Linear motion (LM) guides are so named because they help to guide the movement of equipment in a straight line. LM guides have become critical parts of machinery because they facilitate gentle, smooth and precise motion by converting a slipping action into controlled motion with a rolling component.

The motion of machinery parts can be divided into two types, linear and rotary. To illustrate using familiar office equipment, the backward and forward motion of the drawer in a desk is an example of linear motion, while the revolution of a swivel chair is a type of rotary motion.

In the early days of machines, all the moving parts—whether the motion was linear or rotary—would come into mutual contact on different surfaces that had to slip over one another. However, due to the considerable resistance caused by friction, such reliance on "slippage" left considerable room for improvement in terms of both the smoothness and speed of motion that could be achieved. The development of rotary bearings approximately a century ago provided a solution to this problem for rotating components by facilitating a rolling action. However, it was not until the 1960s, when the linear bushing was first developed in the United States, that a rolling action was developed to enable slippage-free linear motion for machine parts.

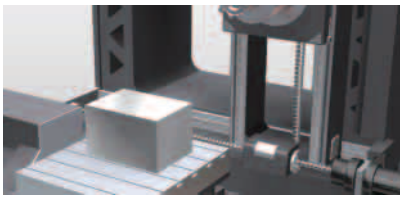
But the linear bushing was not widely adopted by machine tool manufacturers, reflecting its inadequate rigidity and low durability. In 1971, we developed the ball spline, a major improvement on the linear bushing since it overcame the latter's shortcomings. This paved the way for creating a practical solution to introduce a rolling action for linear-motion components. The following year, we successfully adapted the ball spline structure to create the LM guide, which remains our mainstay product to this day.

After machine tool manufacturers in the United States first started using LM guides because of key characteristics such as high rigidity and long service life—both critical for moving parts in machinery—the rate of adoption within machine tools increased rapidly. Today, LM guides are essential components used in various types of capital goods, including machine tools, industrial robots and semiconductor production equipment. In recent years, the range of applications for LM guides has expanded to include consumer-related sectors. Examples include seismic isolation devices, which help to protect people, buildings and household goods from the threat of earthquake, and automotive components that play a vital role in improving vehicle safety and comfort.

The pioneer and leading manufacturer of LM guides, today we retain a leading share of the world market for these products. Our extensive lineup of LM guides is adapted to cater to varied customer requirements.

Linear Motion (LM) Guides

In 1996 THK became the first company in the world to successfully develop the next generation of LM guides featuring caged ball technology. Since then we have striven to expand the usage of these improved LM guides. The ball cages are plastic parts that keep the balls in place and guide them. This stops direct contact between the balls, eliminating noise and friction. Compared with first-generation LM guides, the use of caged ball technology reduces noise, extends service life and enables longer maintenance-free periods. LM guides based on caged ball technology are now vital components of many types of equipment. They have made a major contribution to the development of high-speed, low-noise industrial machinery with longer productive lives, notably in the machine tool and semiconductor production equipment sectors.



LM guide used in a machining center (a type of machine tool)

Application of LM guides and ball screws

LM guides with cage-embedded technology contain belt-shaped ball cages that hold the balls in place while preventing contact between them. This design translates into benefits such as extended service life, reduced noise and less generation of heat and dust, thus reducing overall costs for customers.

Ball Screws

Ball screws are machinery parts that function by causing a large number of balls to circulate between the screw shaft and the nuts. This mechanism of action efficiently converts rotary motion into linear motion. Primarily employed in various types of industrial machinery, ball screws are laborsaving devices that act as drive components in motors. THK has also developed ball screws featuring caged ball technology that have made a significant contribution to the development of high-speed, low-noise industrial machinery with extended service lives, especially in sectors such as machine tools, industrial robots and semiconductor production equipment. Other ball screws supplied by THK are designed to support high loads, making them ideally suited for replacing the hydraulic cylinders used in capital equipment such as injection molding machines, presses, die-cast machines, blow molding machines and extrusion molding machines.

