on the ceiling and the slide faces downward), should the end cap be damaged causing the balls or rollers to fall out, the slide may detach from the rail and fall. For such use, take measures including installing safety devices.

(4) Storage

Store properly.

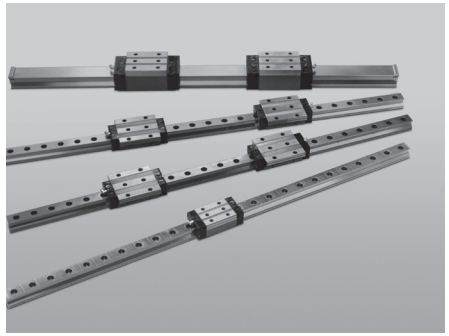
a. When storing the product, store it in the original packaging. Do not open the package or break the inner packaging unnecessarily. It may cause foreign matter to enter or rusting and may cause deterioration of functions.

b. A place where the indoor environment is hot and humid is not suitable because it significantly reduces the rust prevention effect. Store in a place with low humidity and little temperature change.

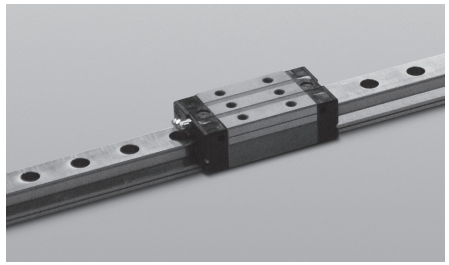
c. Linear guides may bend if the rail is stored in an inappropriate position. Place it on a suitable surface, and store it in a flat position.

Installation of NSK Linear Guides™
[No.1 Machine Tools]

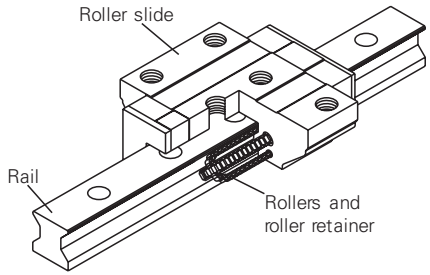
We thank you very much for your patronage of NSK linear guides. This manual describes the procedure for handling of NSK Linear Guides and installation in machine tools with the prescribed accuracy.



We recommend two types of NSK linear guides for the machine tools application. One is Roller Guide RA Model that offers high rigidity, highly reliable durability and high impact load carrying capacity. The other is Linear Guide LA Model that has been widely accepted in the field.

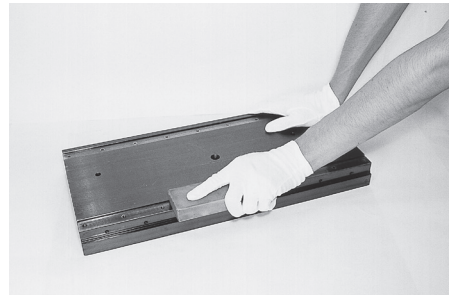


NSK Linear Guides are composed of a rail that governs linear motion of slides, and slides containing recirculating rolling elements that allow smooth movement and retain rigidity of a machine's table or saddle.
Note: Be aware that balls of LA Model fall out a ball slide when it is removed from a rail.



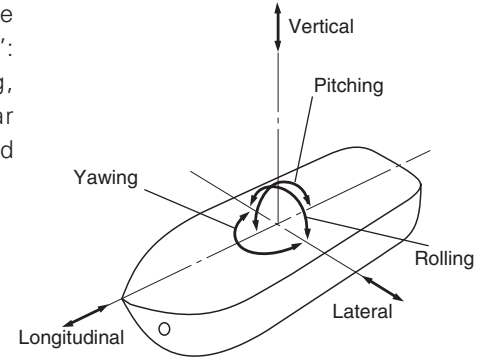
In "installation of the linear guide to the machine tool", it is important to take sufficient measurement data during trial installation and install surely.
Before installing linear guides for the first time, we recommend a trial installation to gain experience with the procedure. In this trial installation, carefully measure the accuracy of the mounting surfaces on the machine and the accuracy of the linear guides to clarify the relation with the required table accuracy. This will enable you to judge the required accuracy of the machine base and accuracy grade of linear guides, as well as how and what degree you have to measure related accuracy, so that no problems will arise after the machines are finally put into mass production. When installing linear guides for the first time, carefully follow the procedure in this manual.

Remove burrs and roughness on the machine base mounting surfaces with an oil stone.
Apply machine oil or similar oil with low viscosity to the mounting surface to increase the rust preventive effect.



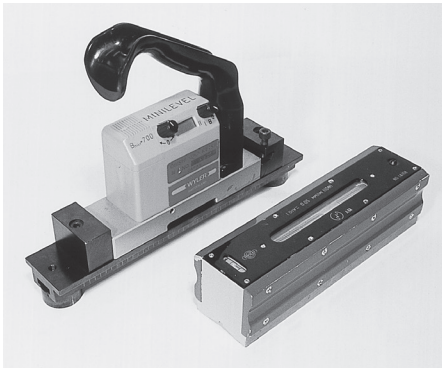
Highly precise measurements of the machine base are necessary; therefore, appropriate instruments in good condition must be used.
Suitable instruments are described next.

