

# 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, selecting a negative clearance (i.e., a preload\* is applied) while taking into account possible vibrations and impact generated from reciprocating motion favorably affects the service life and the accuracy.

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 model HR, GSR and GSR-R, which are separate types) are adjusted as specified before shipment, and therefore they do not need further preload adjustment.

\*Preload is an internal load applied to the rolling elements (balls, rollers, etc.) of an LM block in advance in order to increase its rigidity.

Table12 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>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 tool</li> </ul>
Examples of applications	<ul style="list-style-type: none"> <li>Beam-welding machine</li> <li>Book-binding machine</li> <li>Automatic packaging machine</li> <li>XY axes of general industrial machinery</li> <li>Automatic sash-manufacturing machine</li> <li>Welding machine</li> <li>Flame cutting machine</li> <li>Tool changer</li> <li>Various kinds of material feeder</li> </ul>	<ul style="list-style-type: none"> <li>Grinding machine table feed axis</li> <li>Automatic coating machine</li> <li>Industrial robot</li> <li>various kinds of material high speed feeder</li> <li>NC drilling machine</li> <li>Vertical axis of general industrial machinery</li> <li>Printed circuit board drilling machine</li> <li>Electric discharge machine</li> <li>Measuring instrument</li> <li>Precision XY table</li> </ul>	<ul style="list-style-type: none"> <li>Machining center</li> <li>NC lathe</li> <li>Grinding stone feed axis of grinding machine</li> <li>Milling machine</li> <li>Vertical/horizontal boring machine</li> <li>Tool rest guide</li> <li>Vertical axis of machine tool</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 elastically deform 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 race, 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.

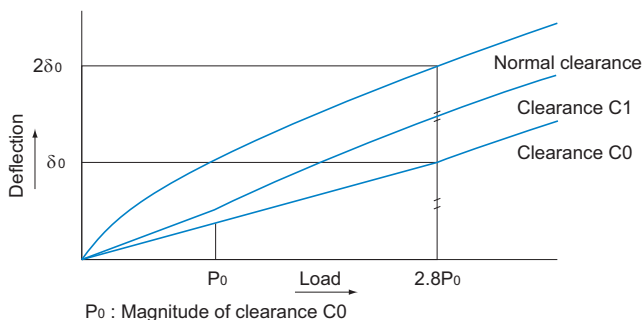


Fig.10 Rigidity Data

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

K	: Rigidity value	(N/μm)
δ	: Deflection	(μm)
P	: Calculated load	(N)

## Guidelines for Accuracy Grades by Machine Type

Table13 shows guidelines for selecting an accuracy grade of the LM Guide according to the machine type.

Table13 Guideline for Accuracy Grades by Machine Type

Type of machine		Accuracy grades				
		Normal	H	P	SP	UP
Machine tool	Machining center			●	●	
	Lathe			●	●	
	Milling machine			●	●	
	Boring machine			●	●	
	Jig borer				●	●
	Grinding machine				●	●
	Electric discharge machine			●	●	●
	Punching press		●	●		
	Laser beam machine		●	●	●	
	Woodworking machine	●	●	●		
	NC drilling machine		●	●		
	Tapping center		●	●		
	Palette changer	●				
	ATC	●				
	Wire cutting machine			●	●	
Dressing machine				●	●	
Industrial robot	Cartesian coordinate	●	●	●		
	Cylindrical coordinate	●	●			
Semiconductor manufacturing equipment	Wire bonding machine			●	●	
	Prober				●	●
	Electronic component inserter		●	●		
	Printed circuit board drilling machine		●	●	●	
Other equipment	Injection molding machine	●	●			
	3D measuring instrument				●	●
	Office equipment	●	●			
	Conveyance system	●	●			
	XY table		●	●	●	
	Coating machine	●	●			
	Welding machine	●	●			
	Medical equipment	●	●			
	Digitizer		●	●	●	
Inspection equipment			●	●	●	

Normal : Normal grade  
 H : High accuracy grade  
 P : Precision grade

SP : Super precision grade  
 UP : Ultra precision grade

## List of Parts Symbols

- For supported model numbers, see the correspondence table of options by model number on **A1-484**.
- For the overall block length (dimension L) of each model with seal options attached, see **A1-497** to **A1-504**.
- For the overall block length (dimension L) with the QZ option attached, see **A1-518** to **A1-521**.

