

Maintenance-free Series Monocarrier®

Compact actuator combines ball screws and linear bearings. Clean lubricating unit protects the environment while providing low-cost, maintenance-free operation. Power-up Monocarrier with NSK K1.



The landmark multi-functional actuator dramatically reduces design, assembly and adjustment loads due to the Monocarrier combination structure, which was developed as a key component for automation device mechanical parts. In addition, the maintenance-free lubrication unit NSK K1™ is built-in as a standard feature and surface-treatment is included in standard specifications.

Monocarrier is a new standard-setting product developed to meet accelerating industry needs for labor saving, energy conservation and factory automation. Production systems adopting integrated automation devices are currently coming on line in every area of the industry. This production system is well suited for a variety of applications, including automatic assembly, inspection, packaging and transportation and will be further promoted. Monocarrier was developed as a key component of automation device mechanical parts, the core of this production system. The sophisticated multi-functional electric actuator represents a successful combination of ball screws (for feeding) and linear bearings (for guides), which are internationally recognized for reliability. This combination dramatically reduces design and assembly loads of automation devices, total costs and line operation time, while achieving high precision, high speed, and lower costs. Long-term, maintenance-free operation was achieved by installing the lubrication unit NSK K1™, which contributed to reduced piping and supply time and improved machine economization, with full consideration for the global environment.

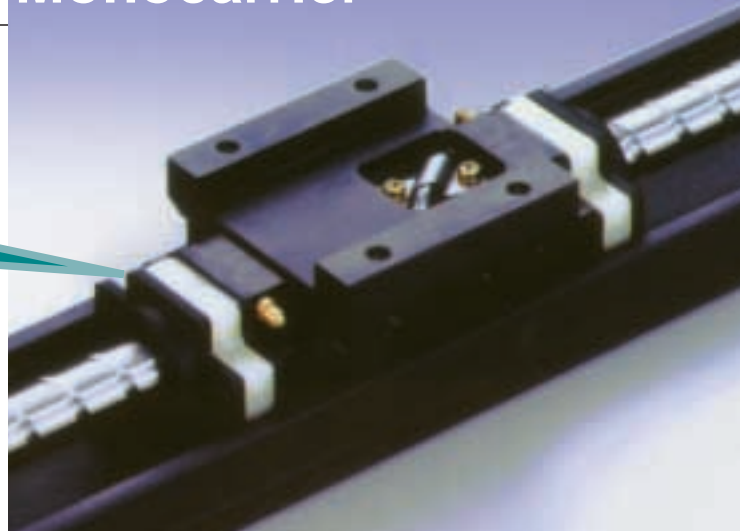
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Guide to NSK K1

NSK K1 is applied to the Monocarrier guide and ball screw parts.

In combination with grease, meets demand for long-term and maintenance-free operation.



Incorporates porous synthetic resin, a newly developed material which retains a generous volume of lubricating oil; the continuous release of oil reinforces overall lubricating performance.

1. Features

Exhibits outstanding efficiency with NSK K1, an effective lubricating unit, incorporating a light-weight, compact Monocarrier designed for easy installation, with surface-treatment on rail and slider for maintaining optimum performance.

Long-term, maintenance-free usage

In mechanical environments where lubrication is difficult to apply, long-term running efficiency is maintained by using the NSK K1 in combination with grease.

Manufacturing equipment for automobile parts processing, etc.

Prevention of oil-related environmental pollution

In locations where oil greatly affects the environment, or in mechanisms with severe hygienic restrictions, sufficient lubrication is provided using the NSK K1 in combination with minimal grease.

Food Processing, medical equipment, manufacturing devices for liquid crystal displays and semi-conductors, etc.

Excellent corrosion resistance capability

Black chrome treatment on rail and slider as a standard feature prevents corrosion under ordinary storage and usage conditions.

FA line

Simplified design and installation

The main base, ball screw, and support bearings are fully integrated into one unit. Combining these four parts brings considerable savings in man-hours for design and time and effort for installation.

