

# Predicting the Rigidity

## Selecting a Radial Clearance (Preload)

Since the radial clearance of an LM Guide greatly affects the running accuracy, load carrying capacity, and rigidity of the LM Guide, it is important to select an appropriate clearance according to the application. In general, the service life and accuracy are favorably affected by selecting a negative clearance (i.e., applying a preload<sup>1</sup>) while taking into account possible vibrations and impacts generated from reciprocating motion.

For specific radial clearances, contact THK. We will help you select the optimal clearance according to the conditions.

The clearances of all LM Guide models (except models HR, GSR, and GSR-R, which are separate types) are adjusted as specified before shipment, and therefore they do not need further preload adjustment.

<sup>1</sup>Preload is an internal load applied in advance to the rolling elements (balls, rollers, etc.) of an LM block in order to increase its rigidity.

Table 12: Types of Radial Clearance

	Normal clearance	Clearance C1 (light preload)	Clearance C0 (medium preload)
Condition	<ul style="list-style-type: none"> <li>The loading direction is fixed, impact and vibrations are minimal and 2 rails are installed in parallel.</li> <li>Very high precision is not required, and the sliding resistance must be as low as possible.</li> </ul>	<ul style="list-style-type: none"> <li>An overhang load or moment load is applied.</li> <li>The LM Guide is used in a single-rail configuration.</li> <li>Light load and high accuracy are required.</li> </ul>	<ul style="list-style-type: none"> <li>High rigidity is required and vibrations and impact are applied.</li> <li>Heavy-cutting machine tools</li> </ul>
Examples of applications	<ul style="list-style-type: none"> <li>Beam-welding machines</li> <li>Book-binding machines</li> <li>Automatic packaging machines</li> <li>XY axes of general industrial machinery</li> <li>Automatic sash-manufacturing machines</li> <li>Welding machines</li> <li>Flame cutting machines</li> <li>Tool changers</li> <li>Various kinds of material feeders</li> </ul>	<ul style="list-style-type: none"> <li>Grinding machine table feed axes</li> <li>Automatic coating machines</li> <li>Industrial robots</li> <li>Various kinds of high-speed material feeders</li> <li>NC drilling machines</li> <li>Vertical axes of general industrial machinery</li> <li>Printed circuit board drilling machines</li> <li>Electric discharge machines</li> <li>Measuring instruments</li> <li>Precision XY tables</li> </ul>	<ul style="list-style-type: none"> <li>Machining centers</li> <li>NC lathes</li> <li>Grinding stone feed axes of grinding machines</li> <li>Milling machines</li> <li>Vertical/horizontal boring machines</li> <li>Tool rest guides</li> <li>Vertical axes of machine tools</li> </ul>

## Service Life with a Preload Considered

When using an LM Guide under a medium preload (clearance C0), it is necessary to calculate the service life while taking into account the magnitude of the preload.

To identify the appropriate preload for any selected LM Guide model, contact THK.

## Rigidity

When a load is applied to an LM Guide, the bearings and LM block will undergo elastic deformation within the allowable load range. The ratio of displacement to applied load is referred to as "rigidity." The radial internal clearance (preload) for the LM Guide can be specified in order to reduce displacement.

By using balls larger than the width of the raceway, they will naturally deform elastically as they roll, allowing the load to be maintained for longer while limiting displacement in the LM Guide.

The effect of the preload can be up to 2.8 times greater than the size of the preload itself. If that level is exceeded, the preload is released and the effect of the preload is lost.

When a preloaded LM Guide takes an external load, the displacement will be linear. The level of displacement will be approximately half that of an LM Guide with no preload.

The preload, in addition to reducing displacement, helps prevent premature failure due to vibration and impact/shock.

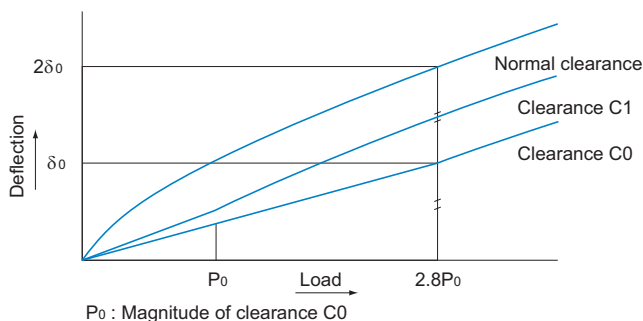
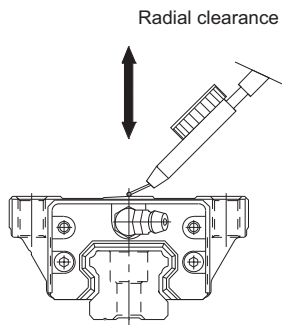


Fig. 10: Rigidity Data

$$K = \frac{P}{\delta}$$

K	: Rigidity value	(N/ $\mu$ m)
$\delta$	: Deflection	( $\mu$ m)
P	: Calculated load	(N)