The motion of any object can be separated into six "degrees of freedom": three angular movements (pitching, yawing, and rolling) and three linear movements (longitudinal, vertical, and lateral).

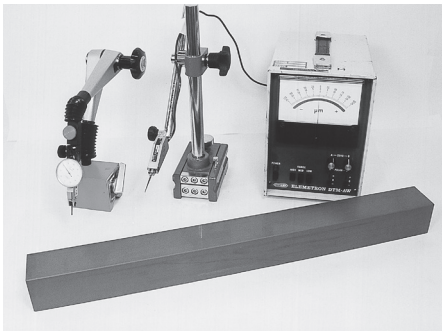


Instruments, which are suitable for only specific measurements, must be maintained and used properly.

Most levels utilize bubbles in a fluid, but some are electric and have a digital indicator. Both types can measure angular wobble in pitching and rolling.

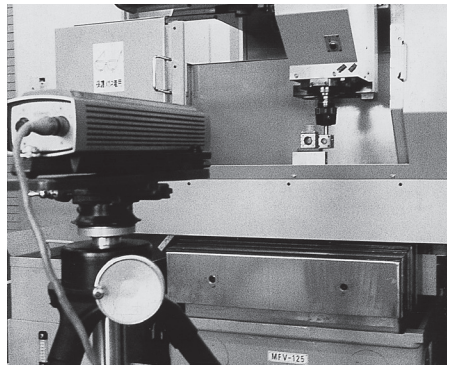


A good straightedge and a dial indicator or an electrical micrometer can be used under the ordinarily conditions to measure pitching, yawing, and rolling as well as vertical and lateral movements.



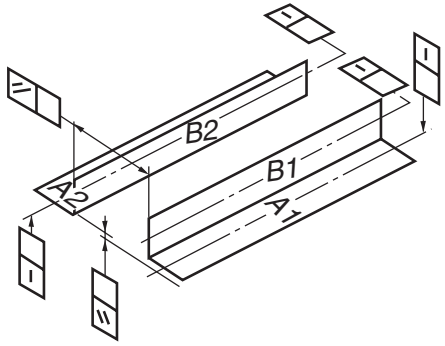
Autocollimators measure angular movement using reflected light, so they can measure pitching and yawing accurately.

Laser interferometer can read pitching, yawing, and linear movement with high accuracy; however, it is hard to handle and requires much time for the setting.

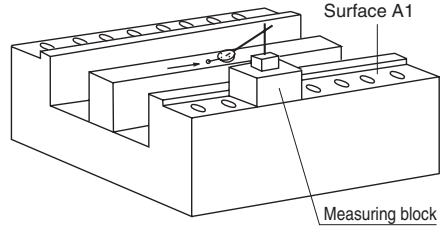


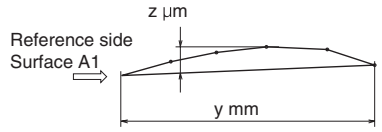
For the purposes of this manual, the combination of a straightedge and a dial indicator was chosen.

The machine base mounting surfaces are designated here as “A” for the rail bottoms and “B” for the rail sides.
The linearity and parallelism of these surfaces are measured in the following manner.

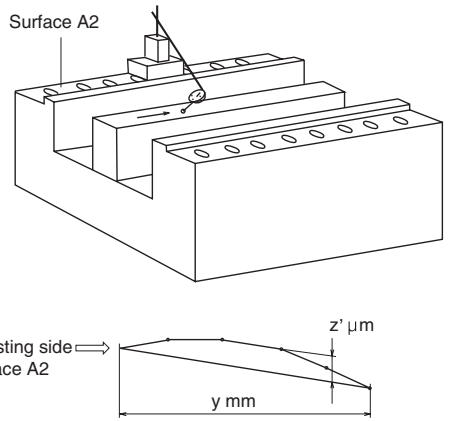


To measure the linearity of A1 surface, place a suitable measuring block on one surface and attach a dial indicator to it with its stylus on a straightedge lying parallel to surface A1. Holding the block firmly against surface B1 with both hands, slide the block along surface A1 for a specified step, record the measurement, then repeat the same to the end of the rail.

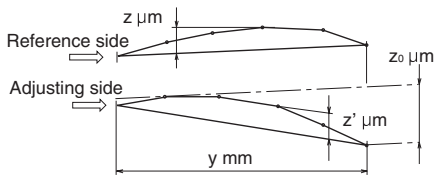




Then repeat the measurements for A2 surface. When doing this, it is important not to move the straightedge.

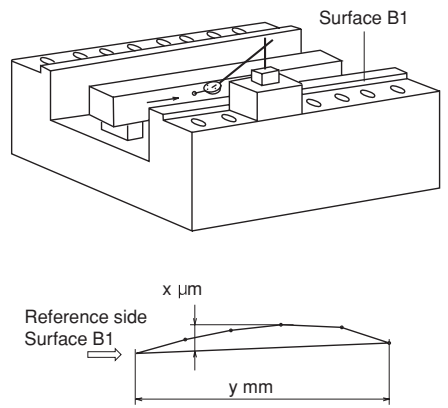


From the measurements of the A1 and A2 surfaces, determine their parallelism.

