

Technical  
Reference



# Smooth Silent Ecological

## Caged Technology

For details, visit THK at [www.thk.com](http://www.thk.com)

\*Product information is updated regularly on the THK website.

**THK CO., LTD.**  
TOKYO, JAPAN

CATALOG No.268-10E

# Caged Technology

## Introduction

Since ball bearings in the initial stage of development were not provided with a cage, they produced high levels of noise, had a short service life and were unable to be used at high rotating speeds.

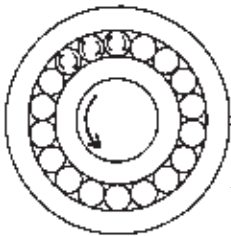
Later, caged ball bearings were developed that exhibited low noise levels even at high rotating speeds.

In addition, these caged ball bearings were able to demonstrate long service life despite the number of balls being fewer than full ball types, and evolved significantly so that they were able to be used in a wide range of applications.

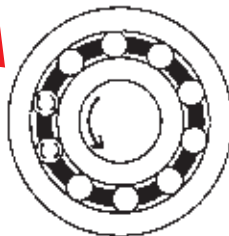
THK, the first manufacturer in the world to develop the LM Guide, has developed its LM Guide with Caged Ball Technology that is able to achieve a dramatic improvement in performance over conventional products. The LM Guide with Caged Ball Technology delivers a long service life and excellent high-speed performance in the same manner as roller bearings, while also eliminating maintenance for a long period of time.

## Rotary Bearings

### Initial Stage of Development (Full Ball Type)



- Metal contact between balls caused a shortage of grease life.
- Short service life

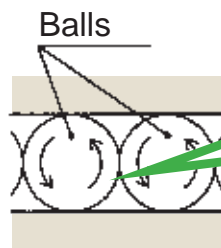
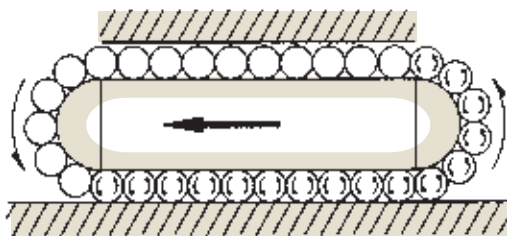


### Current Bearings (Caged Ball Type)

- Grease is held by the cage for excellent lubrication.
- No metal contact between balls for extended service life.
- No metal contact between balls suppresses generation of heat.
- No metal contact between balls eliminates ball collision noise.
- Balls exhibit orderly movement for smooth operation.

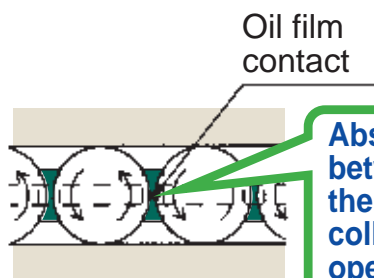
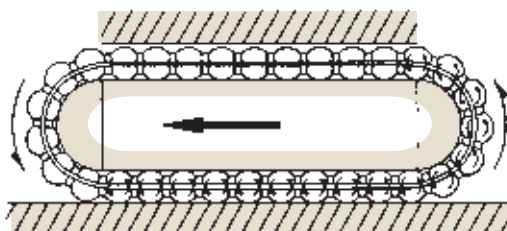
## Case of the LM Guide

Without caged ball



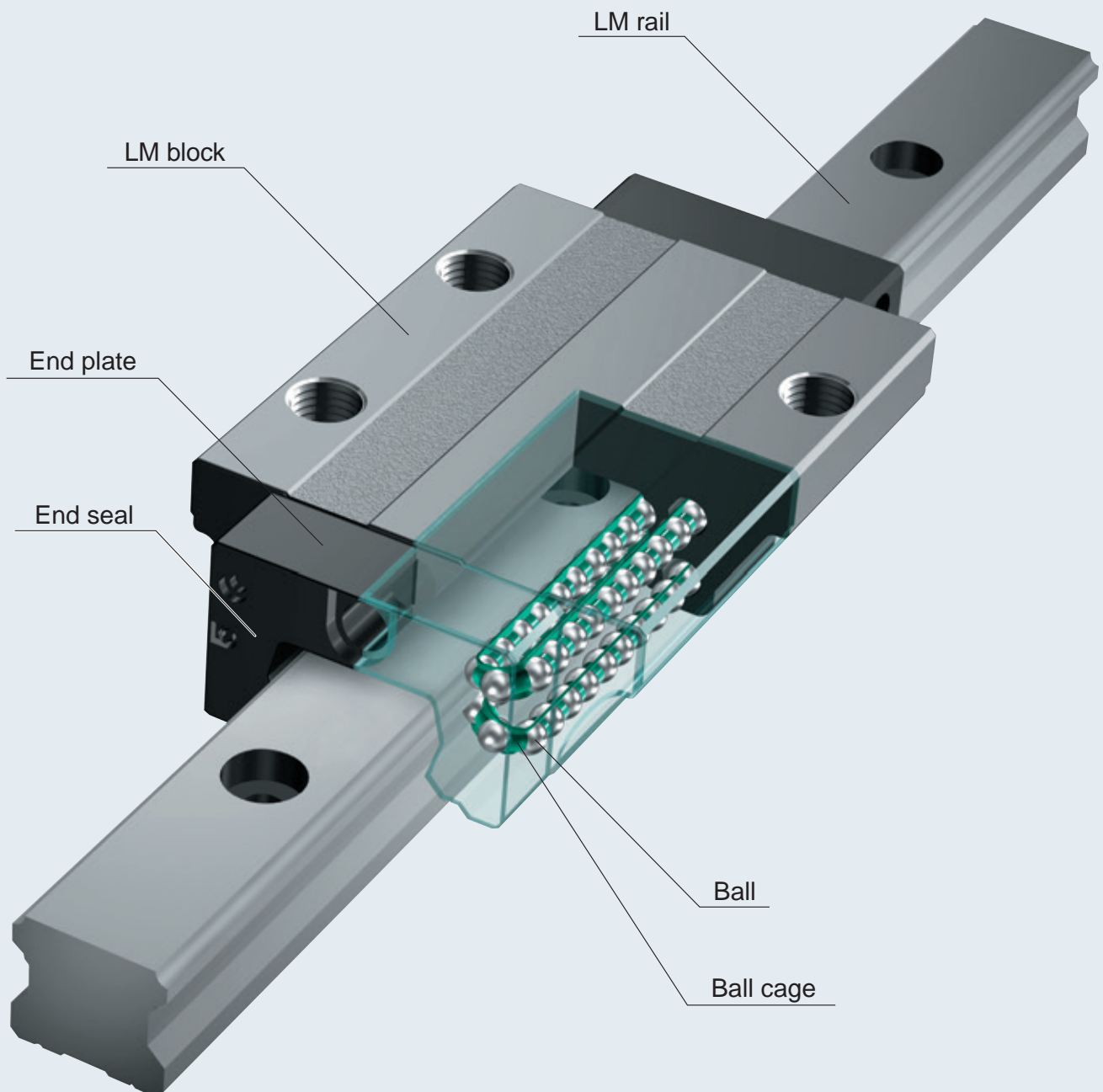
Friction occurs between balls resulting in the generation of collision noise

With caged ball



Absence of friction between balls eliminates the generation of collision noise for quiet operation