(Installation dimensions are identical to the existing Monocarrier.)

Lightweight and compact size

Integration minimizes cross sectional size, while reducing weight by one-half of the existing combination type, mono-axis table.

High rigidity

Although light in weight, the main base is concave to resist bending, and can be handled even with cantilever support. Elastic deformation of the linear guide bearing is small due to preload.

Longer operating life

Rolling structure contributes to less wear and longer operation.

Smooth movement and high precision

Rolling structure contributes to less friction and higher positioning accuracy.

Four-directional iso-load

Contact angle of guide bearing is set at 45° to provide equivalent support for vertical and lateral loads.

Double slider

Double slider specifications for improving moment load capacity or straightness are also available.

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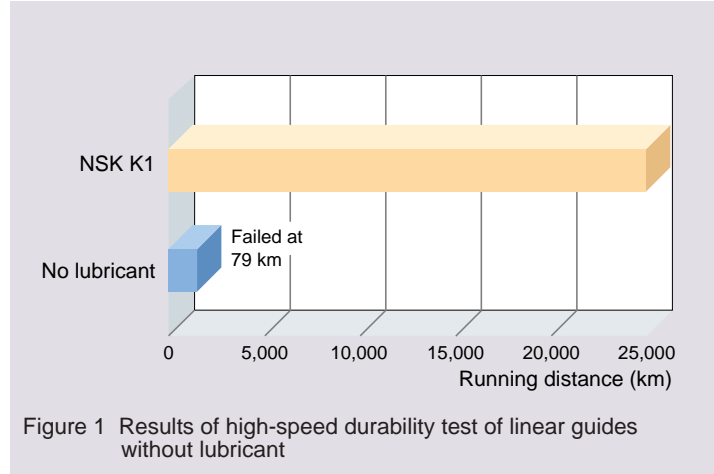
2. Performance

NSK K1 unit exhibits outstanding features, confirmed by abundant experimental data, along with proven performance of the NSK K1 Equipped Linear Guide and NSK K1 Equipped Ball Screw.

2.1 High-speed durability test of linear guides without lubricant

Results of high-speed durability testing of linear guide without lubricant are shown in Figure 1. While the linear guide cannot be operated without lubricant for even short periods without damage, the installation of the NSK K1 permits the linear guide to run over 25,000 km without any problem.

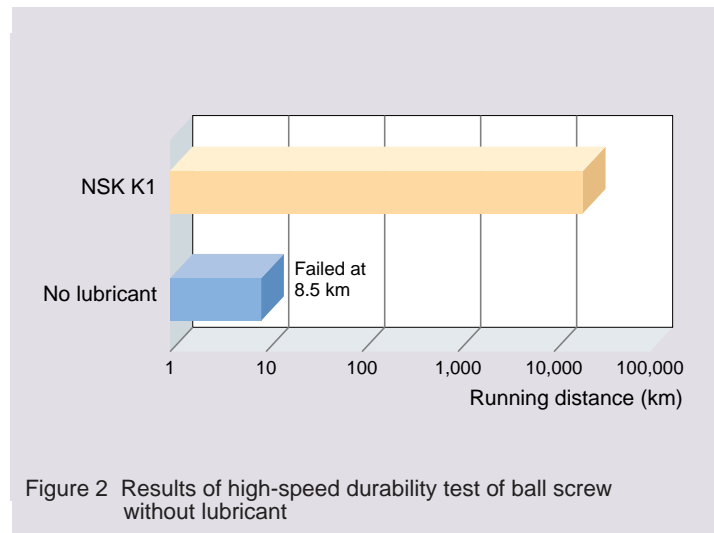
Conditions	Test piece: LH30AN (Preload Z1)
	Speed: 200 m/min
	Stroke: 1800 mm
No lubricant	All grease removed
NSK K1	All grease removed + NSK K1



2.2 High-speed durability test of ball screws without lubricant

Results of high-speed durability testing of ball screw without lubrication are shown in Figure 2. While the ball screw cannot be operated without a lubricant at 8.5 km without damage, the installation of the NSK K1 permits the ball screw to run over 21,000 km without any problem.