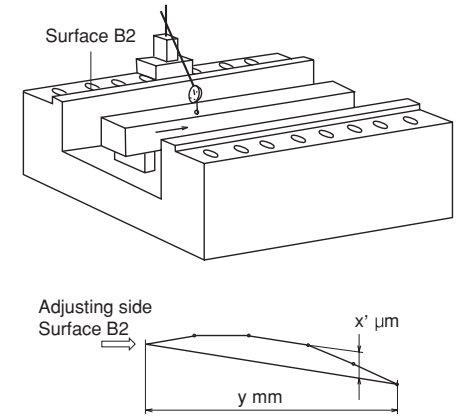


Parallelism of surface A1 and A2 z_0 µm /y mm

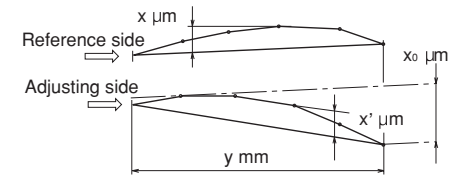
To measure the linearity of the B1 surface of the machine base, use an arrangement similar to that for the A surfaces but with the dial indicator stylus against the side of the straightedge.



For the B2 surface measurement, the same procedure is required.
In this case also, the straightedge must not be moved.



The measurements of B1 and B2 surfaces also determine their parallelism.

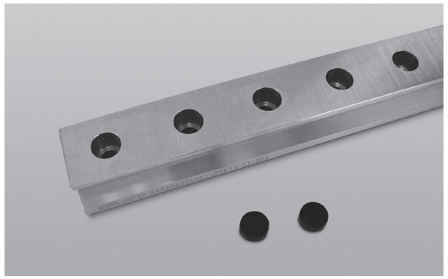


Parallelism of surface B1 and B2 x_0 µm /y mm

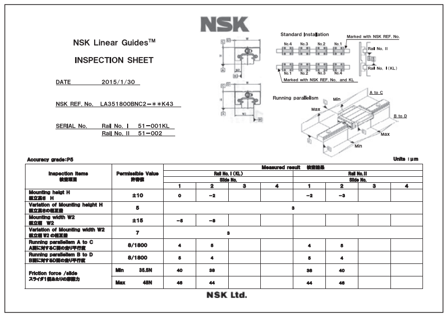
The accuracy measurement of the linear guide mounting surfaces is now complete. The linear guides should be carefully installed using the following procedure.

NSK linear guides are packed in corrugated cardboard boxes. Generally we pack the linear guides for machine tools as a pair in the shipping container. The linear guides are first wrapped in polyethylene films and placed in their boxes together with an inspection sheet or a certification sheet.

Caps for the rail mounting holes are also included if requested by the customer.



For the P3, P4 and P5 accuracy grades, actual inspection data are listed on the inspection sheets.



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NSK Linear Guides™

INSPECTION SHEET

DATE 2015/1/30

NSK REF. No. LA351800BNC2−∗∗K43

SERIAL No. Rail No. I 51−001KL
Rail No. II 51−002

Standard Installation

Marked with NSK REF. No.

No.4 No.3 No.2 No.1

Rail No. II

Rail No. I (KL)

No.1 No.2 No.3 No.4

Marked with NSK REF. No. and KL

Running parallelism

A to C

B to D

Min

Max

Accuracy grade:P5

Units : μm

Inspection Items	Permissible Value		Measured result							
			Rail No. I (KL)				Rail No. II			
			Slide No.				Slide No.			
			1	2	3	4	1	2	3	4
Mounting heigt H	±10		0	−2			−2	−3		
Variation of Mounting height H	5		3							
Mounting width W2	±15		−5	−8						
Variation of Mounting width W2	7		3							
Running parallelism A to C	8/1800		4	5			4	5		
Running parallelism B to D	8/1800		5	4			5	4		
Friction force /slide	Min	35.5N	40	38			38	40		
	Max	48N	46	44			44	46		

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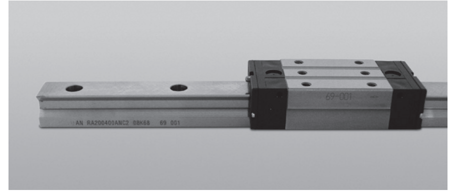
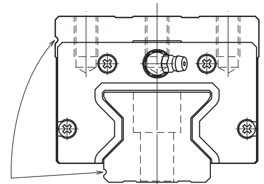
Remove the wrapping and look for the reference and production numbers on the sides of the rails and slides.

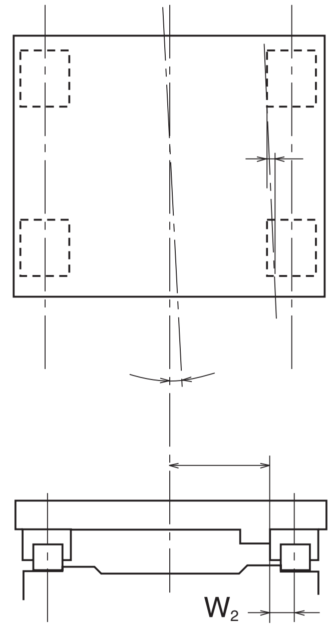


Both rails and slides are marked with groove mark that designate the datum surface.