Ball screw used in a dicing saw (for semiconductor production)

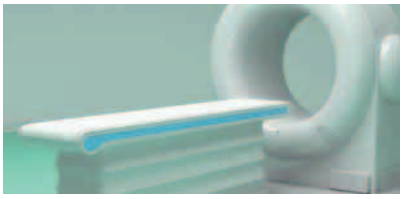
Application of ball screws and LM guides

Ball screws with cage-embedded technology employ ball cages to facilitate higher speeds, longer service life and lower noise levels—all features that are in high demand from customers.

Actuators

Actuators are hybrid products combining a guide component such as an LM guide with a ball screw, linear motor or other drive component. In industries such as electronics, there is an increasing need to shorten development and manufacturing lead-times. Modularization allows actuators to realize benefits such as simplified design and fewer assembly components, thus helping to meet such requirements.

THK supplies a varied lineup of actuators ranging from basic, low-priced units to high-end components designed to operate at high speed or perform to clean-room specifications. Such advanced actuators have become indispensable parts in equipment used in the manufacture or inspection of semiconductors and flat-panel displays.



Actuators are used in medical equipment such as CT scanners.

Application of actuators and LM guides

Integrating an LM guide and ball screw into a single component, LM guide actuators deliver high precision and rigidity within a compact space.

Ball Splines

Developed in 1971, the same year that the company was established, ball splines were the precursor to the LM guide. Balls roll along an R-shaped groove machined into the spline axle. This critical advance boosts the load that the device can tolerate and permits the transmission of torque, resulting in a revolutionary linear-motion system. Compared with conventional linear motion bearings, which do not contain such grooves, ball splines boost the tolerable load by a factor of 13 and service life by a factor of 2,200. Today, ball splines play a number of highly functionalized roles in a variety of machines. Usage examples include industrial robots, medical equipment and chip mounters.

Use in bathing assistance equipment

Application of ball splines

Ball splines are devices in which balls embedded in the spline nut are allowed to move smoothly along a precision-machined groove in the rolling surface of the spline axle. This design creates a linear-motion system that is capable of transmitting torque.

Link Balls

Link balls are specialty bearings that are used primarily as automotive parts. THK has developed a proprietary process for link ball production in which a die-casting process is employed to fabricate holders for the high-precision steel ball bearings that form the spherical surfaces. The shank portions are then specially welded. We use an integral molding process for the aluminum die-cast, which makes the link balls highly resistant to corrosion and wear due to abrasion. They are also considerably lighter than the steel parts traditionally used. Link balls are used widely in automobile undercarriages, particularly in ground-clearance sensors and the joint sections connecting the stabilizers to the suspension. As such they provide an important role in improving safety and comfort on the road. Over the past few years we have begun supplying link balls for an increasing number of vehicle models to leading automakers in Japan, Europe and North America.

Usage in automotive parts

Application of link balls

Use of an integral molding process for the aluminum die-cast produces lightweight link balls that are highly resistant to corrosion and abrasion. These are used widely in vehicle undercarriages.

Cross Roller Rings

Cross roller rings are roller bearings that feature internal cylindrical rollers arranged orthogonally so as to facilitate load bearing in every direction. The incorporation of the spacer cages between these orthogonally arranged rollers prevents roller skew and reciprocal abrasion between the rollers. These rings are highly rigid despite their compact structure. Cross roller rings are used in the rotating parts of many different types of industrial machinery, including the joint areas and swiveling parts of industrial robots, machining center swivel tables, the rotating parts of industrial manipulators and precision rotary tables. Other applications include medical equipment, measuring instruments and equipment for manufacturing integrated circuits.

Usage in industrial robots

Application of cross roller rings

Cross roller rings feature internal cylindrical rollers arranged orthogonally to facilitate load bearing in every direction.