Conditions	Test piece: RBS2020 (ball screw)
	Shaft diameter: 20 mm
	Lead: 20 mm
	Load: none
	Speed: 4000 rpm (80 m/min)
	Stroke: 600 mm
No lubricant	All grease removed
NSK K1	All grease removed + NSK K1

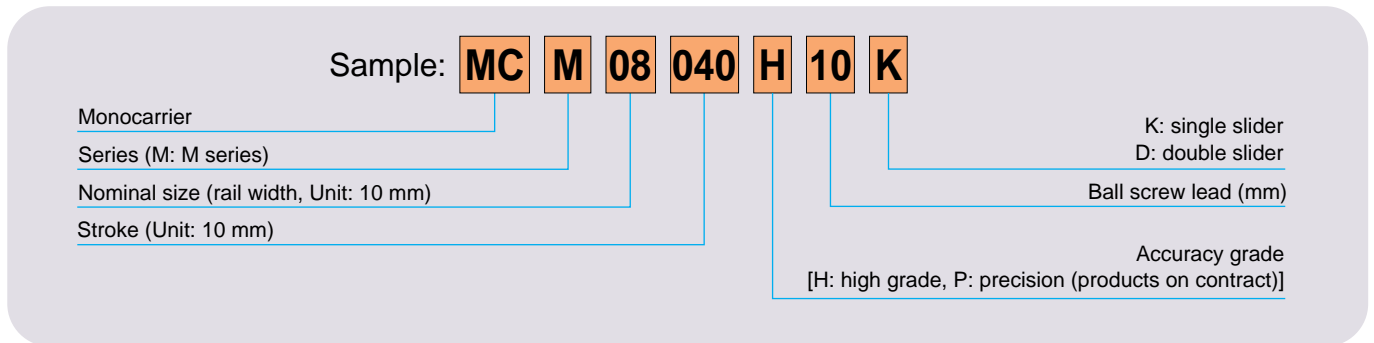


3. Standard Specification

- (1) NSK K1 is equipped between the side seal and end cap. (MCM03 will be available soon.)
- (2) Surfaces of rail and slider are treated with black chrome.
- (3) NSK standard grease is packed into a slider for shipment (AV2 grease).
- (4) Accuracy grade, preload and ball screw lead are the same specification as the existing standard series.
(Dynamic torque is slightly increased due to the equipped NSK K1.) Please refer to torque specifications in each dimension table.

4. Reference Numbers

The reference number of Monocarrier Maintenance-free Series is composed of main basic specifications.



NSK also offers E series in addition to M series; please contact NSK for details.