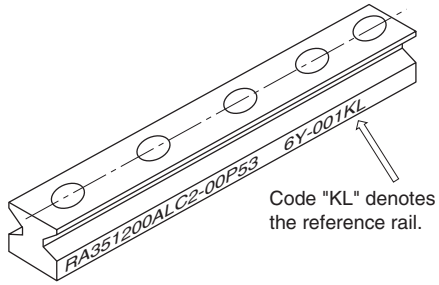


Groove mark indicates the datum face.

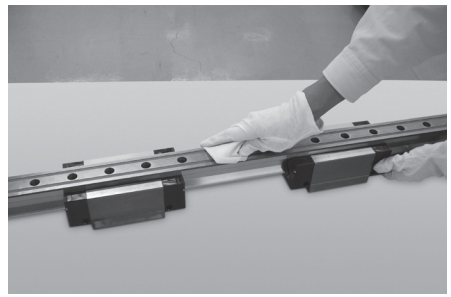
The two rails look similar but one of them is the reference rail that has controlled dimensional variation on the slide datum faces against that of the rail. If other slides are installed against the table's reference side surface, the table will be skewed as shown by the alternate long and short dash lines in the figure.
Generally, no reference side face is provided on the table for the other rail; therefore, the slide face variation is not controlled so closely. This rail is called the "adjusting side rail."



The reference rail is distinguished from the adjusting side rail by the letters KL following the production number on the rail side.

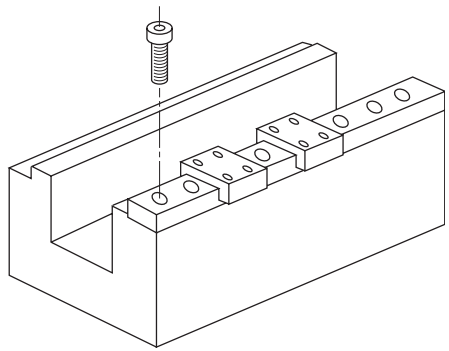


Linear Guides have been coated with rust preventive oil, so wipe it off thoroughly.

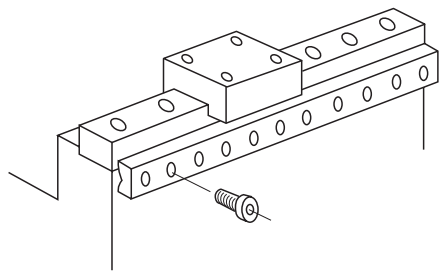


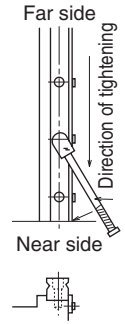
Place a linear guide on the machine base as it is ready for installation.

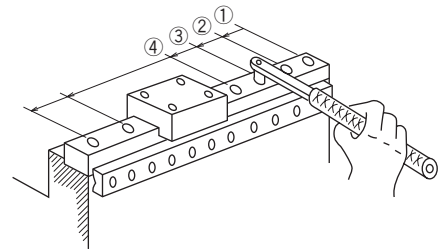
Confirm that the rail is reference side rail, and the datum surface of the rail comes to face to face with the datum surface of the machine base. Keep the slides on the rail, and carefully place the rail on the machine base on its mounting surface. Loosely tighten the rail fixing bolts so that the rail's bottom is firmly against the base.



At this time, press the rail from sideways to make the rail tightly contact to the mounting surface of the machine base. Apply tightening torque to the bolt in Table 1 on page 11 when tightening a shoulder plate. If the rigidity of the mounting surface is low, adjustment of the torque is required.







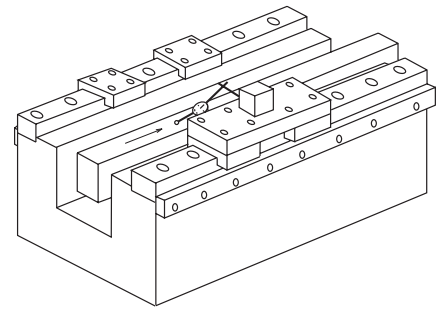
For final tightening of the bolts to secure the rail, tighten the bolt on either end of the rail first, then proceed to other end. Apply tightening torque to the bolt in Table 1. If the datum surface is on the left side as shown in figure, tighten the bolt at the farthest end first, then proceed to the near end. This way creates a bolt rotating force that presses the rail against the shoulder.

Table1 Tightening torque of bolts (Material: Chromium molybdenum steel)

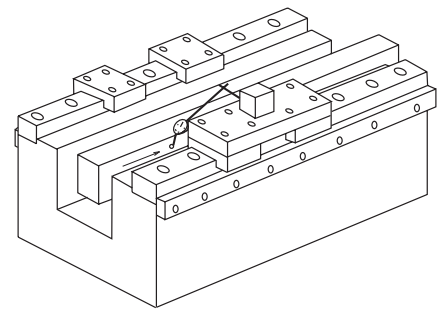
Unit : N·m

Bolt size	Tightening torque	Bolt size	Tightening torque
M2.3	0.38	M10	43
M2.5	0.58	M12	76
M3	1.06	M14	122
M4	2.5	M16	196
M5	5.1	M18	265
M6	8.6	M22	520
M8	22	—	—

After installing the linear guides as explained above, mount a steel plate on the pair of slides on one rail and measure the pitching by following the same procedure used for inspecting the machine base reference surfaces.