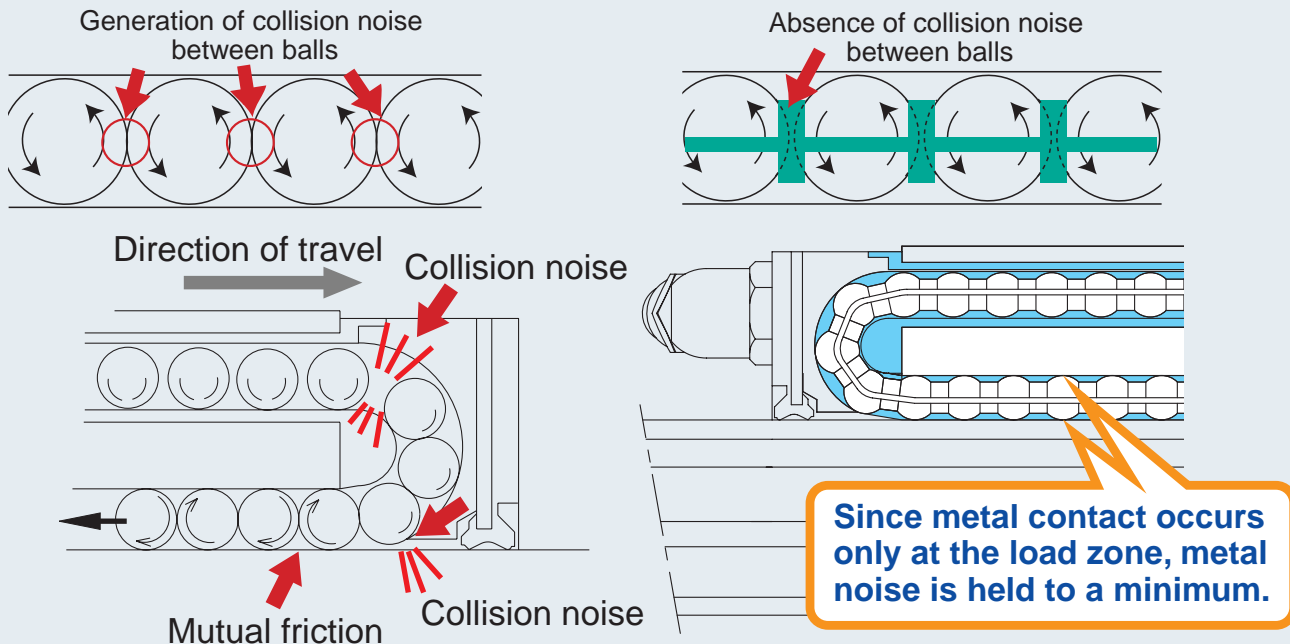
# Structure of the LM Guide with Ball Cage



## Advantage 1 of Caged Ball

### Quiet Operation that Minimizes Metal Contact

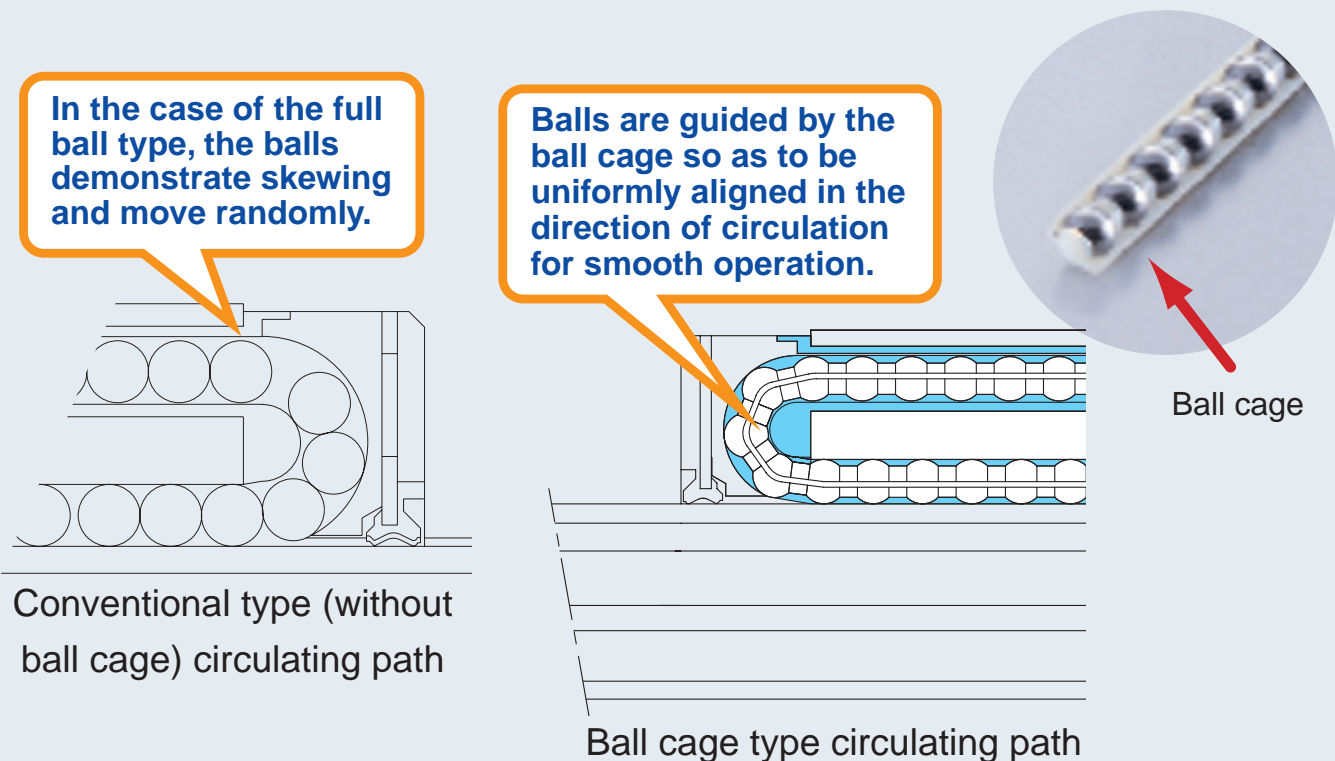
Collision noise between balls is eliminated by the ball cage resulting in quiet operation.



## Advantage 2 of Caged Ball

### Orderly Ball Movement

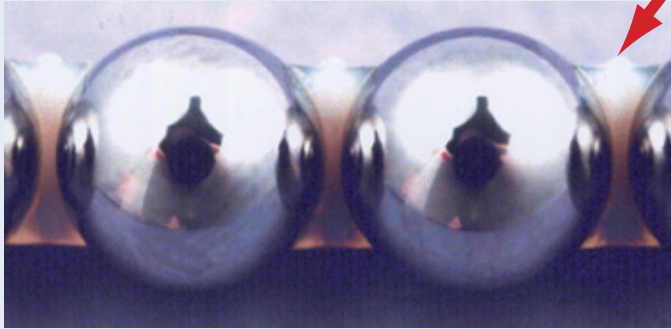
Since the balls are held by the ball cage in the form of a belt, they are aligned uniformly and move in a circulating manner. There is no skewing of the balls, while sudden variations in friction are also eliminated, allowing for stable movement.



## Advantage 3 of Caged Ball

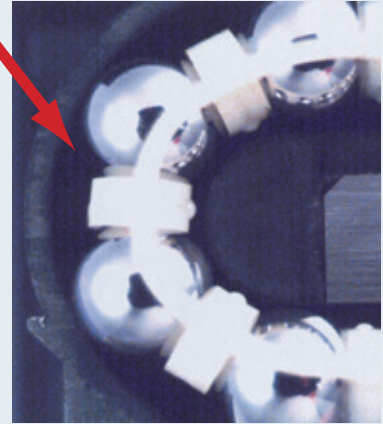
### Original Cage Structure Exhibiting Excellent High-Speed Performance

The use of ball cages eliminates generation of heat caused by friction between balls resulting in excellent high-speed performance.



