Developing technology to deliver added value to society

— Creating new value and pursuing customer satisfaction —

■ Providing innovative new products

The central focus of THK's technological development activities is the effort to cultivate creative products that anticipate the customer's needs, in accordance with THK's corporate philosophy, "providing innovative products to the world and generating new trends to contribute to the creation of an affluent society".

By developing innovative new products, THK can create new areas of demand within the machine tool industry. In this way, THK seeks to play a leading role in the creation of new markets. THK's approach to technology has always been based on performing the greatest possible amount of work using minimal force, by converting sliding motion into rolling motion. This constitutes an enormous contribution in terms of energy conservation and high performance, two qualities that are highly valued these days.

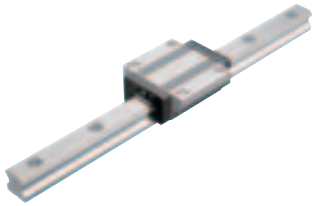
In 1972, shortly after the company was founded, THK produced the world's first rolling linear motion system—the LM Guide. The LM Guide overturned conventional wisdom in the machine tool industry, making it possible to consume only one-tenth the power required with conventional sliding-motion guides. This was a highly significant advantage in terms of environmental concerns. In the midst of the economic boom Japan was enjoying at the time, the LM Guide was also the first product in the Japanese industrial world to embrace the value of "environmental friendliness" by reducing the need for lubricants and enabling machine tools to become smaller and consume less power.

By the latter half of the 1990s, amid the development and dissemination of information technology, it had become necessary to address the new value of "high precision". THK responded by developing new LM Guides and other products suitable for use in semiconductor manufacturing. In 1996 THK introduced a second-generation LM Guide called the Caged Ball LM Guide, the culmination of 10 years of development. In the Caged Ball LM Guide, the internal rolling elements, or balls, are enclosed within a plastic retainer, or cage. This revolutionary new product not only addressed the need for high precision, it also embodied new values—silent operation, high durability, and low maintenance—to meet the needs of a new age.

■ Milestones in the development of creative products and attainment of customer satisfaction

THK is the first to convert sliding motion into rolling motion.

High-speed, high-precision, low-noise, environment-friendly products



THK's early years

- 1971: Ball Spline
- 1972: The original LM Guide
- 1979: Precision Ball Screw

Perfecting core technology

- 1981: 4-way Equal Load LM Guide (Worldwide standard)
- 1983: Ball Screw with a Large Lead (First in the industry with finished shaft ends)
- 1989: Nut-rotating Ball Screw (First in the industry)
- 1990: Offset Ball Screw (THK original)
- 1990: Model LT Ball Spline
- 1990: Model LTR Ball Spline

Perfecting high-value-added technology

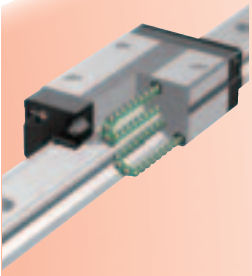
- 1996: Model SSR Caged Ball LM Guide
- 1998: Model SHS Caged Ball LM Guide
- 2000: Model SRG Caged Roller LM Guide
- 2000: Model SBN High-Speed Caged Ball Screw
- 2002: Model HBN High-Load Caged Ball Screw
- 2002: Model SBK High-Speed Caged Ball Screw

■ Anticipating needs 5 to 10 years in advance

Another focus of technological development at THK is the pursuit of customer satisfaction—accurately identifying the needs of customers and of society in general and responding in a timely manner. THK's stakeholders are concerned about the global environment and about helping to provide a safe and secure society. To earn the confidence and continuing patronage of the larger community, THK must provide products and technology that meet people's needs, in a timely manner.

Once a technological development has been achieved, it takes time to convert it into a viable new product. In order to make needed technology available at the time the need becomes apparent, it is necessary to anticipate customers' needs five to ten years in advance, long before customers themselves are aware of them. In this sense, an accurate assessment of the market is absolutely essential. The use of THK technology has expanded beyond the machine tool industry and is now helping to ensure a safe and secure society. Examples of this include the incorporation of THK technology into seismic isolation devices and THK's collaboration in the development of medical robots.