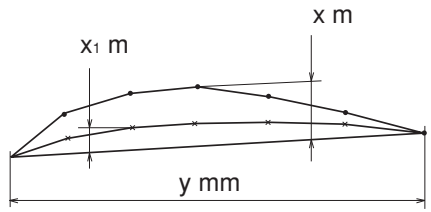
Measure the yawing in the same way and compare the data with that obtained for the machine base reference surfaces to find the variation caused by the installation of the guides.



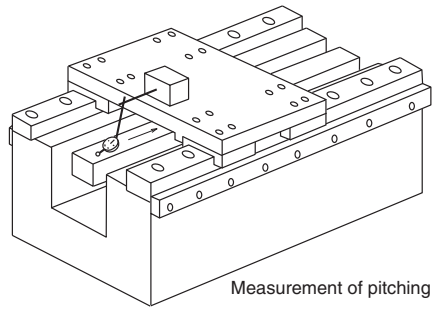
Linear guides will deform to fit the contour of the machine base; i.e., they will become concave if the machine base is concave. If it is not attained, use care when taking measurements since vibration of the machine or floor will cause trouble.

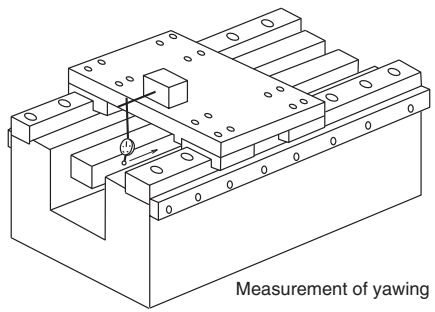
Finally, install the table and check the accuracy of the entire assembly.
The check can be done with the saddle or interim table.
The graph on the right is image of angular movement. (To measure rolling value, pitching value must be subtracted.)
First, arrange the slides so that locations match to their mounting section of the table. Carefully place the table on the slides. Loosely tighten all bolts.
While pressing the table from sideways, further tighten the bolts which secure the slides on the reference side, so the table shoulder and the slide's mounting datum surface are sufficiently tightly pressed.
Then, further tighten the bolts for slides on the adjusting side rail.
Move the table by hand to confirm that there is no abnormality such as excessive friction force during stroking. (This confirms that the correct installation steps were taken.)
Finally, tighten all bolts with the specified torque.
The linearity of the completed assembly should be better than that for individual slides; however, this depends on the rigidity of the machine and the installing accuracy.
The measurements obtained are important characteristics of each machine built, and are essential data for your installation work instruction at the mass production.

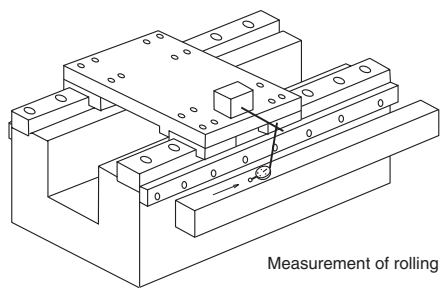
If you removed rust preventive oil or grease from surfaces of the linear guides when installing linear guides, we recommend supplying a rust preventive oil or grease on rail surfaces after installation.



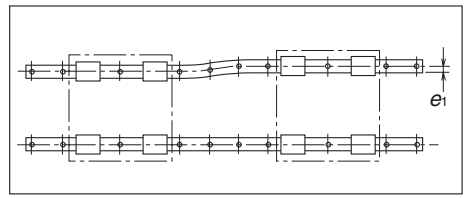
x : Straightness of mounting surface
x_1 : Straightness of the table

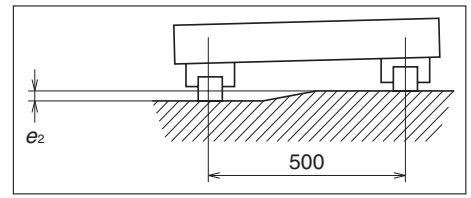

Measurement of pitching


Measurement of yawing


Measurement of rolling

The installation of linear guides is easy if the instructions in this manual are followed carefully. As the final part of the manual, this section describes the allowable tolerances for installation in order to maximize the performance of NSK linear guides. The allowable errors, which are shown below, consist of the error in parallelism (e_1) and error in height (e_2) of the two rails.