Contact state between balls and ball cage

Ball cage

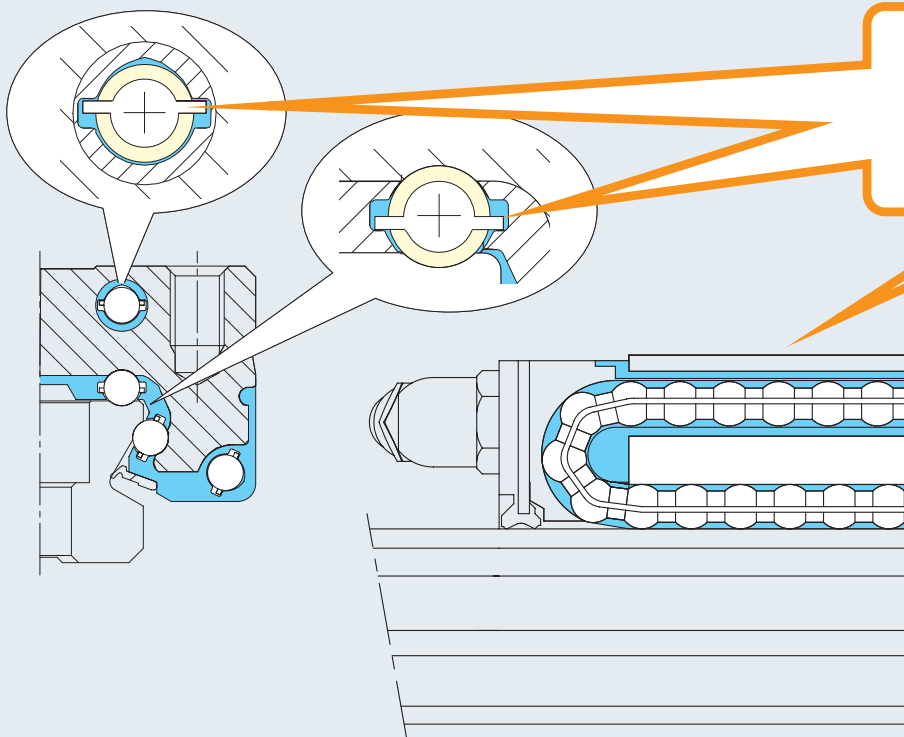


State at turning sections

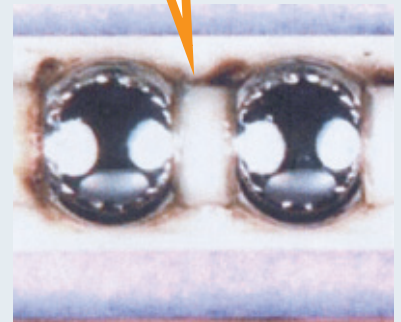
## Advantage 4 of Caged Ball

### Grease Holding Structure (Consecutive Grease Pockets) for Long-Term, Maintenance-Free Operation, Long Service Life

Grease pockets are provided consecutively over the entire ball circulation path to constantly lubricate the balls enabling long-term, maintenance-free operation, Long Service Life.



Grease pockets are provided throughout the ball cage.



Grease retention status after travel  
(SHS45LV: load endurance test)

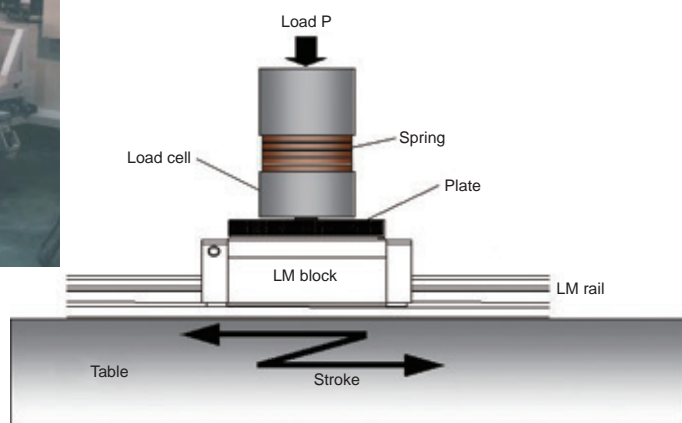
# Data on LM Guide with Caged Ball

## Improved Service Life

The Caged Ball not only allows the LM guide to be run for a long time period free of maintenance, but also significantly improves the service life of the system. As described below, a performed service life test has offered data about this improvement.

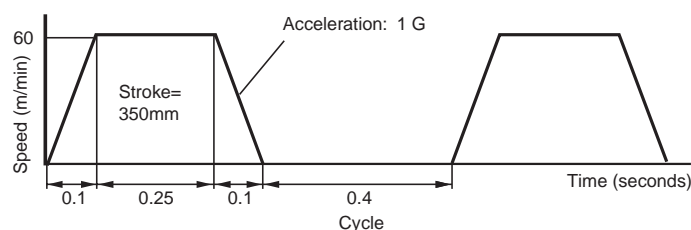
## Service life test for LM Guide

### 1. Testing instrumentation

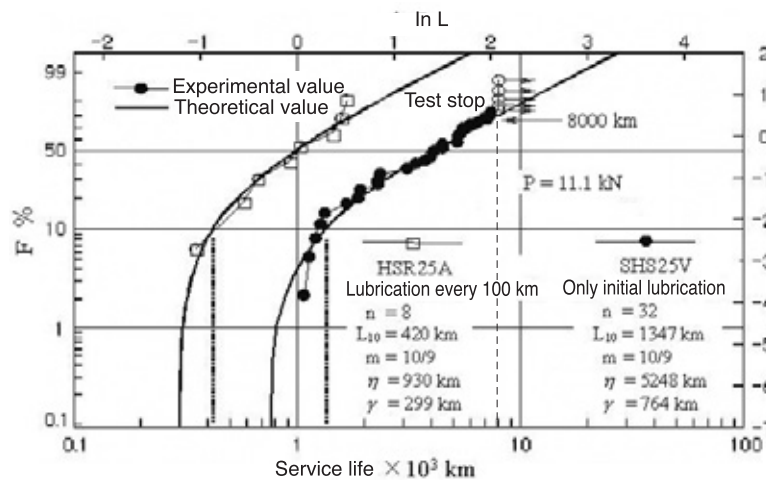


### 2. Testing parameters

Model : SHS25V1SS+580LP / HSR25A1UU+580LP  
Number of pieces : 32  
Load : 11.1 kN per LM block (0.35 C of SHS25V)  
Lubricant : Lithium soap base grease No. 2, Only initial lubrication



### 3. Test results



Status of Remaining Grease after the Durability Test



Ball cage before running



Ball cage after running 8,000 km  
(Test stop)

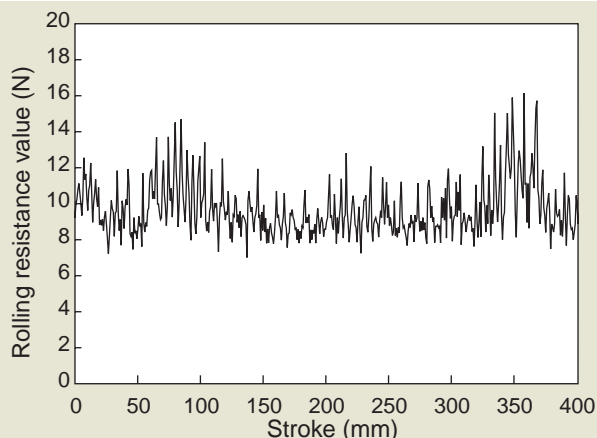
Remaining grease is observed in the ball cage.