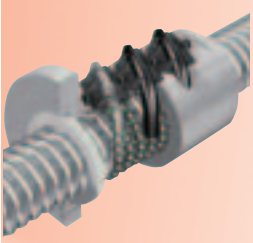
THK is working to expand its activities in a wide range of fields, in pursuit of ever greater customer satisfaction, and to provide products that meet customers' needs, in order to place its accumulated technology at the service of society.



● Automobiles

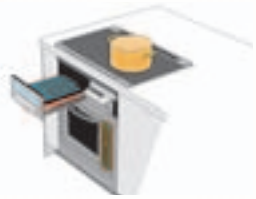
● Housing

New fields of business



● Robotics

● Consumer products



Providing the link between creative product development and customer satisfaction

THK Technology Center

THK's technological development efforts were formerly carried out at individual production sites. In 2005 the company established the THK Technology Center in Ota Ward, Tokyo, as its base for research and development activities. The Technology Center serves as the source for information related to THK technology and a venue for design and development activities as well as testing and examination procedures. Some 220 engineers are employed at the Center, which is equipped with a variety of processing machines, durability testers, three-dimensional measuring instruments, and other devices.

THK's Engineering and Development Department oversees the development of new products. A project team is assigned to each development project to ensure rapid development. Newly developed products are sent off to the manufacturing plants, so that development personnel working at the site of production can further improve the quality of each product.

■ Developing technology: Case 1

Super-high Rigidity / Super-low Waving LM Guide

Creating new value by developing new technology

Received 2009 JSPE Technology Award from Japan Society for Precision Engineering

Key points in product development

- **Greater accuracy, higher load-bearing capacity**
- **Superior environmental performance**

The challenge was to ensure that the movement of a table incorporating LM Guides was accurate to the nanometer—one-millionth of a millimeter. It was already possible to achieve accuracy to the micrometer (one-thousandth of a millimeter), but in most cases nanometer-level accuracy was obtainable only through the use of static pressure. Attaining greater accuracy with LM Guides had been a longtime challenge for the industry, entailing two difficult problems. The first was dealing with a phenomenon known as waving, caused by slight fluctuations in the load bearing on the rolling element. Every manufacturer knew that this problem could be resolved by reducing the ball diameter, but this gave rise to the second problem: smaller balls meant less load-bearing capacity.

Toru Takahashi, the head of THK's Fundamental Technology Research Laboratory, was casually sketching on a sheet of paper when he suddenly came up with a solution to this dilemma. He had drawn a standard cross-sectional view of four balls when it occurred to him that, by making each ball smaller, he could create space for more balls to be added, one at a time. He knew, of course, that the rated load could increase along with any increase in the number of grooves.

The smaller the balls, the more waving can be suppressed and the more grooves there are; with more grooves, the rated load can increase. Takahashi was aware of all these principles, but it was only when he drew his sketch that they came together to form a viable solution. His theory was promptly studied and prototypes were prepared and tested, proving the validity his proposal.

The Super-high Rigidity/Super-low Waving LM Guide, created by doubling the grooves of the 4-groove LM Guide, delivers nanometer-level accuracy. Moreover, it proved to be a remarkably environmentally friendly product because, unlike static-pressure units, which the Super-high Rigidity/Super-low Waving LM Guide will replace, the lubricants are contained in the block. This keeps the work area free from contamination. With static pressure, lubricants continually flow between the base of the machine and the table during operation, so the work area gets contaminated with lubricants.

The Super-high Rigidity/Super-low Waving LM Guide is the ideal linear guide for machining centers and lathes that previously relied on static pressure. The new guide greatly improves initial cutting accuracy, reducing the need for grinding after the cutting is done, and this is only one of its cost-saving benefits.

