Rigidity

When using an LM System, it is necessary to select a type and a clearance (preload) suitable to the service conditions in order to achieve the required rigidity of the machine/equipment.

Selecting a Clearance/Preload for an LM System

Since the clearances and preload standards of each LM System are set individually by model, you can select a clearance and a preload according to the operating conditions.
For separate-type models, THK cannot adjust their clearances at shipment. Therefore, the user must adjust the clearance when installing the product.
Determine a clearance/preload while referring to the following section.

Clearance and Preload

Clearance (Internal Clearance)

Clearance of an LM System is a play between the block (nut), the rail (shaft), and the ball (or roller). The sum of vertical clearances is called radial clearance, and the sum of circumferential clearances is called angular backlash (clearance in the rotational direction).

(1) Radial clearance
With the LM Guide, a radial clearance refers to the value of movement of the block center when the LM block is gently moved vertically with constant force applied in the center of the fixed LM rail in the longitudinal direction.

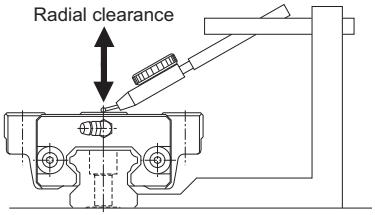

Fig. 3: Radial Clearance of the LM Guide

(2) Angular backlash (clearance in the rotational direction)
With the ball spline, angular backlash (clearance in the rotational direction) refers to the value of rotational motion of the nut when the spline shaft is fixed and the nut is gently rotated forward and backward with constant force.

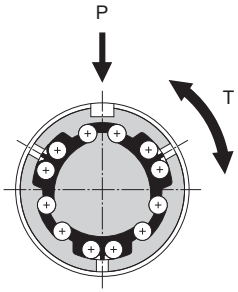

Fig. 4: Angular Backlash of the Ball Spline

Preload

Preload is a load that is preliminarily applied to the rolling elements in order to eliminate the clearance in an LM System and increase its rigidity.
A negative clearance indication (negative value) in an LM System means that a preload is provided.

Table 3: Examples of Radial Clearances for LM Guide Model HSR
Unit: μm

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

Note: For specific clearances and preloads, see the section concerning the corresponding model.

Preload and Rigidity

Providing a preload to an LM System will increase the rigidity according to the amount of the preload. Fig. 5 shows the amount of deflection for each clearance (normal clearance, C1 clearance, and C0 clearance) in LM Guide Model HSR.

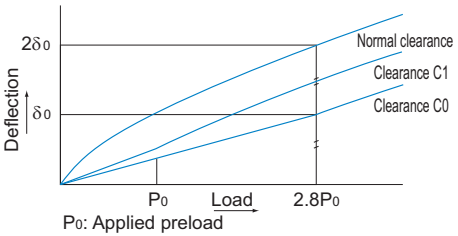

Fig. 5: Rigidity Data

Thus, the effect of a preload is up to approximately 2.8 times that of the applied preload itself. With a preload, the deflection under a given load is smaller and the rigidity is much greater than that without a preload.

Fig. 6 shows how the radial deflection of an LM Guide changes with a preload. As indicated in Fig. 6, when an LM Guide block receives a radial load of 2.45 kN, the radial deflection is 9 μm if the radial clearance is zero (normal clearance) or 2 μm if the radial clearance is -30 μm (clearance C0), thus increasing the rigidity by 4.5 times.

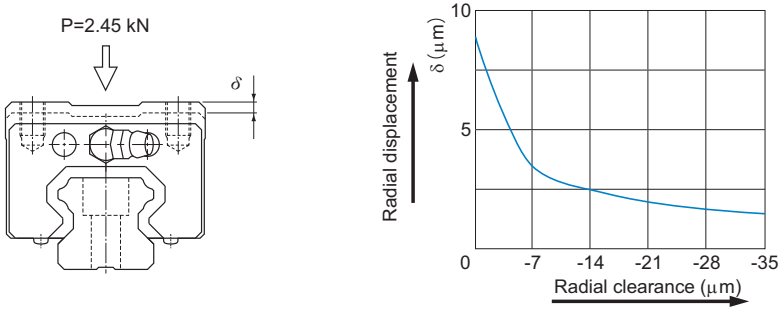

Fig. 6: Radial Clearance and Deflection

Note: For selecting a specific clearance, see the section concerning selection of a radial clearance for the corresponding LM System model.