Permissible values of mounting error for the RA Model — Unit: μm

Value	Preload	Model No.							
		RA15	RA20	RA25	RA30	RA35	RA45	RA55	RA65
Permissible values for parallelism error of two rails e_1	Z3, ZH	5	7	9	11	13	17	19	30
Permissible values for height error of two rails e_2	Z3, ZH	150 μm / 500 mm							

Permissible values of mounting error for the LA Model — Unit: μm

Value	Preload	Model No.					
		LA25	LA30	LA35	LA45	LA55	LA65
Permissible values for parallelism error of two rails e_1	Z3	15	17	20	25	30	40
	Z4	13	15	17	20	25	30
Permissible values for height error of two rails e_2	Z3, Z4	185 μm / 500 mm					

Permissible values of mounting error for the NH Model — Unit: μm

Value	Preload	Model No.							
		NH15	NH20	NH25	NH30	NH35	NH45	NH55	NH65
Permissible values for parallelism error of two rails e_1	Z1, ZZ	18	20	25	30	35	45	55	70
	Z3, ZH	13	15	20	25	30	40	45	60
Permissible values for height error of two rails e_2	Z1, ZZ, Z3, ZH	330 μm / 500 mm							

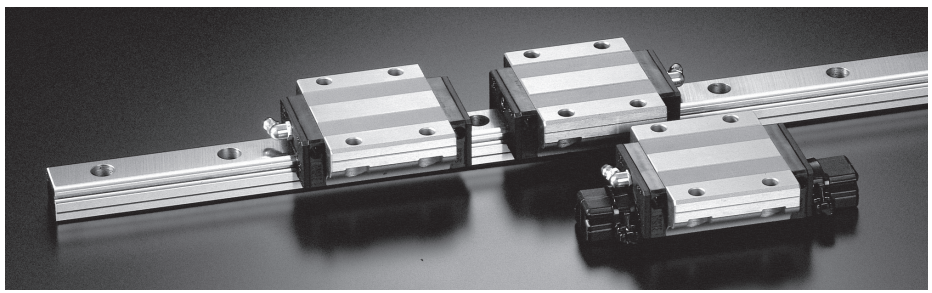
Naturally, errors should be as small as possible to achieve the highest performance and reliability of your products. For allowable installation error, refer to the catalog "Precision Machine Components".

The procedure for installing linear guides is not too difficult, but care is required. In case of an improper installation, it is necessary to remove them and check all the related parts; however, we hope this will never be necessary. Many machine tool builders install linear guides regularly with no difficulty by following the procedure that is modified to meet their way of checkings based on this manual.
For assistance or more information, please contact an NSK branch office.

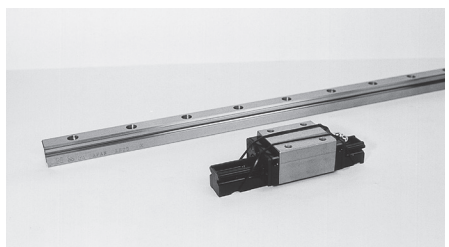
Assembly and Installation of NSK Linear Guides™
[No.2: General Industrial Machines]

Thank you for choosing NSK linear guides. This manual briefly describes the recommended handling and installation of NSK linear guides for general industrial use.
There are two ways installing the linear guides into general industrial machines. One of them provides a datum shoulder on the mounting base of the machine for accurate horizontal alignment the same as the way for machine tools, while the other is not required a datum shoulder. Refer to "No.1 Machine Tools" for installation procedure that requires a datum shoulder for accurate horizontal alignment. The installation procedure described in this manual assumes that the datum shoulder is not required for horizontal alignment.

For general industrial machines, wide variations of model are available, mainly NH, NS, and LW models that have high self-aligning capability and the capacity to absorb errors in installation.
The products of interchangeable rails and ball slides are standardized for easy addition of ball slides and their replacement, and that support short-term delivery.



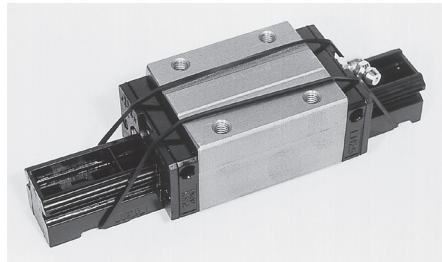
For interchangeable NH, NS, and LW models linear guides, interchangeable ball slides and rails are possible and they are stocked separately. The ball slides are mounted on plastic provisional rails that allows for easy transfer of the ball slide to and from the steel rail.

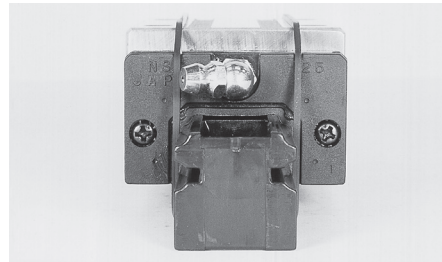


The ball slides are designed with retainers to prevent the balls from falling out when they are removed from the rail. However, NSK recommends that the ball slide should be stored on a provisional rail prior to installation to prevent contamination from dust and other foreign objects.

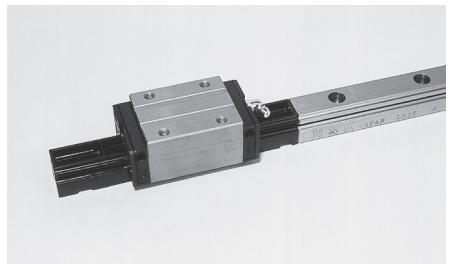
The following is a description of how the ball slide should be removed from and replaced on the linear guide rail.