The results of the performed test indicate that the dynamic durability values of the LM guide implemented by Caged Technology are higher than of the conventional LM guide.

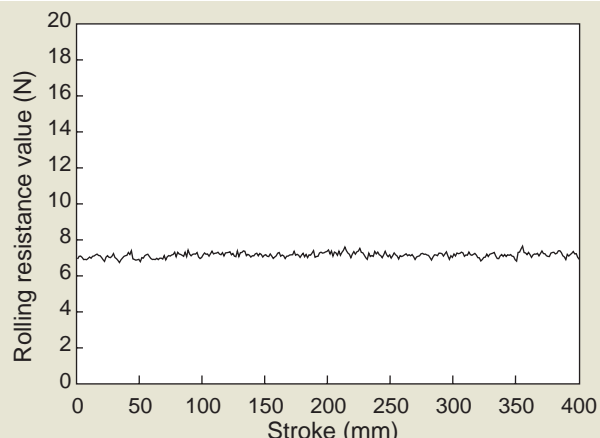
# LM Guide with Caged Ball Technology

## Rolling Resistance Data

The use of a ball cage enables the balls to be uniformly aligned, eliminating crowding of the balls that occurs when they enter the block. As a result, smooth and stable movement can be obtained in all forms of installation, and fluctuations in rolling resistance are reduced for the realization of high accuracy.



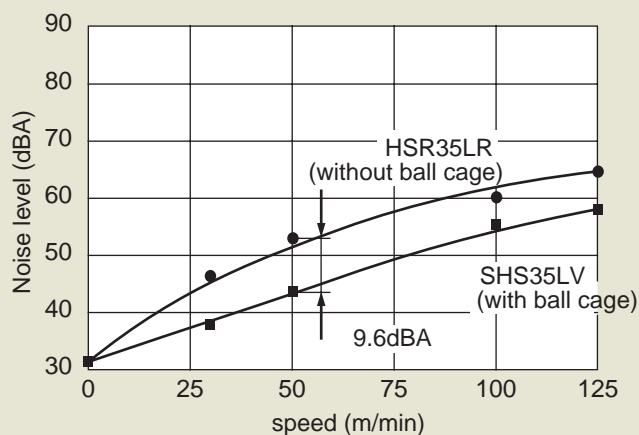
Results of Measuring Fluctuations in Rolling Resistance of HSR25LR (without ball cage)  
(feeding speed: 10 mm/sec)



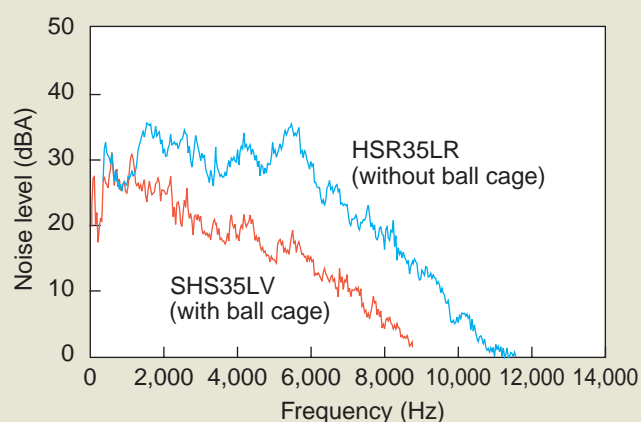
Results of Measuring Fluctuations in Rolling Resistance of SHS25LV (with ball cage)  
(feeding speed: 10 mm/sec)

## Noise Level Data

The use of a ball cage eliminates interference between balls resulting in low noise levels.



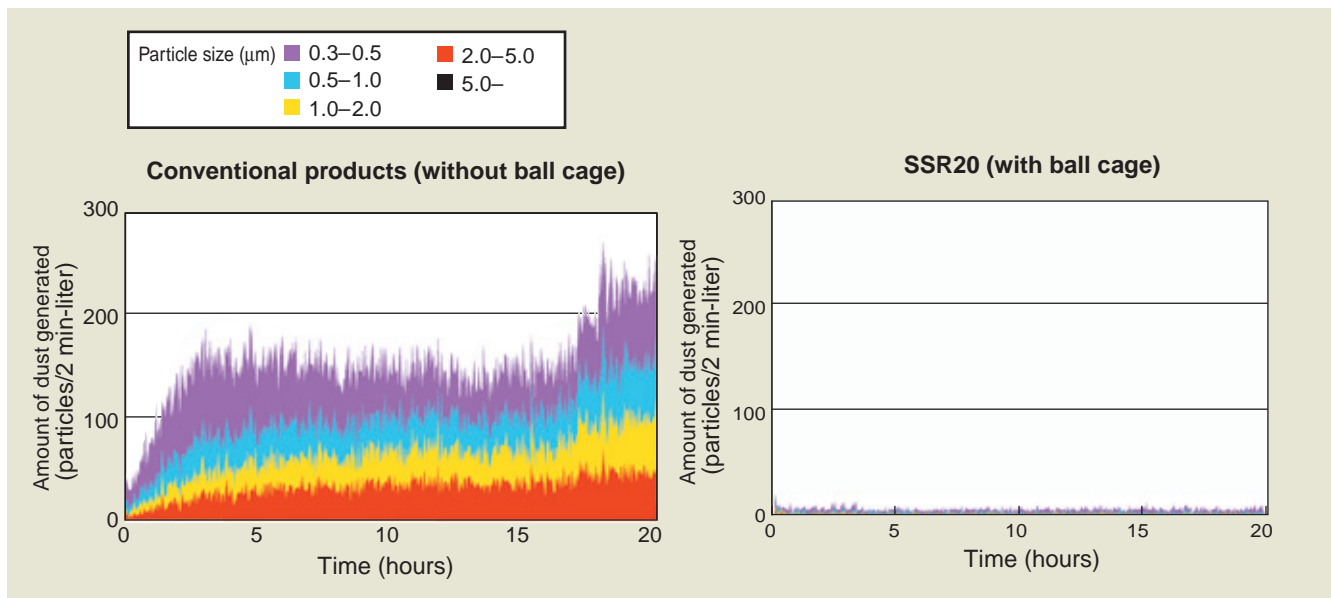
Comparison of Noise Levels Between the SHS35LV and HSR35LR



Comparison of Noise Levels Between the SHS35LV and HSR35LR  
(speed: 50 m/min)

## ■ Low Generation of Dust

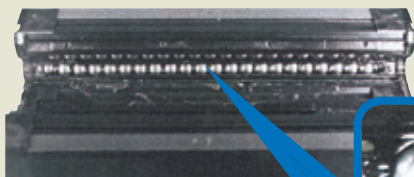
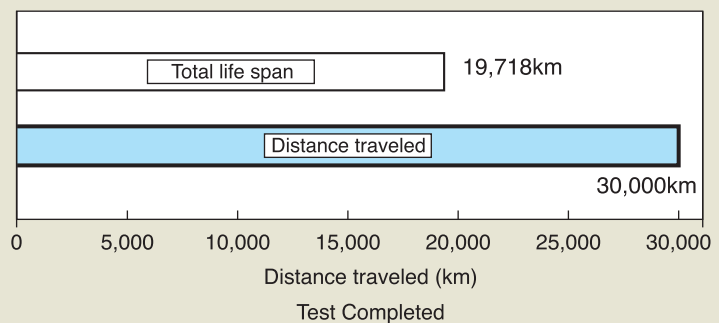
The use of a ball cage eliminates friction between balls resulting in a corresponding decrease in the generation of metal wear fragments for outstanding effects against prevention of the generation of dust.