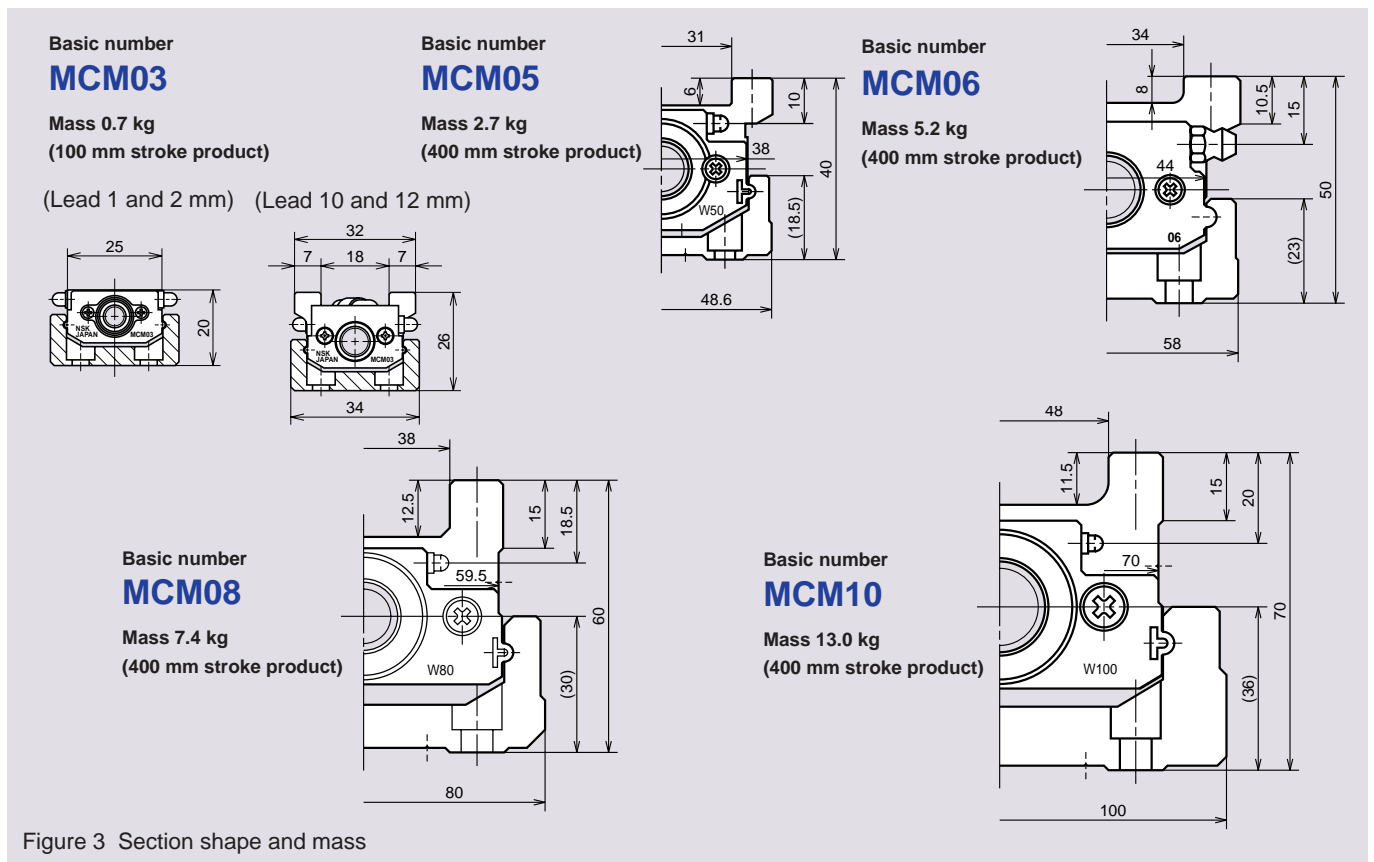


Figure 3 Section shape and mass

Handling instructions

To maintain the high efficiency of NSK K1 over a long period of time, please follow these instructions.

1. Permissible temperature range
 - Max. operating temperature: 50°C
 - Max. peak temperature: 80°C
2. Use of chemicals
 - Never leave the Monocarrier in close proximity to grease-removing organic solvents such as hexane, thinners, etc.
 - Never immerse the Monocarrier in kerosene or rust preventative oils which contain kerosene.

Note: Other oils present no problems: water-based cutting oil, oil-based cutting oil, grease (mineral oil-AV2, ester-PS2).

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5. Stroke and Lead of Products with Standard Specification

In order to meet customer requests for fast delivery, three types of ball screw lead are available as standard: 5, 10 and 20 mm. The accuracy grades of high grade (H) products are also provided as standard inventory by type of stroke as shown in Table 1. As for MCM03, leads 1, 2, 10 and 12 mm are available.

In order to increase rigidity and load capacity for guides, double slider specifications with an additional subslider provided only with linear guide function are set as standard specifications, and the types of stroke shown in Table 2 are available. (A double slider is not included as a standard specification for MCM03.)