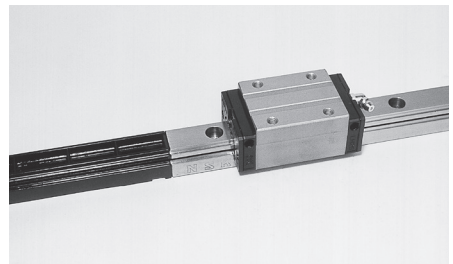
The ball slide is held on the provisional rail using a band. The band should catch the bottom channel in the provisional rail and secure the ball slide.





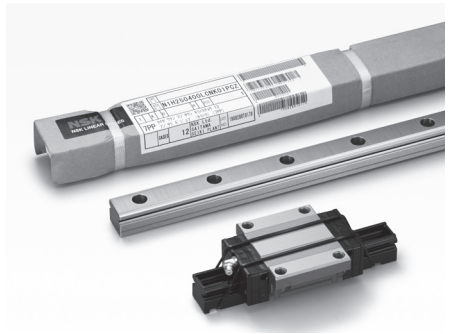
When transferring the ball slide from the provisional rail onto the rail, or vice versa, butt the provisional rail up against the rail and slide the ball slide directly from one onto the other. It is a good idea to secure the ball slide onto the provisional rail with a band after removal from the rail.





The following section describes how to install the linear guides on the machine.

Ball slides and rails are supplied separately. Each is wrapped in polyethylene film, and packed in a container. The label which guarantees each product adheres to it.

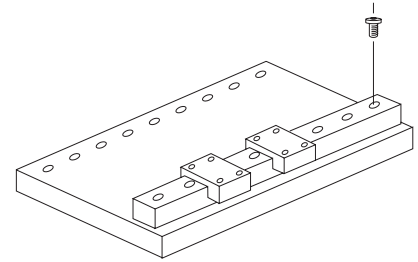


Caps for rail mounting holes are available upon request.

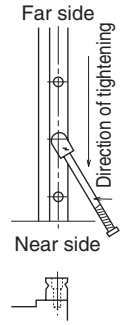
The rail is always shipped with rust preventive oil, which should be wiped off before applying grease to the rail. Ball slides are pre-packed with NSK standard grease, so no cleaning is required prior to installation.

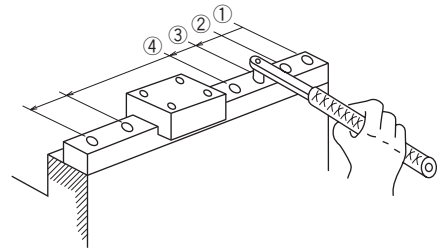
Now the linear guide is ready for installation. Put it on a mounting surface.

Temporarily tighten its mounting bolts lightly so that the rail's bottom is firmly against the base.



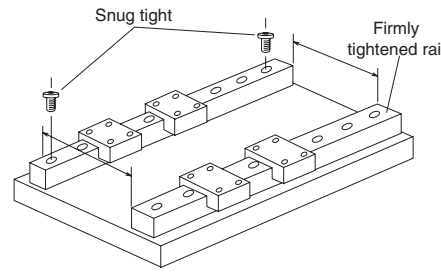
Then tighten the bolts firmly with torque wrench to the specified torque starting from the one end.

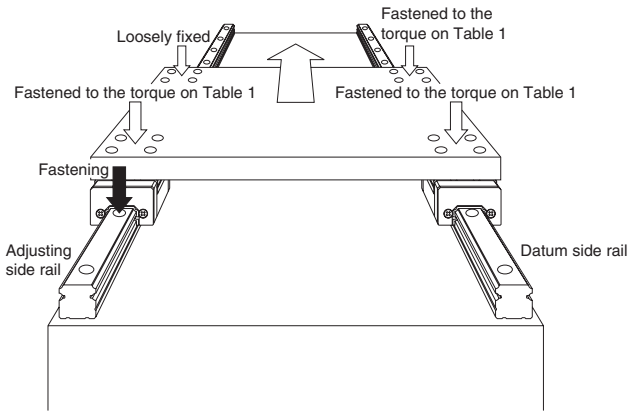




When installing a linear guide rail on a flat surface the same as this case, the rail tends to be slightly bent in the shape of S letter if the bolts are tightened indiscriminately starting near the middle because of friction at the seat of bolt head. NSK recommends that the bolts be tightened starting at one end with the wrench as shown in the above figure.

The rail that has been tightened can now be used as a reference rail. Using a vernier calipers or other accurate tool, measure the distance between the two rails, and adjust each end until they are the same. Tighten a bolt snugly at each end of the rail.



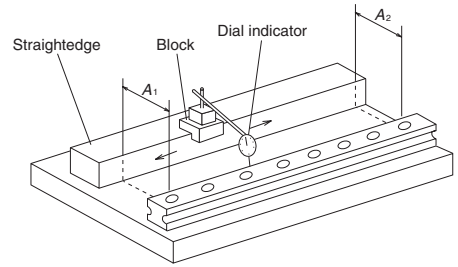


Place the table on the linear guides. Tighten the slides on the reference side rail and one slide on the adjustment side rail with the specified torque. Leave the rest of the slide on the adjusting side rail loosely tightened.
While moving the table with each pitch of the bolt for rail: With the specified torque, tighten the rail mounting bolt which is located immediately adjacent to the slide on the adjusting side rail that had been firmly tightened. Take this procedure from one end to the other.
Return the table to the original position once. Then tighten the rest of the slides on the adjusting side to the specified torque. By the same procedure as before, tighten the rest of the rail mounting bolts to the specified torque. Move the table to check any abnormality such as large friction force.