## ■ High-Speed Durability Test Results

Since the use of a ball cage eliminates friction between balls, there is less generation of heat making it possible to demonstrate excellent high-speed operation.

Sample : SHS65LVSS  
 Speed : 200 m/min  
 Stroke : 2500 mm  
 Lubrication : Initial injection of grease only  
 Load : 34.5 kN  
 Acceleration : 1.5 G



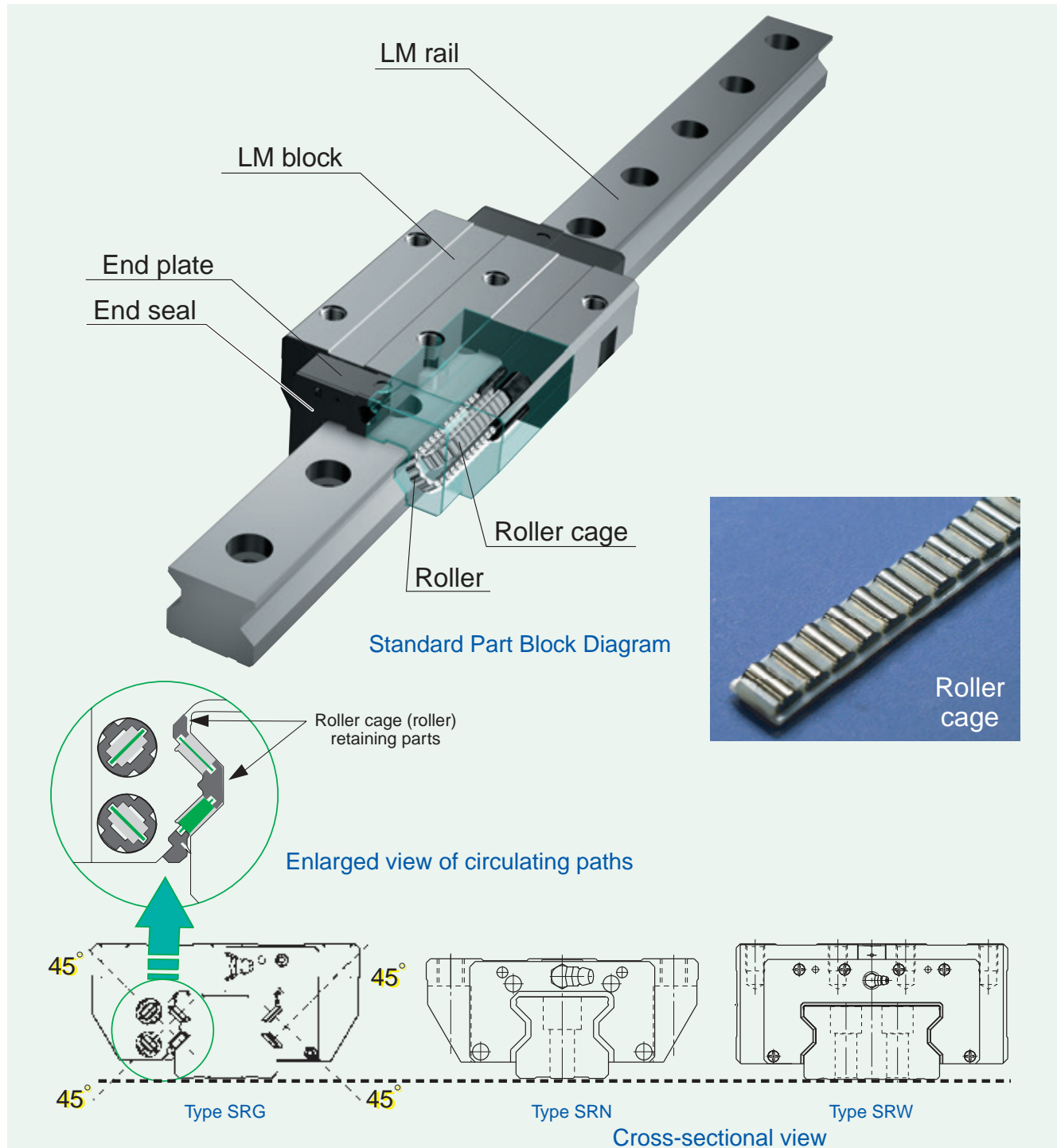
**Grease was still present and there were no abnormalities observed in the balls or grease.**

Detailed drawing of ball cage

# Caged Roller Technology

## ***SRG/SRN/SRW***

### Structure of the ***SRG/SRN/SRW*** type



## Features of the ***SRG/SRN/SRW*** type

### **Prevents roller skewing**

The use of a roller cage allows the rollers to circulate while uniformly aligned, preventing skewing when entering block load area, and reducing variation in rolling resistance to obtain stable and smooth movement.

### **Long-Term, Maintenance-Free Operation**

The use of a roller cage eliminates friction between rollers, and retains lubricant in the grease pockets between adjacent rollers, ensuring the required amount of lubricating oil is supplied to the curved contact surfaces of the spacers and rollers of the circulating path to realize long-term maintenance-free operation.

### **Ultra-High Rigidity**

Ultra-high rigidity is achieved by using rollers having a low degree of elastic deformation for the rolling elements and an optimized roller diameter and length. Also, each row of rollers is arranged at a 45° contact angle so that an equal load rating is applied in four directions (radial, reverse radial, and lateral directions).

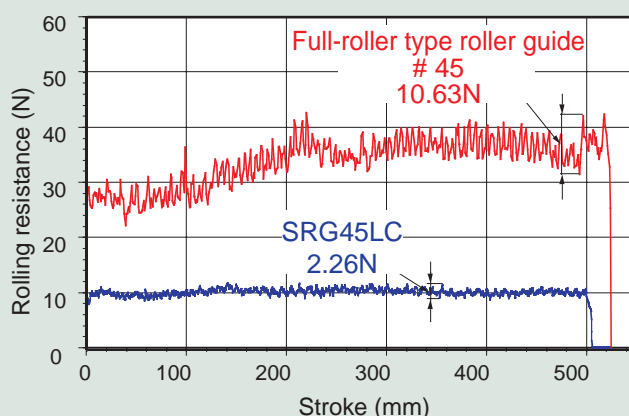
### **Global Standard Dimensions**

The dimensional design complies with the Type HSR developed by THK as the pioneer of linear motion systems and has become the global standard.

# LM Guide with Caged Roller Technology

## ■Rolling Resistance Value Data

The use of a roller cage eliminates friction between rollers while also enabling the rollers to circulate while uniformly aligned. As a result, there is reduced occurrence of skewing allowing stable movement.



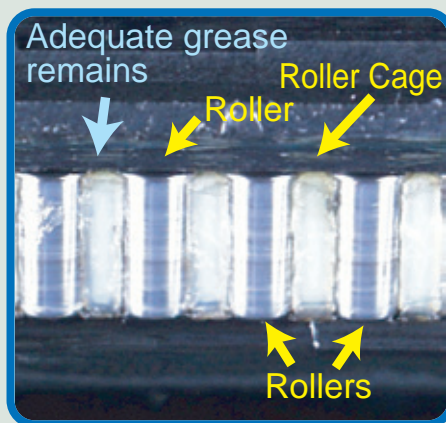
## ■Durability Data

The use of a roller cage enables grease to be retained in the space between adjacent rollers, realizing long-term, maintenance-free operation by inhibiting the escape of grease from the circulating path.

