

# The ABCs of Linear Motion Rolling Guides

## Improving System Performance One Application at a Time

Matthew Jaster, Senior Editor

According to the Encyclopedia Britannica (Yes, it still exists), Newton's first law (also known as the principle of inertia) is defined as a body with no net force acting on it will either remain at rest or continue to move with uniform speed in a straight line, according to its initial condition of motion. In fact, in classical Newtonian mechanics, there is no important distinction between rest and uniform motion in a straight line; they may be regarded as the same state of motion seen by different observers, one moving at the same velocity as the particle, the other moving at constant velocity with respect to the particle. Somewhere in this paragraph of scientific innuendo, we find the basic principle of linear motion which is simply motion that occurs in one spatial dimension. Therefore, linear motion rolling guides are simply positioning systems for high-precision, low friction machine motion. When it comes to designing these products, engineers have plenty of options. PTE re-

cently caught up with IKO, Rollon and THK to breakdown the basics in linear motion rolling guides.

### IKO International moves towards miniaturization

As the trend moves toward the availability of smaller and smaller track rails, IKO International prides itself on having a product library of multiple sizes, styles and configurations.

"The industry is moving toward miniaturization," said John Longo, general manager at IKO. "We offer linear guides as small as 1 mm track rail diameter in ball type and 10 mm diameter in roller type. Our C-Lube series starts at 3 mm diameter for ball type and 10 mm for roller type."

The four main features of IKO International's linear motion rolling guides are C-Lube technology, interchangeability, multiple slide unit lengths and materials for harsh environments. Longo said that C-Lube continuously supplies lubricating oil directly to the slide unit's rolling elements



IKO's products have been used in a variety of applications including robotic surgery, medical analysis equipment, automation and life sciences.

and carries it through to the loading area to provide long-term, maintenance-free operation without slide resistance. Interchangeability lets users change out single components without purchasing a new assembly, and they can choose from different accuracy classes, tailor preload settings to their application and prepare for different scenarios.

“Customers can choose from up to four slide unit lengths, depending on the series, with sizes ranging from just 1 mm wide to large versions that provide high rigidity and load capacity. We offer carbon and stainless steel material construction, so our linear rolling guides can be deployed in tough environments. Customers can also specify steel end plates for use in high-temperature or vacuum conditions,” Longo added.

Many of IKO International’s linear guides come with C-Lube technology— a capillary system within the circulation path of the slide unit’s rolling elements. As the rollers within the linear guide circulate, lubricating oil is continuously distributed to the loading area along the track rail. It can extend the re-lubrication interval to several years versus several months.

“As a result, C-Lube guides provide long-term maintenance-free operation. Because C-Lube does not make contact with the track, the guide delivers smooth motion without an increase in the slide unit’s length, cost or its rolling resistance and with minimal elastic deformation under load,” Longo said.

The advantages of using linear rolling guides are many,



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according to Longo. Mainly, this would be considered versus a ball bushing construction. In this regard, the linear rolling guide offers better accuracy, capacity and life for similar or slightly higher pricing. For any applications requiring moderate or better accuracy, linear guides have been replacing ball bushing assemblies for decades for the aforementioned reasons.

And what are the key factors in determining what product will work best for a particular application?

“Consider the operating environment. Do you need



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stainless steel or other construction? If the guide will be used in homes or offices, look for guides made from non-flammable or self-extinguishing materials. If you will be handling a heavy load, look for guides whose slides have cylindrical rollers that have a larger contact area with the rail versus slides with ball bearings. If you require greater design freedom, look for guides with interchangeable parts in which the slide units and track rails can be combined, added or freely exchanged," Longo said.

IKO's products have been used in a variety of applications including robotic surgery, medical analysis equipment, automation and life sciences. "Our miniature linear guides are designed to fit ever-shrinking medical equipment, and many of our guides provide low, uniform sliding resistance over their travel distances to deliver smooth, noise-free motion when deployed near patients," he added.

"NASA's Jet Propulsion Laboratory (JPL) used our LWL miniature motion rolling guide in Mars rover Curiosity's Mastcam—a camera system that captures pictures of the landscape and stitches them together to create panoramic views for navigation and to be sent back to Earth for analysis. JPL selected our LWL miniature motion rolling guide to provide continuously smooth motion for Curiosity's focusing mechanism, made possible by the guide's optimized ball recirculating and ball retaining features. The guides were customized to operate smoothly in temperatures as low as -130°C. Modifications include corrosion-resistant stainless steel materials and end plates along with packaging suitable

for vacuum and cleanroom environments. JPL requires systems and components to be able to operate on their own via remote control for the entire mission. After launching in 2011, Curiosity's two-year mission was extended indefinitely, and it is still operational today!" Longo said.

In the future, rolling guide changes might include reducing mass or adding other coatings. IKO has already achieved miniaturization down to a 1 mm rail width for up to four different slide unit lengths, depending on the series being used as previously mentioned. How much smaller these components get will depend greatly on the applications they will be required to operate.



### Rollon Puts an Emphasis on Design

The more things change the more they stay the same. This can also be applied to rolling guides.