Comments from the developer

Toru Takahashi

Manager, Fundamental Technology Research Laboratory, Engineering Division

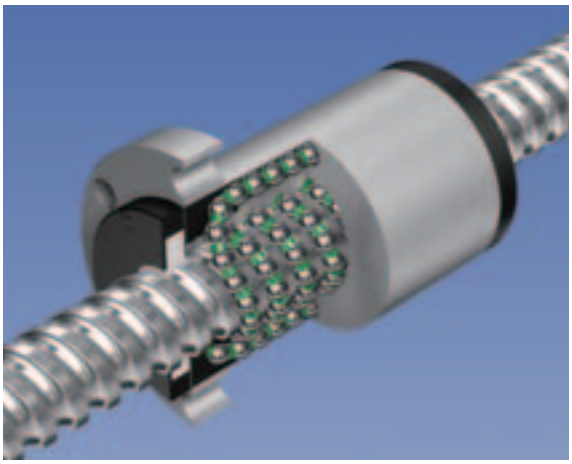
I hope this Super-high Rigidity/Super-low Waving LM Guide is appreciated by our customers and seen as a very good product, worth the price. It'll be an ideal replacement when a customer has trouble with an existing LM Guide or wants to upgrade. Ideally, when customers using guides made by other companies want greater accuracy, the only product they'll consider is the THK Super-high Rigidity/Super-low Waving LM Guide—that's the kind of product this should be.

■ Developing technology: Case 2

The SBKH

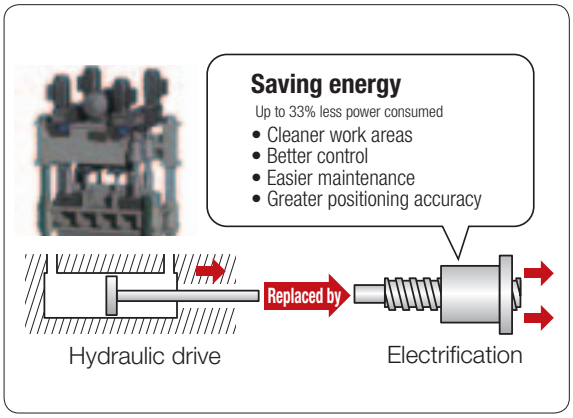
High-Load, High-Speed Caged Ball Screw

Developing technology to ensure customer satisfaction



Key points in product development

- **Enhanced durability, high load-bearing capacity, low noise**
- **Superior environmental performance**



There was rising demand for a High-Load Ball Screw capable of generating thrust by itself. The availability of such a product would make it possible to replace conventional hydraulic drives with electric drives in presses, injection molding machines, and other large machines. Switching to electric drives would provide many benefits: (1) reduced power consumption—up to 33%, (2) cleaner work areas, (3) better control of the machine, (4) easier maintenance, and (5) greater positioning accuracy. When High-Load Ball Screws were first incorporated into injection molding machines, however, problems arose due to damaged balls. With hydraulic units, even if the actuator isn't propelled in a perfectly straight direction, the driving force is still properly transmitted. Because a Ball Screw is a precision component, however, if the load is positioned at an oblique angle the balls won't bear the load evenly, and this is why problems occurred (see the illustrations at right). Occasionally, abrasion caused by contact between the balls themselves also adversely affected the Ball Screw's operation.

To resolve the problems that had arisen and also prevent abrasion from occurring, retainers were inserted between the balls. The product's basic structure was revised to make it far more durable, and the flow of the balls inside the Ball Screw was improved to reduce operational noise. The result was the SBKH High-Load, High-Speed Caged Ball Screw, which is now on the market.

The SBKH Ball Screw is suitable for high-speed applications. By enabling hydraulic drives to be replaced by electric drives, it eliminates the need for hydraulic pumps and various other ancillary devices, along with their power requirements. Thus, the SBKH Ball Screw both addresses environmental concerns and helps reduce costs.

Comments from the developer

Tsutomu Togashi

Research and Development Unit I,
Engineering and Development Department

At the outset the big challenge we faced in developing the SBKH High-Load, High-Speed Caged Ball Screw was striking the right balance between providing high value-added performance and holding down costs in order to end up with a price that would keep our customers happy. As the developer, I found this pretty difficult at first, but we resolved the issues one by one and eventually came up with the product our customers were asking for, and this provided a great sense of fulfillment.