Sample) : SRG45LCC0

Conditions) : Pre-loading : C0 clearance  
Speed : 180 m/min  
Acceleration : 1.5 G  
Stroke : 2300 mm  
Lubricant : Initial injection of grease only

- Intermediate results:  
No abnormalities during 15,000 km of travel  
( flaking or insufficient grease was not observed )



No discoloration of grease is observed.

Detailed drawing of roller cage

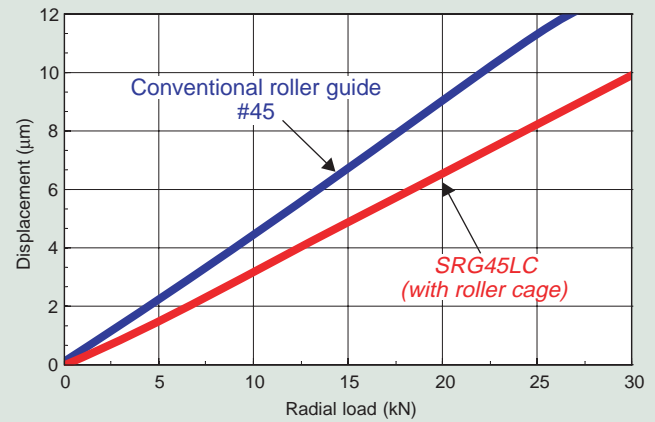
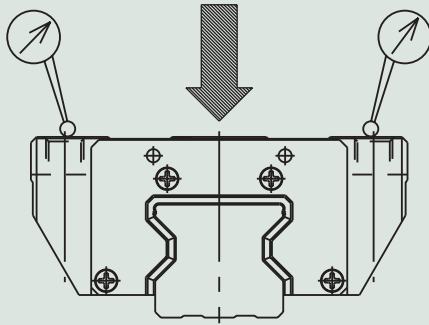
## ■ Rigidity values

Radial clearance

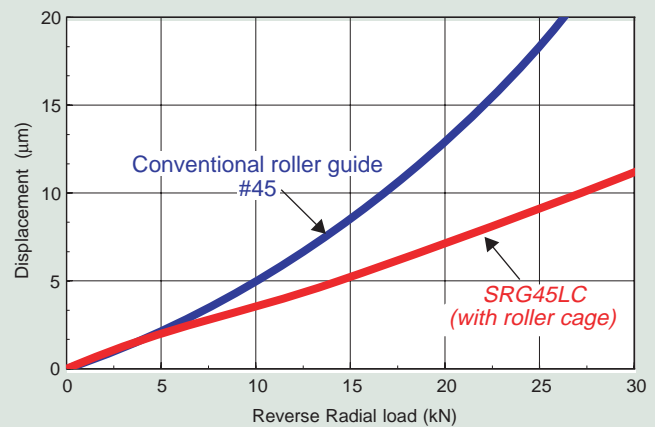
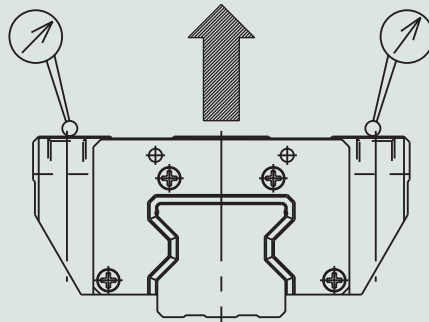
SRG  
Conventional roller guide

: Clearance C0  
: Equivalent to C0

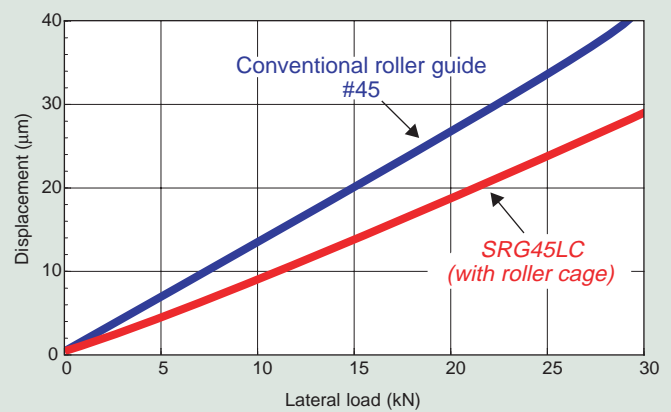
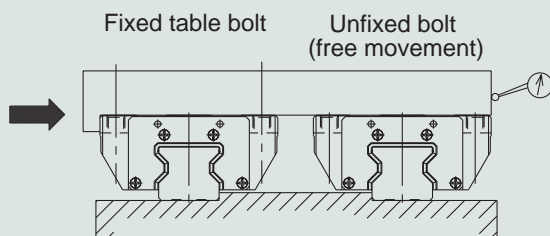
### Radial rigidity