Table 1 Stroke and lead of products with a single slider as a standard specification

● mark: standard inventory, ○ mark: made to order Unit: mm

Nominal size Stroke \ Lead	MCM03				MCM05			MCM06			MCM08			MCM10	
	1	2	10	12	5	10	20	5	10	20	5	10	20	10	20
50	○	○	-	-	○	●	-	○	○	-	○	-	-	-	-
100	○	○	○	○	○	●	-	●	●	-	○	●	-	-	-
150	○	○	○	○	○	●	-	-	-	-	○	-	-	-	-
200	-	-	○	○	○	●	-	●	●	-	○	●	-	●	-
250	-	-	○	○	-	●	-	-	-	-	-	-	-	-	-
300	-	-	-	-	-	●	●	●	●	●	-	●	●	●	●
400	-	-	-	-	-	●	●	●	●	●	-	●	●	●	●
500	-	-	-	-	-	●	●	○	○	○	-	●	●	○	○
600	-	-	-	-	-	●	○	-	○	○	-	●	○	●	○
700	-	-	-	-	-	-	-	-	●	●	-	○	○	○	○
800	-	-	-	-	-	-	-	-	○	○	-	○	○	●	○
900	-	-	-	-	-	-	-	-	-	-	-	-	-	○	○
1000	-	-	-	-	-	-	-	-	-	-	-	-	-	○	○

Table 2 Products with a double slider as a standard specification

○ mark: made to order Unit: mm

Nominal size Stroke \ Lead	MCM05		MCM06			MCM08		MCM10	
	10	20	5	10	20	10	20	10	20
70	-	-	-	-	-	-	-	○	-
80	○	-	-	-	-	-	-	-	-
95	-	-	-	-	-	○	-	-	-
130	○	-	○	○	-	-	-	-	-
170	-	-	-	-	-	-	-	○	○
180	○	-	-	-	-	-	-	-	-
195	-	-	-	-	-	○	○	-	-
230	○	○	○	○	○	-	-	-	-
270	-	-	-	-	-	-	-	○	○
295	-	-	-	-	-	○	○	-	-
330	○	○	○	○	○	-	-	-	-
370	-	-	-	-	-	-	-	○	○
395	-	-	-	-	-	○	○	-	-
430	○	○	○	○	○	-	-	-	-
470	-	-	-	-	-	-	-	○	○
495	-	-	-	-	-	○	○	-	-
530	○	○	-	○	○	-	-	-	-
570	-	-	-	-	-	-	-	○	○
595	-	-	-	-	-	○	○	-	-
630	-	-	-	○	○	-	-	-	-
670	-	-	-	-	-	-	-	○	○
695	-	-	-	-	-	○	○	-	-
730	-	-	-	○	○	-	-	-	-
870	-	-	-	-	-	-	-	○	○

6. Accuracy Standard

The accuracy grade of Monocarrier standard inventories is high grade(H).

Please contact NSK for details on precision grade (P).

Table 3 Accuracy standard

Unit: mm

Class Stroke (mm)	High grade (H)			Precision (P)			
	Repeatability	Running parallelism (vertical)	Backlash	Repeatability	Positioning accuracy	Running parallelism (vertical)	Backlash
50	±0.010	0.014	0.020 or less	±0.003	0.020	0.008	0.003 or less
100							
150							
200							
250							
300		0.016			0.025		
400							
500						0.012	
600							
700		0.023			0.030	0.015	
800							
900	0.035						
1000							

NSK assessment system is adopted.

7. Monocarrier Rigidity

7.1 Linear guide rigidity

Using its own high-precision processing technique, NSK successfully eliminated Monocarrier linear guide clearance with micron-meter level processing accuracy. The linear guide requires virtually no clearance and exhibits the load/deformation characteristics shown in Figure 4.

Rigidity value for load in each direction is shown in Table 4.

Table 4 Monocarrier rigidity

Basic number	Rigidity in radial direction (N/ μ m)		Moment rigidity ($\times 10^3$ N-m/rad)		
	Vertical direction	Lateral direction	Rolling direction	Pitching direction	Yawing direction
MCM03 (lead 1 and 2)	25	25	19	9	9
MCM03 (lead 10 and 20)	34	34	20	11	11
MCM05	120	120	39	20	20
MCM06	145	145	69	39	39
MCM08	195	195	175	98	98
MCM10	215	215	265	125	125

The above figures are obtained as a result of calculations based on the deformation amount under 2.8% of dynamic load rating for radial rigidity and 5% load of static moment rating for moment rigidity.