## Radial Clearance Standard for Each Model



### Radial Clearances for Models SHS and SCR

Unit:  $\mu\text{m}$ 

Indication symbol	Normal	Light preload	Medium preload
Model No.	No symbol	C1	C0
15	-5 to 0	-12 to -5	—
20	-6 to 0	-12 to -6	-18 to -12
25	-8 to 0	-14 to -8	-20 to -14
30	-9 to 0	-17 to -9	-27 to -17
35	-11 to 0	-19 to -11	-29 to -19
45	-12 to 0	-22 to -12	-32 to -22
55	-15 to 0	-28 to -16	-38 to -28
65	-18 to 0	-34 to -22	-45 to -34

### Radial Clearances for Models SVR/SVS, NR-X/NRS-X, and NR/NRS

Unit:  $\mu\text{m}$ 

Indication symbol	Normal	Light preload	Medium preload
Model No.	No symbol	C1	C0
25	-3 to +2	-6 to -3	-9 to -6
30	-4 to +2	-8 to -4	-12 to -8
35	-4 to +2	-8 to -4	-12 to -8
45	-5 to +3	-10 to -5	-15 to -10
55	-6 to +3	-11 to -6	-16 to -11
65	-8 to +3	-14 to -8	-20 to -14
75	-10 to +4	-17 to -10	-24 to -17
85	-13 to +4	-20 to -13	-27 to -20
100	-14 to +4	-24 to -14	-34 to -24

### Radial Clearances for Model SSR

Unit:  $\mu\text{m}$ 

Indication symbol	Normal	Light preload
Model No.	No symbol	C1
15	-4 to +2	-10 to -4
20	-5 to +2	-12 to -5
25	-6 to +3	-15 to -6
30	-7 to +4	-18 to -7
35	-8 to +4	-20 to -8

### Radial Clearances for Models SRS, RSX, and RSX-M1

Unit:  $\mu\text{m}$ 

Indication symbol	Normal	Light preload
Model No.	No symbol	C1
5	0 to +1.5	-1 to 0
7	-2 to +2	-3 to 0
9	-2 to +2	-4 to 0
12	-3 to +3	-6 to 0
15	-5 to +5	-10 to 0
20	-5 to +5	-10 to 0
25	-7 to +7	-14 to 0

Note) Model RSX includes types 5, 7, 9, 12, and 15.  
 The Model RSX-M1 is available in models 9, 12, and 15.

### Radial Clearances for Model SHW

Unit:  $\mu\text{m}$ 

Indication symbol	Normal	Light preload	Medium preload
Model No.	No symbol	C1	C0
12	-1.5 to 0	-4 to -1	—
14	-2 to 0	-5 to -1	—
17	-3 to 0	-7 to -3	—
21	-4 to +2	-8 to -4	—
27	-5 to +2	-11 to -5	—
35	-8 to +4	-18 to -8	-28 to -18
50	-10 to +5	-24 to -10	-38 to -24

### Radial Clearances for Model EPF

Unit:  $\mu\text{m}$ 

Indication symbol	Normal
Model No.	No symbol
7M	0 or less
9M	
12M	
15M	

### Radial Clearances for Models HSR, CSR, HSR-M1, and HSR-M1VV

Unit:  $\mu\text{m}$ 

Indication symbol	Normal	Light preload	Medium preload
Model No.	No symbol	C1	C0
8	-1 to +1	-4 to -1	—
10	-2 to +2	-5 to -1	—
12	-3 to +3	-6 to -2	—
15	-4 to +2	-12 to -4	—
20	-5 to +2	-14 to -5	-23 to -14
25	-6 to +3	-16 to -6	-26 to -16
30	-7 to +4	-19 to -7	-31 to -19
35	-8 to +4	-22 to -8	-35 to -22

Unit:  $\mu\text{m}$ 

Indication symbol	Normal	Light preload	Medium preload
Model No.	No symbol	C1	C0
45	-10 to +5	-25 to -10	-40 to -25
55	-12 to +5	-29 to -12	-46 to -29
65	-14 to +7	-32 to -14	-50 to -32
85	-16 to +8	-36 to -16	-56 to -36
100	-19 to +9	-42 to -19	-65 to -42
120	-21 to +10	-47 to -21	-73 to -47
150	-23 to +11	-51 to -23	-79 to -51

### Radial Clearances for Models SR and SR-M1

Unit:  $\mu\text{m}$ 

Indication symbol	Normal	Light preload	Medium preload
Model No.	No symbol	C1	C0
15	-4 to +2	-10 to -4	—
20	-5 to +2	-12 to -5	-17 to -12
25	-6 to +3	-15 to -6	-21 to -15
30	-7 to +4	-18 to -7	-26 to -18
35	-8 to +4	-20 to -8	-31 to -20
45	-10 to +5	-24 to -10	-36 to -24
55	-12 to +5	-28 to -12	-45 to -28
70	-14 to +7	-32 to -14	-50 to -32
85	-20 to +9	-46 to -20	-70 to -46
100	-22 to +10	-52 to -22	-78 to -52
120	-25 to +12	-57 to -25	-87 to -57
150	-29 to +14	-69 to -29	-104 to -69

