

2.1. Structure and Features of the Caged Ball[®] LM Guide[®]

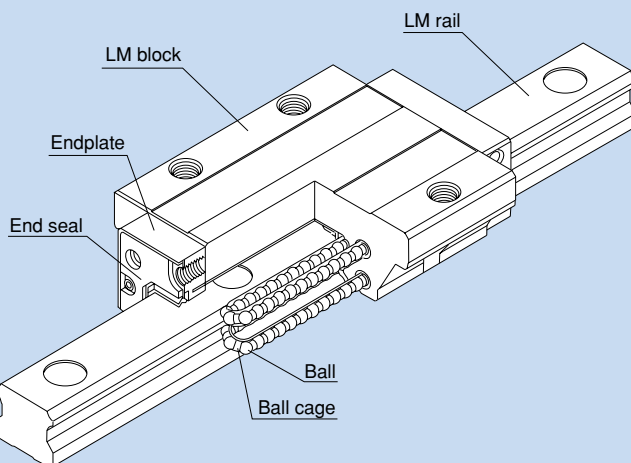


Fig. 1 Structural Drawing of the Caged Ball LM Guide Model SHS

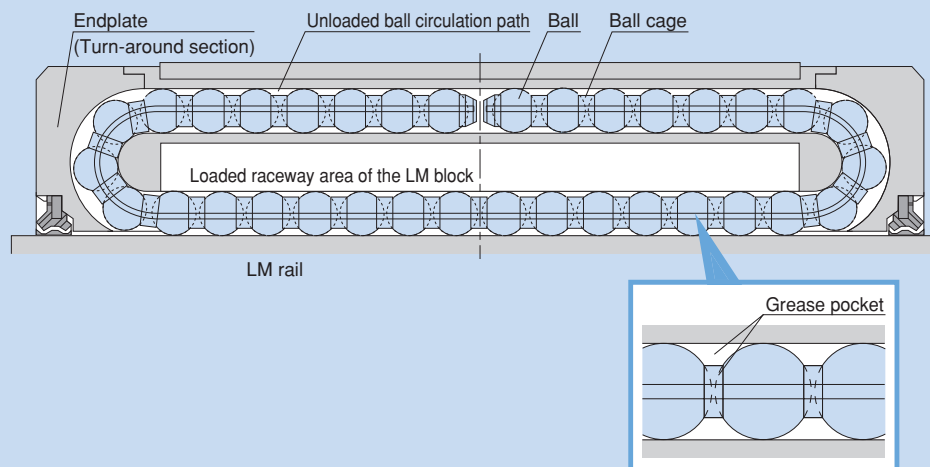


Fig. 2 Circulation Structure inside the LM Block of the Caged Ball LM Guide

With the Caged Ball LM Guide, the use of a ball cage allows lines of evenly spaced balls to circulate, thus to eliminate friction between the balls.

In addition, grease held in a space between the ball circulation path and the ball cage (grease pocket) is applied on the contact surface between each ball and the ball cage as the ball rotates, forming an oil film on the ball surface. This minimizes the risk of oil-film break.

2.1.1. Advantages of the Ball Cage® Technology

- ① The absence of friction between balls, together with increased grease retention, achieves long service life and long-term maintenance-free (lubrication-free) operation.
- ② The absence of ball-to-ball collision achieves low noise and acceptable running sound.
- ③ The absence of friction between balls achieves low heat generation and high-speed operation.
- ④ The circulation of lines of evenly spaced balls ensures smooth ball rotation.
- ⑤ The absence of friction between balls allows high grease retention and low dust generation.

Long Service Life and Long-term Maintenance-free Operation

Rated life equation for the LM Guide

$$L = \left(\frac{C}{P} \right)^3 \times 50$$

L : Rated life (km)

C : Basic dynamic load rating (N)

P : Applied load (N)

As indicated in the equation, the greater the basic dynamic load rating, the longer the rated life of the LM Guide.

[Example of calculation]

Comparison of rated life between the Caged Ball LM Guide model SHS25LR and the conventional full-ball type model HSR25LR

Calculation assuming $P = 13.6 \text{ kN}$

Basic dynamic rated load (C) of SHS25LR = 36.8 kN

Basic dynamic rated load (C) of HSR25LR = 27.2 kN

$$\text{Model SHS25LR} \quad L = \left(\frac{C}{P} \right)^3 \times 50 = \left(\frac{36.8}{13.6} \right)^3 \times 50 = 990 \text{ km}$$

$$\text{Model HSR25LR} \quad L = \left(\frac{C}{P} \right)^3 \times 50 = \left(\frac{27.2}{13.6} \right)^3 \times 50 = 400 \text{ km}$$

The rated life of the Caged Ball LM Guide model SHS25LR is **2.4 times*** longer than the conventional full-ball type model HSR25LR.

* Note: When selecting a model number, it is necessary to perform a service life calculation according to the service conditions.

■ Data on Long Service Life and Long-term Maintenance-free Operation

Use of a ball cage eliminates friction between balls and increases grease retention, thus to achieve long service life and long-term maintenance-free operation.