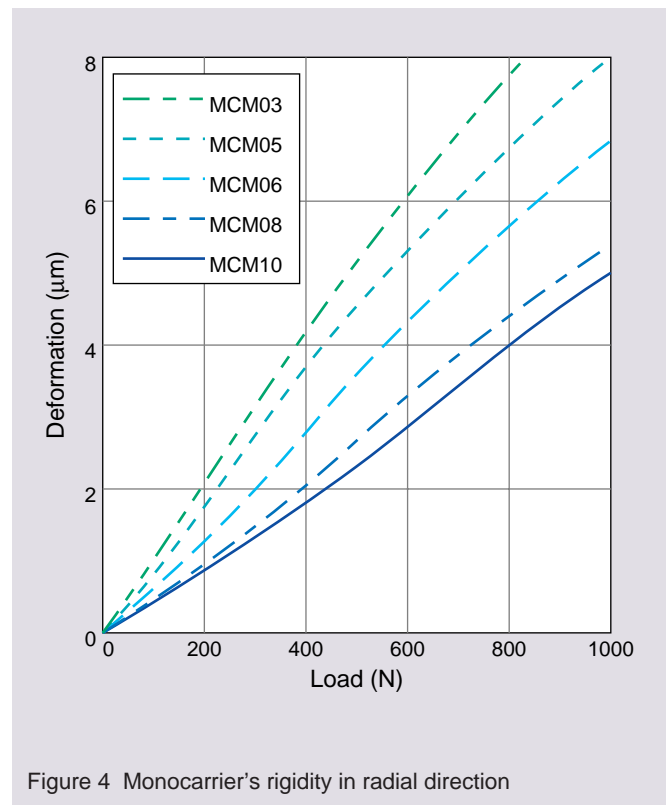
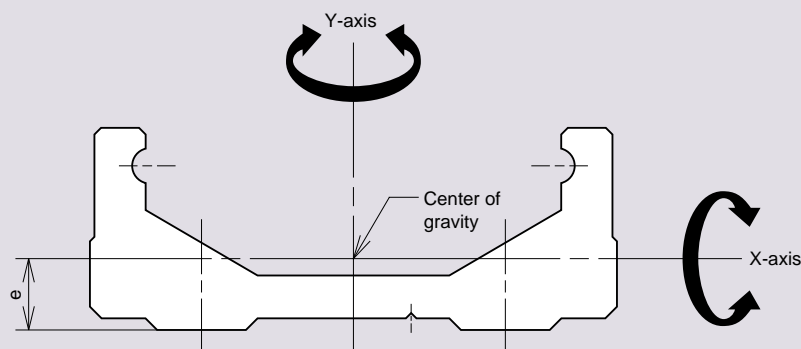


Figure 4 Monocarrier's rigidity in radial direction

7.2 Rail material rigidity

The Monocarrier rail features a special concave shape with a small space maintaining high resistance to deflection and distortion. Geometrical moment of inertia and polar moment of inertia of area of rail in each direction are shown in Figure 5.



Basic number	Geometrical moment of inertia (mm ⁴)		Polar moment of inertia of area (mm ⁴ /rad)	Center of gravity (mm)
	I _x (X-axis periphery)	I _y (Y-axis periphery)	I _p (Torsion)	e
MCM03	0.30×10^4	0.33×10^4	0.22×10^4	4.5
MCM05	0.78×10^4	1.14×10^5	0.53×10^4	6.0
MCM06	2.14×10^4	2.61×10^5	2.64×10^4	7.0
MCM08	5.90×10^4	8.10×10^5	5.10×10^4	9.2
MCM10	15.6×10^4	21.9×10^5	18.4×10^4	12.2

Figure 5 Rail moment of inertia