### Radial Clearances for Model HRW

Unit:  $\mu\text{m}$ 

Indication symbol	Normal	Light preload	Medium preload
Model No.	No symbol	C1	C0
12	-1.5 to +1.5	-4 to -1	—
14	-2 to +2	-5 to -1	—
17	-3 to +2	-7 to -3	—
21	-4 to +2	-8 to -4	—
27	-5 to +2	-11 to -5	—
35	-8 to +4	-18 to -8	-28 to -18
50	-10 to +5	-24 to -10	-38 to -24
60	-12 to +5	-27 to -12	-42 to -27

### Radial Clearances for Models RSR, RSR-W, and RSR-M1

Unit:  $\mu\text{m}$ 

Indication symbol	Normal	Light preload
Model No.	No symbol	C1
2	0 to +4	—
3	0 to +1	-0.5 to 0
9	-2 to +2	-4 to 0
12	-3 to +3	-6 to 0
14	-5 to +5	-10 to 0
15	-5 to +5	-10 to 0
20	-7 to +7	-14 to 0

### Radial Clearance for Model MX

Unit:  $\mu\text{m}$ 

Indication symbol	Normal	Light preload
Model No.	No symbol	C1
5	0 to +1.5	-1 to 0
7	-2 to +2	-3 to 0

## Selection Criteria

### Predicting the Rigidity

#### Radial Clearances for Model JR

Unit:  $\mu\text{m}$ 

Indication symbol	Normal
Model No.	No symbol
25	0 to +30
35	0 to +30
45	0 to +50
55	0 to +50

#### Radial Clearances for Model NSR-TBC

Unit:  $\mu\text{m}$ 

Indication symbol	Normal	Light preload	Medium preload
Model No.	No symbol	C1	C0
20	-5 to +5	-15 to -5	-25 to -15
25	-5 to +5	-15 to -5	-25 to -15
30	-5 to +5	-15 to -5	-25 to -15
40	-8 to +8	-22 to -8	-36 to -22
50	-8 to +8	-22 to -8	-36 to -22
70	-10 to +10	-26 to -10	-42 to -26

#### Radial Clearances for Models SRG and SRN

Unit:  $\mu\text{m}$ 

Indication symbol	Normal	Light preload	Medium preload	Heavy preload	Super heavy preload
Model No.	No symbol	C1	C0	CN1	CN2
15	-0.5 to 0	-1 to -0.5	-2 to -1	—	—
20	-0.8 to 0	-2 to -0.8	-3 to -2	—	—
25	-2 to -1	-3 to -2	-4 to -3	—	—
30	-2 to -1	-3 to -2	-4 to -3	—	—
35	-2 to -1	-3 to -2	-5 to -3	-6 to -5	-7 to -6
45	-2 to -1	-3 to -2	-5 to -3	-6 to -5	-8 to -6
55	-2 to -1	-4 to -2	-6 to -4	-7 to -6	-9 to -7
65	-3 to -1	-5 to -3	-8 to -5	-9 to -8	-11 to -9
85	-3 to -1	-7 to -3	-12 to -7	—	—
100	-3 to -1	-8 to -3	-13 to -8	—	—

Note) Heavy preload and super heavy preload are available only for Model SRG-C/LC/SLC and Model SRN-C/LC/SLC. Contact THK if you desire a heavy preload or super heavy preload.

#### Radial Clearances for Model SRW

Unit:  $\mu\text{m}$ 

Indication symbol	Normal	Light preload	Medium preload
Model No.	No symbol	C1	C0
70	-2 to -1	-3 to -2	-5 to -3
85	-2 to -1	-4 to -2	-6 to -4
100	-3 to -1	-5 to -3	-8 to -5
130	-3 to -1	-7 to -3	-12 to -7
150	-3 to -1	-8 to -3	-13 to -8

#### Radial Clearances for Models HCR and HMG

Unit:  $\mu\text{m}$ 

Indication symbol	Normal	Light preload
Model No.	No symbol	C1
12	-3 to +3	-6 to -2
15	-4 to +2	-12 to -4
25	-6 to +3	-16 to -6
35	-8 to +4	-22 to -8
45	-10 to +5	-25 to -10
65	-14 to +7	-32 to -14

#### Radial Clearances for Model HSR-M2

Unit:  $\mu\text{m}$ 

Indication symbol	Normal	Light preload
Model No.	No symbol	C1
15	-4 to +2	-12 to -4
20	-5 to +2	-14 to -5
25	-6 to +3	-16 to -6

#### Radial Clearances for Model HRX

Unit:  $\mu\text{m}$ 

Indication symbol	Medium preload
Model No.	C0
25	-2 to -1
30	-2 to -1
35	-2 to -1
45	-3 to -2
55	-3 to -2
65	-4 to -2