5. Designing Rigidity

5.1 Determining Radial Clearance and the Magnitude of a Preload

5.1.1 Radial Clearance

The radial clearance of the LM Guide is the displacement of the LM block caused by the vertical plane when the block is lightly pushed forward or backward at the longitudinal center of the LM rail secured in place.

The radial clearance is divided into ordinary clearance and negative clearance, and further divided into clearance C1 (under a light preload) and clearance C0 (under a moderate preload). The most appropriate clearance can be selected in accordance with the intended applications. The radial clearances and preload values are standardized for each type of LM Guide.

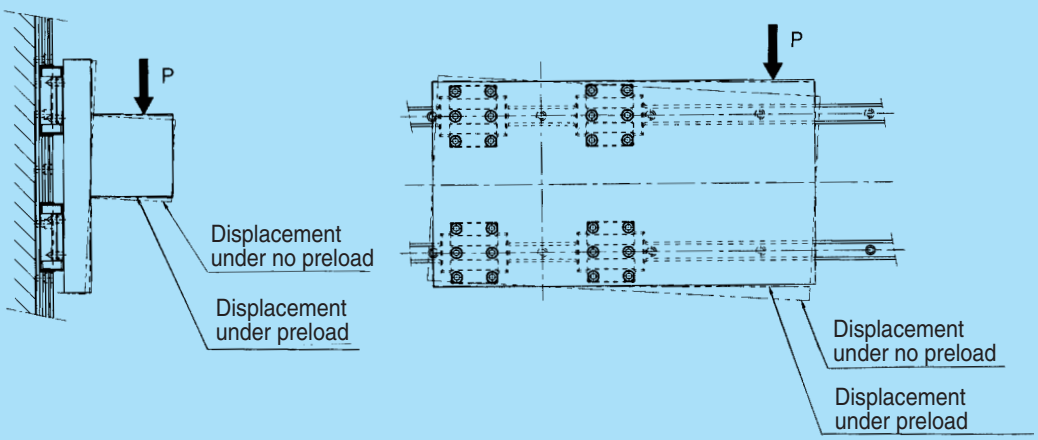
The radial clearance of the LM Guide significantly affects its running precision, load-withstanding performance, and rigidity. It is therefore particularly important to select the correct clearance for your purpose. In general, a negative clearance has a favorable effect on service life and precision, if the LM Guide is subjected to significant vibration and impact due to reciprocal motion.

5.1.2 Preload

The preload is an internal load exerted on rolling elements in the LM block, for the purposes of increasing the block rigidity and reducing clearances. Clearance symbols for the LM Guide, C1 and C0, represent negative clearances resulting from a preload and are expressed in negative values.

All LM Guide models (excluding the separate type GSR) are shipped with their clearances adjusted to user specifications. Therefore, it is not necessary for users to adjust the preload themselves.

We will select the clearances best suited to your operating conditions. Please contact us.



Difference between the displacement under preload and under no preload (Vertical installations)

Difference between the displacement under preload and under no preload (Horizontal installations)

Fig. 41 Relationship Between Preload and Displacement

Table 14 Selecting Radial Clearances

	Radial clearance		
	Ordinary clearance	Clearance C1 (light preload)	Clearance C0 (moderate preload)
Operating conditions	• The loading direction is fixed; impact and vibration are slight; two axes are installed in parallel. • Very high precision is not required, and the sliding resistance must be as low as possible.	• The location is under an overhang and a moment load. • The LM Guide is used in a one-axis configuration. • The location requires a light load and high precision.	• The location requires high rigidity and is subjected to vibration and impact. • The application is a heavy-cutting machine tool or the like.
Sample applications	Beam-welding machine/ book-binding machine/ automatic packing machine/ general-industrial-machine X- and Y-axes/automatic sash-bar finishing machine / welding machine/arc cutter/ tool changer/various kinds of material feeder	Grinding-machine table feed shaft/automatic painting machine/industrial robot/various kinds of high-speed material feeder/NC drilling machine/ general-industrial-machine Z-axis/printed-circuit-board drilling machine/electric discharge machine/measuring instrument/precision XY table	Machining center/NC lathe/ grinding-machine grinding-wheel feed shaft/ milling machine/vertical- and horizontal-boring machines/ tool rest guide/machine-tool Z-axis

5.2 Applied Load and Service Life Considering Preload

When the LM Guide is used under a preload (medium), the LM block receives an internal load. Therefore, the service life should be calculated in consideration of the preload. For preload considerations, please contact us, specifying the model numbers you have selected.

5.3 Rigidity

When the LM Guide receives a load, the balls, LM blocks, and rails undergo elastic deformation within a permissible range. The ratio of displacement at this deformation to the load received is known as the rigidity value. The rigidity of the LM Guide increases as the preload increases. Fig. 42 shows the differences among the ordinary clearance, clearance C1, and clearance C0. As shown, in the case of the four-way equal-load type, the effect of preloading remains valid until the load increases to some 2.8 times the preload applied.

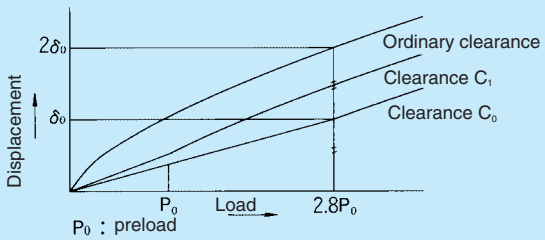


Fig. 42 Rigidity Data

When changing a synthetic-resin sliding surface and a machine-tool guideway of the sliding type to the LM Guide type, the rigidity of the ball screw must be reconsidered. Ball-screw rigidity varies significantly with variations in the shaft diameter, the magnitude of preload, the lead angle, and the number of turns. For details on selecting the correct type of ball screw when introducing the LM Guide into your guide system, contact us.