### [Symbols for Seals and Metal Scraper]

Symbol	Configuration of seal and metal scraper
No Symbol	Without seal
UU	End seal
SS	With end seal + side seal + inner seal*
DD	With double seals + side seal + inner seal*
ZZ	With end seal + side seal + inner seal* + metal scraper
KK	With double seals + side seal + inner seal* + metal scraper

\* Some models are not equipped with inner seals.(See **A1-484**)

### [Symbols for QZ Lubricator and Laminated Contract Scraper LaCS]

Symbol	Configuration of options	Example
* * HH	(Seal and metal scraper) + LaCS	UUHH
* * HHYY	(Seal and metal scraper) + LaCS + side scraper	DDHHYY
QZ * *	With QZ + (seal and metal scraper)	QZZZ
QZ * * HH	With QZ + (seal and metal scraper) + LaCS	QZZZHH
QZ * * HHYY	With QZ + (seal and metal scraper) + LaCS + side scraper	QZKKHHYY

Note1) \* \* in the table represents the symbol for a seal and metal scraper.

Note2) Those models equipped with QZ Lubricator cannot have a grease nipple. When desiring a grease nipple for a model attached with QZ, contact THK.

### [Symbols for Light-Resistance Contact Seal LiCS]

Symbol	Configuration of options
GG	LiCS
PP	With LiCS + side seal + inner seal*
QZGG	With QZ + LiCS
QZPP	With QZ + LiCS + side seal + inner seal*

\* Some models are not equipped with inner seals.(See **A1-484**)

Note) Those models equipped with QZ Lubricator cannot have a grease nipple. When desiring a grease nipple for a model attached with QZ, contact THK.

**[High Chemical Resistance Fluorine Seal FS Symbol]**

Symbol	Configuration of options
F2	Fluorine seals + side seals + inner seals
FZ2	Fluorine seals + side seals + inner seals + metal scrapers
FJ2	Fluorine seals + side seals + inner seals + protectors
F4	Fluorine seals (double) + side seals + inner seals
FZ4	Fluorine seals (double) + side seals + inner seals + metal scrapers
FJ4	Fluorine seals (double) + side seals + inner seals + protectors
QZF2	Fluorine seals + side seals + inner seals + QZ
QZFZ2	Fluorine seals + side seals + inner seals + metal scrapers + QZ
QZFJ2	Fluorine seals + side seals + inner seals + QZ + protectors
QZF4	Fluorine seals (double) + side seals + inner seals + QZ
QZFZ4	Fluorine seals (double) + side seals + inner seals + metal scrapers + QZ
QZFJ4	Fluorine seals (double) + side seals + inner seals + QZ + protectors

**[Symbols for Protector]**

\* Supported models: SVR/SVS, SRG, NR/NRS, and NR-X/NRS-X

Symbol	Configuration of options
JJHH	With End seal + side seal + inner seal* + LaCS + protector (also has a metal scraper function)
TTHH	With Double seals + side seal + inner seal* + LaCS + protector (also has a metal scraper function)
JJHHYY	With End seal + side seal + inner seal* + LaCS + protector (also has a metal scraper function) + side scraper*
TTHHYY	With Double seals + side seal + inner seal* + LaCS + protector (also has a metal scraper function) + side scraper*
QZJJHH	With QZ + end seal + side seal + inner seal* + LaCS + protector (also has a metal scraper function)
QZTTHH	With QZ + double seals + side seal + inner seal* + LaCS + protector (also has a metal scraper function)
QZJJHHYY	With QZ + end seal + side seal + inner seal* + LaCS + protector (also has a metal scraper function) + side scraper*
QZTTHHYY	With QZ + double seals + side seal + inner seal* + LaCS + protector (also has a metal scraper function) + side scraper*

\* Some models are not equipped with inner seals. (See **■1-484**)

Note1) HH type (with LaCS) for models SVR/SVS, SRG, NR/NRS, and NR-X/NRS-X comes with a protector (see **■1-493**). The protector also acts as a metal scraper.

Contact THK if you want to use the Protector with other options.

Note2) Those models equipped with QZ Lubricator cannot have a grease nipple. When desiring a grease nipple for a model attached with QZ, contact THK.