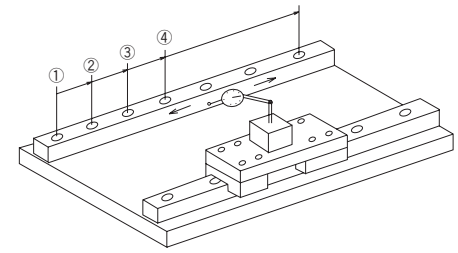
We recommend supplying a rust preventive oil or grease on rail surfaces after installation.

As described above, installation of the linear guides is not difficult work if you carefully follow the above procedure.
However, objective of the preceding procedure is only for an assembly of the table that moves smoothly. If you need to control motion accuracy of the table (straightness), it requires to add the following procedure.

When bolting the first rail on the machine base, align it straight using a straightedge and a dial indicator.
Bolt on the rail at the both ends lightly, and position a straightedge beside it. Set the straightedge parallel to the rail measuring distance A1 and A2 by a dial indicator.
Using the straightedge as the reference, with a dial indicator, check parallelism with the rail, and adjust the rail. Then tighten the bolts. Ensure that the straight edge does not move while the bolts are being tightened. This procedure should be carried out starting from one end of the rail to the other end. The straightness of installation should be adjusted to the required straightness of the machine.
Finally tighten all bolts with specified torque and recheck the straightness with a dial indicator.

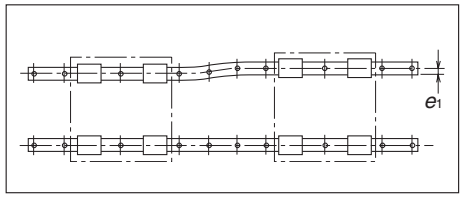


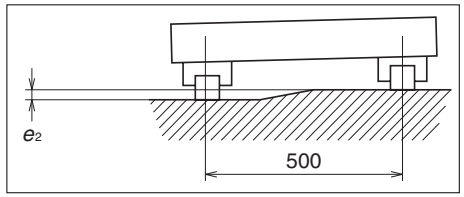
Position the dial indicator on two ball slides on the reference rail as shown in the diagram. Tighten bolts of the adjusting side rail sequentially from the one end while noting the reading of the dial indicator.
We recommend supplying a rust preventive oil or grease on rail surfaces after installation.
There is another way for installation of adjusting side rail; Based on the straight edge which is used for reference side rail installation.



In order to maintain stable production of the tables, we recommend to install the linear guides while checking the alignment accuracy quantitatively even smooth operation is the least requirement.

As the final part of the manual, this section describes the allowable tolerances for installation in order to maximize the performance of NSK linear guides.
We recommend that the mounting errors e_1 and e_2 do not exceed the values shown in the table below.





Permissible values of mounting error for the NH Model — Unit: µm

Value	Preload	Model No.							
		NH15	NH20	NH25	NH30	NH35	NH45	NH55	NH65
Permissible values for parallelism error of two rails e_1	Z0, ZT	22	30	40	45	55	65	80	110
	Z1, ZZ	18	20	25	30	35	45	55	70
	Z3, ZH	13	15	20	25	30	40	45	60
Permissible values for height error of two rails e_2	Z0, ZT	375 µm / 500 mm							
	Z1, ZZ, Z3, ZH	330 µm / 500 mm							

Permissible values of mounting error for the NS Model — Unit: µm

Value	Preload	Model No.				
		NS15	NS20	NS25	NS30	NS35
Permissible values for parallelism error of two rails e_1	Z0, ZT	20	22	30	35	40
	Z1, ZZ	15	17	20	25	30
	Z3, ZH	12	15	15	20	25
Permissible values for height error of two rails e_2	Z0, ZT	375 µm / 500 mm				
	Z1, ZZ, Z3, ZH	330 µm / 500 mm				

Permissible values of mounting error for the LW Model — Unit: µm

Value	Preload	Model No.				
		LW17	LW21	LW27	LW35	LW50
Permissible values for parallelism error of two rails e_1	Z0, ZT	20	20	25	38	50
	Z1, ZZ	9	9	13	23	34
Permissible values for height error of two rails e_2	Z0, ZT	100 µm / 500 mm				
	Z1, ZZ	45 µm / 500 mm				

Naturally, errors should be as small as possible to achieve the highest performance and reliability of your products. For explanations of allowable installation, refer to the catalog "Precision Machine Components".

The procedure for installing linear guides is not too difficult, but care is required. In case of an improper installation, it is necessary to remove them and check all the related parts; however, we hope this will never be necessary.
Please contact your local NSK branch office for any questions regarding the installation of NSK linear guides.

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www.nsk.com

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