Model No. : SHS25/HSR25

Speed : 60m/min

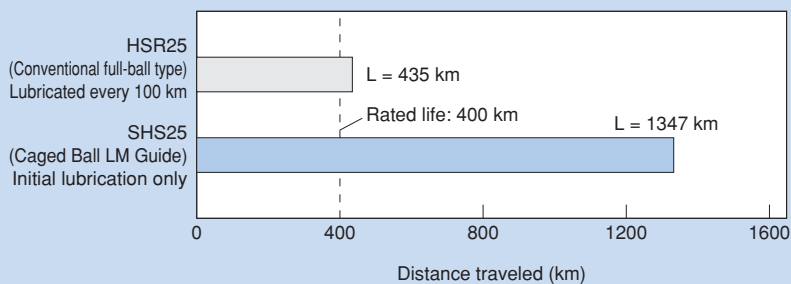
Stroke : 350mm

Acceleration : 9.8m/s^2

Orientation : horizontal

Load : Caged Ball LM Guide model SHS : 11.1 kN

Conventional full-ball type model HSR : 9.8 kN

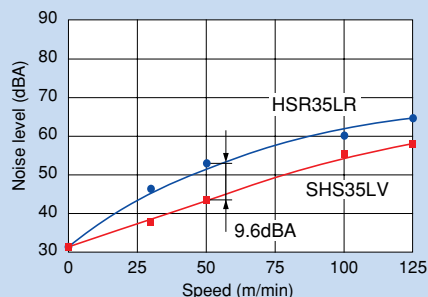


●Low Noise, Acceptable Running Sound

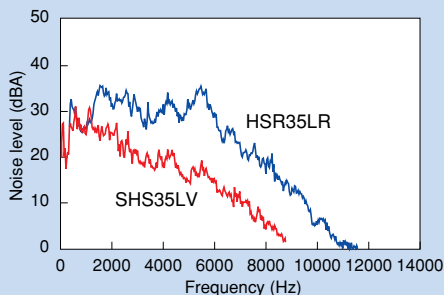
■Noise Level Data

Since the ball circulation path inside the LM block is made of resin, metallic noise between balls and the LM block is eliminated. In addition, use of a ball cage eliminates metallic noise of ball-to-ball collision, allowing a low noise level to be maintained even at high speed.

Model SHS35LV: Caged Ball LM Guide
Model HSR35LR: conventional full-ball type



Noise level comparison between SHS35LV and HSR35LR



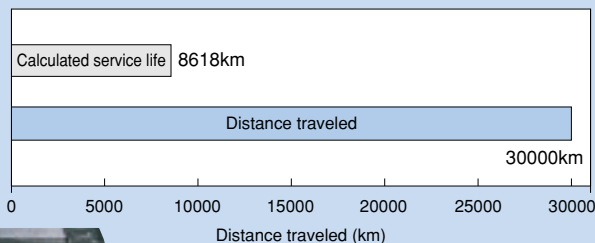
Noise level comparison between SHS35LV and HSR35LR (at speed of 50 m/min)

●High Speed

■High-speed Durability Test Data

Since use of a ball cage eliminates friction between balls, only a low level of heat is generated and superbly high speed is achieved.

Sample : Caged Ball LM Guide model SHS65LVSS
Speed : 200m/min
Stroke : 2500mm
Lubrication : initial lubrication only
Applied load : 34.5kN
Acceleration : 1.5G



Grease remains, and no anomaly is observed in the balls and grease.



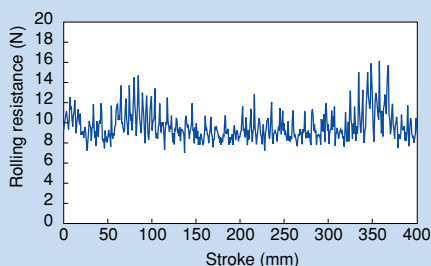
Detail view of the ball cage

● Smooth Motion

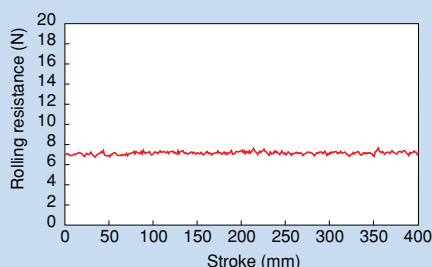
■ Rolling Resistance Data

Use of a ball cage allows the balls to be uniformly aligned and prevents a line of balls to meander as they enter the LM block. This enables smooth and stable motion to be achieved, minimizes fluctuations in rolling resistance, and ensures high accuracy, in any mounting orientation.

Model SHS25LV: Caged Ball LM Guide
Model HSR25LR: conventional full-ball type



Rolling resistance fluctuation data with HSR25LR
(Feeding speed: 10 mm/sec)



Rolling resistance fluctuation data with SHS25LV
(Feeding speed: 10 mm/sec)

● Low dust generation

■ Low Dust Generation Data

In addition to friction between balls, metallic contact has also been eliminated by using resin for the through holes. Furthermore, the Caged Ball LM Guide has a high level of grease retention and minimizes fly loss of grease, thus to achieve superbly low dust generation.