### Reverse radial rigidity



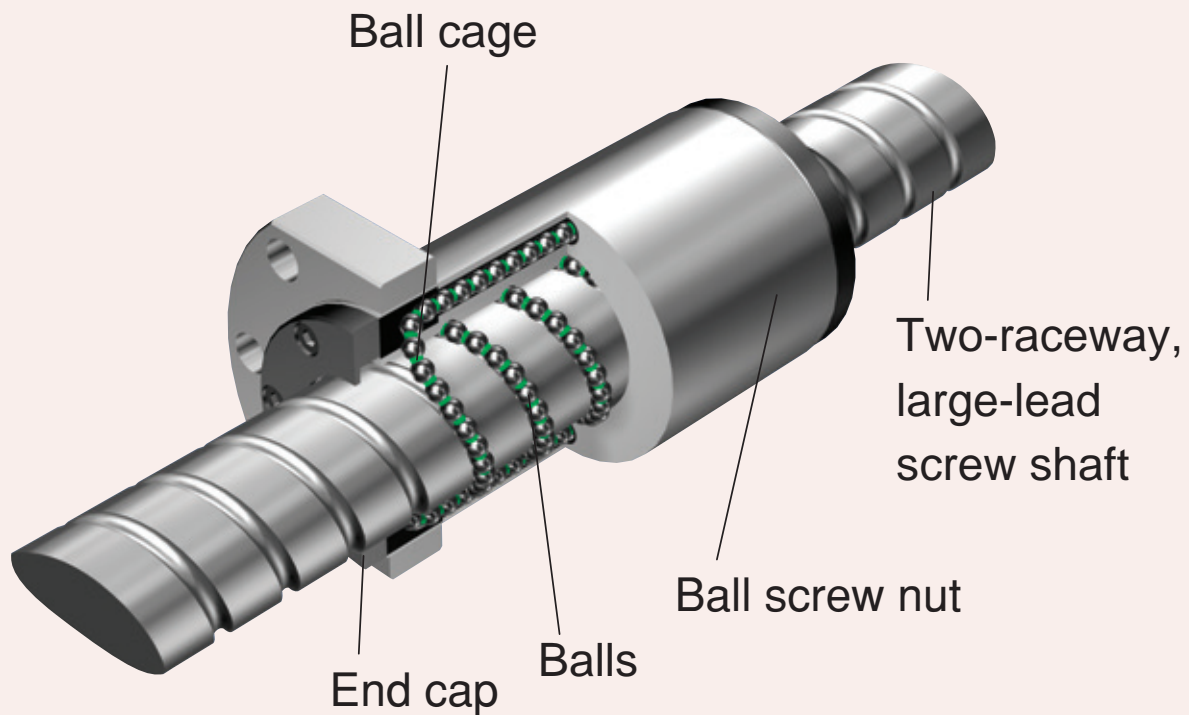
### Lateral rigidity



# Ball Screw with Ball Cage

## ***SBN/SBK/SBKN/SDA/HBN/SBKH***

### Structure of the **SBK** type

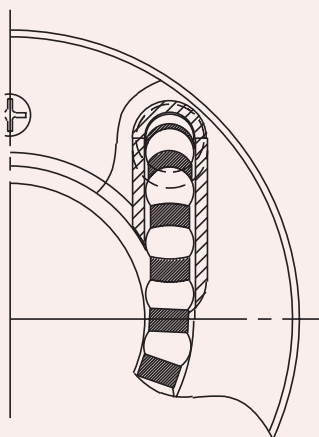


# Features of the **SBK** type

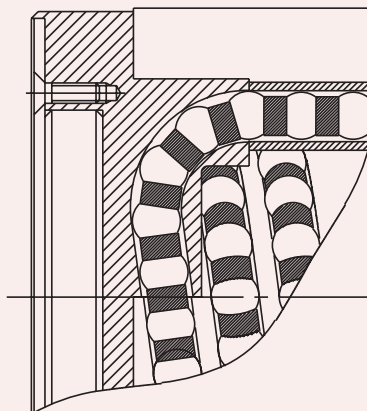
## High-speed Operation

Because of its circulation structure where the end caps enable the balls to be picked up in the tangential direction and the lead angle direction, this model is capable of high-speed operation at a DN value of 160,000, achieving high-speed feed 2.2 times faster than the conventional model.

Balls circulate in the tangential direction

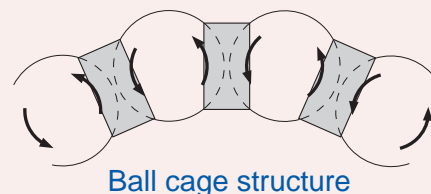


Balls circulate in the lead angle direction



## Low Noise, Acceptable Running Sound

Use of a ball cage allows balls to be evenly spaced and eliminates collision noise between balls. In addition, balls are picked up in the tangential direction, which also contributes to eliminating collision noise. As a result, **low noise and acceptable running sound are achieved**.

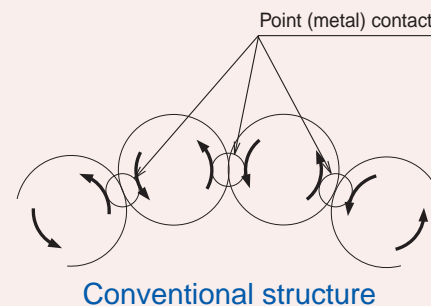


Ball cage structure

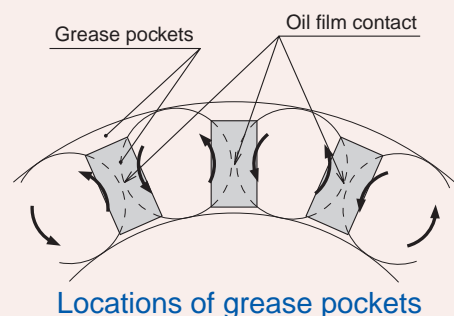
## Long-term Maintenance-free Operation

The formation of grease pockets increases grease retention and achieves **long-term maintenance-free operation**. In addition, even in adverse environments (e.g., coolant, foreign matter), this model ensures long-term maintenance-free operation when attached with an optional wiper ring or a QZ Lubricator\*.

(\*: For wiper ring and QZ Lubricator, contact THK.)



Conventional structure



Locations of grease pockets

## Excellent Sliding Properties

Ball cages arranged between balls eliminate mutual friction of the balls and significantly improve torque characteristics. Pre-load dynamic torque fluctuations are also reduced allowing the obtaining of **excellent sliding properties**.

# Improved Service Life

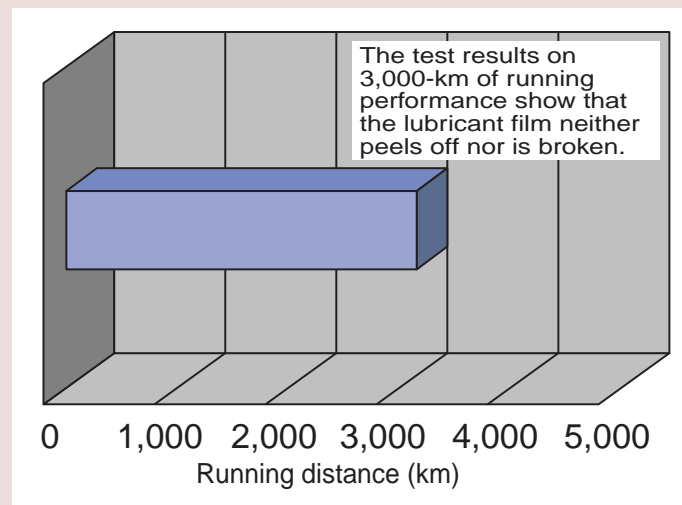
## ■ Service life test

Service life test under a high speed (free of maintenance)

Testing instrumentation for a long-period high-speed test was used to test model SBK with lubrication system QZ. The operating cycles were run under a DN value of 160,000 and with only initial lubrication carried out.

### Conditions

Sample tested	SBK3620-7.6
Number of samples	3
Maximum rotation speed	4200 min <sup>-1</sup> (DN value : 160,000)
Stroke	400 mm
Lubricant	Multemp HRL grease (initial lubrication only)
Grease quantity	8 cm <sup>3</sup>
Applied load	1.87 kN (preload only)
Acceleration	1G



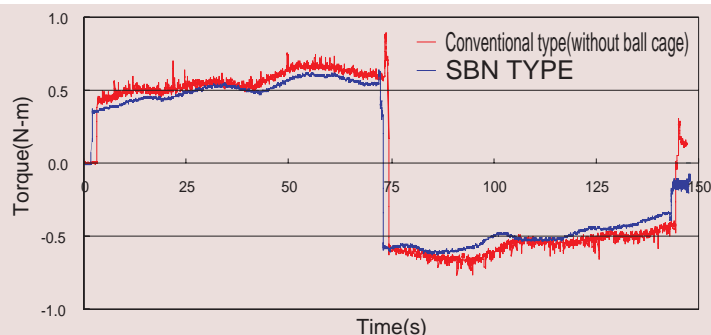
# Ball Screw with Caged Ball Technology

## Torque Fluctuations and Sliding Properties

The ball cage reduces torque fluctuations enabling excellent constant speed characteristics to be obtained even at low speed for a high degree of positioning accuracy.

### Conditions

Item	Description
Shaft diameter/lead	32 / 10 mm
Speed	10 mm/s
Shaft rotational speed	60 min <sup>-1</sup>
Stroke	700 mm
Lubricant	Mobil Vactra No. 2 oil

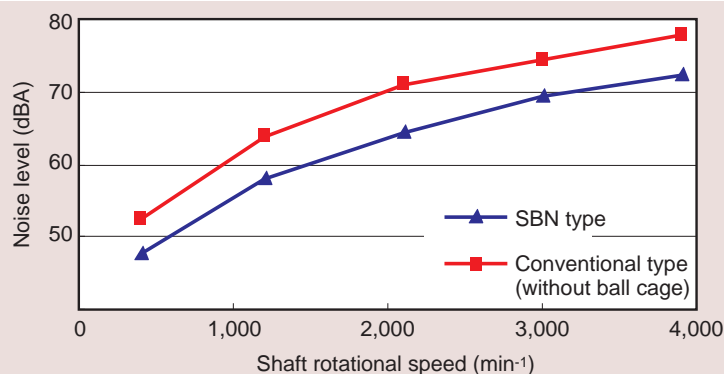


## Noise Level Data

The use of a ball cage reduces friction between balls to realize low noise levels.

### Conditions

Item	Description
Shaft diameter/lead	32 / 10 mm
Lubricant	THK AFG grease
Measuring distance	1 m

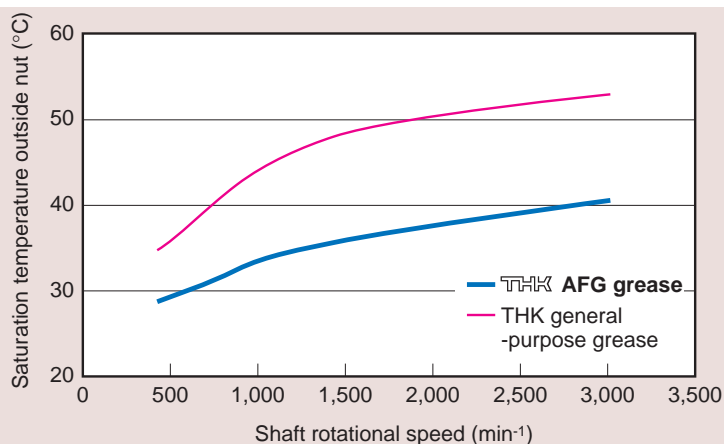


## Heat Generation Data

Although the use of a ball cage eliminates friction between balls making it possible to demonstrate low levels of heat generation and outstanding high-speed operation, the use of THK AFG grease (low heat-generation grease) suppresses heat generation even more.

### Conditions

Item	Description
Shaft diameter/lead	32 / 10 mm
Shaft rotational speed	400-3000 min <sup>-1</sup>
Stroke	400 mm
Lubricant	THK AFG grease THK general-purpose grease

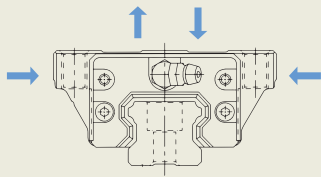


# A Lineup of Caged Ball/Roller LM Systems

## Caged Ball LM Guides

### Global Standard

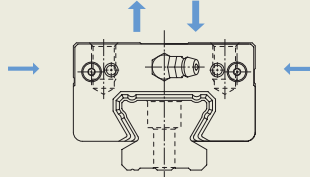
#### Model *SHS*



Conveyance system FPD manufacturing machine  
NC lathe Drilling machine  
Machining center

### Radial Type

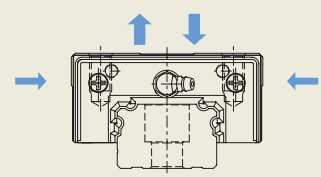
#### Model *SSR*



Conveyance system Semiconductor manu-  
facturing machine  
FPD manufacturing machine  
Medical equipment Chip mounter

### For Machine Tools/Highly dust-proof

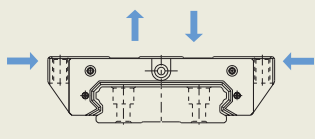
#### Model *SVR/SVS*



Machining center Five-axis milling machine  
NC lathe Grinding machine

### Wide, Low Gravity Center Type

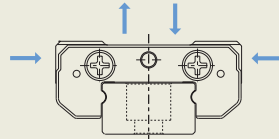
#### Model *SHW*



Semiconductor manu- FPD manufacturing  
facturing machine machine  
Conveyance system Chip mounter

### Lightweight, Compact

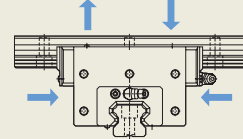
#### Model *SRS*



Semiconductor manufacturing machine FPD manufacturing machine  
Optical stage Printer  
Medical equipment Chip mounter

### Cross Type

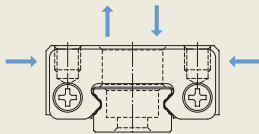
#### Model *SCR*



Precision alignment stage Optical measuring  
Wire-cut electric discharge machine instrument  
XY table Bonding machine

### Finite Stroke

#### Model *EPF*



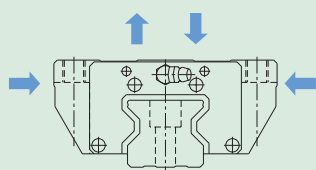
Semiconductor manu- Medical equipment  
facturing machine Industrial machinery  
Inspection equipment

# with Superb Features **S Series**

## Caged Roller LM Guides

Super-ultra-high Rigidity Type

**Model *SRG***

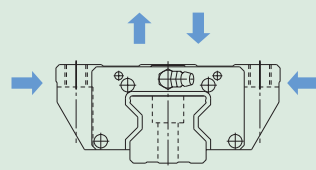


Machining center  
Ultra precision lathe  
Heavy cutting machine

Five-axis milling machine  
Drilling machine

Super-ultra-high Rigidity, Low Gravity Center Type

**Model *SRN***

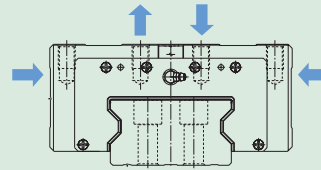


Machining center  
Ultra precision lathe  
Heavy cutting machine

Five-axis milling machine  
Drilling machine

Super-ultra-high Rigidity, Wide Type

**Model *SRW***



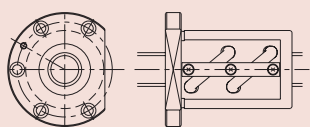
Plano miller  
Large pressing machine  
Injection molding machine

Large five-face milling machine

## Ball Screws with Ball Cage

High Speed Ball Screw

**Model *SBN***

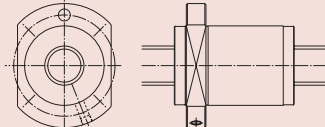


High-speed machining center  
High-speed chip mounter

High-speed conveyance system  
High-speed printed board drilling machine

High Speed Ball Screw

**Model *SBK***

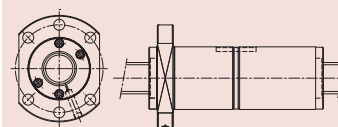


High-speed machining center  
High-speed chip mounter

High-speed conveyance system  
High-speed printed board drilling machine

High Speed Double-Nut Ball Screw

**Model *SBKN***

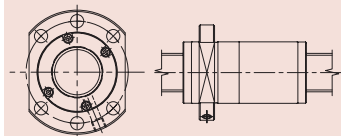


High-speed machining center  
High-speed chip mounter

High-speed conveyance system  
High-speed printed board drilling machine

Compact Ball Screw

**Model *SDA***

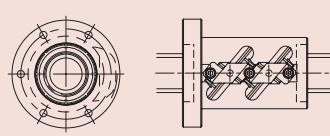


High-speed laser cutting machine  
High-speed chip mounter

High-speed conveyance system  
High-speed printed board drilling machine

High Load Ball Screw

**Model *HBN***

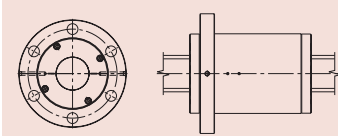


Injection molding machine  
Die-casting machine

Extrusion molding machine  
Pressing machine

High-Load, High-Speed Ball Screw

**Model *SBKH***



Injection molding machine  
Blow molding machine  
Extrusion molding machine

Pressing machine  
Die-casting machine

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