"Over the last 15 years the evolution of the high precision linear guides has not really changed," said Scott Spangler, distribution manager at Rollon Corporation. "The load capacity has been maximized due to ball conformity, cleaner steel, and envelope size. Sealing has been optimized

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The cost of effective use of linear guides starts in the design stage. As Lean Design takes on a larger role within the entire design cycle it becomes imperative that engineers design a cost effective machine to the requirements of their customer.

and aside from adding additional seal accessories, we have just about maximized the amount of debris that can enter the bearing. Relubrication has been optimized to the point where the bearing will fail of other means before running out of lube. All of these factors theoretically increase the life of the bearing, but unfortunately most bearings don't fail because of fatigue, they fail because of misalignment. Until Lean Engineers push the fact that a high precision bearing in a medium precision application will cost the customer tons of money downhill, the compliant linear bearing will not be the "new technology" linear guide."

Rollon provides customers with a compliant linear guide (the Compact Rail), in the range of 10x more compliant than the standard profile rail guide. This compliancy allows the machine builder to reduce cost in machining, assembly time and overall machine design. The feature of the guide allows for misalignment of 4 mm along the linear axis while retaining a stiff and accurate running system.

"The rotary bearings within the carriage are lubed for life. The rolling elements are much larger than the balls in a profile rail guide. So they are much less sensitive to any debris that finds its way to the raceways," Spangler added.

When dealing with automation type applications, the load is typically light (<200 pounds) and accuracies above 200 microns. "There is no reason to use a high accuracy profile rail guide that handles 5,000 pounds and ground to microns of accuracy. If you do, you now need to mount the rails within 25-50 microns of each other. This requires machining of the mounting surfaces, shimming during assembly, and a very rigid mounting structure. All of this costs the machine builder thousands of dollars and is totally unnecessary. The cost of effective use of linear guides starts in the design stage. As Lean Design takes on a larger role within the entire design cycle it becomes imperative that engineers design a cost effective machine to the requirements of their customer. To keep machine costs low, maintenance at minimum and field failures out of the picture, the market must turn away from the profile rail guide and look at more compliant linear guides such as the Compact Rail," Spangler said.

Rollon's guides have been utilized in a variety of areas including machine tools (part loaders, tool changers, machine doors), logistics (automated warehousing, transfer

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systems, automated storage and retrieval systems), factory automation (packaging, assembly, sorting, pick and place, palletizing) and medical applications (scanning equipment, specimen testing, hazardous handling).

In the future, due to new materials and coatings, Spangler says that these rolling guides will find themselves in more food handling and washdown applications.

### THK Invests in Future Linear Motion Growth

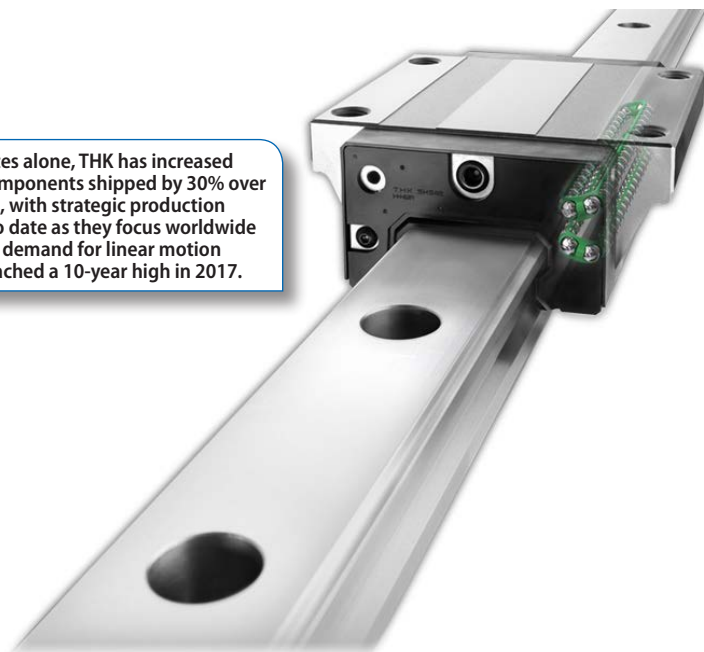
THK is taking major steps to meet the growing worldwide demand for linear motion products. In fact, THK has recently invested over a half-billion dollars in new brick and mortar facilities that will increase floor space for their global manufacturing operations to just under 10.5 million square feet. In the United States alone, THK has increased the number of components shipped by 30% over the last two years, with strategic production increases made to date as they focus worldwide to keep up with a demand for linear motion products that reached a 10-year high in 2017.

Orders for linear motion guides, components that enable machine tools to perform precise positioning operations in industries that include aerospace, machine tool, packaging and medical, increased by 31.6 percent in 2017. This figure far surpassed the industry forecast of 8 percent and late in the year supplies began to tighten as demand for these vital manufacturing components exceeded production capacity. THK, the company that first commercialized linear motion technology in 1972, took a strategic look at how to work expeditiously to fill existing orders and to positively address the long-term need to expand manufacturing to satisfy customer orders.

Committed to investing in the future, THK is expanding production with a capital investment of over a half-billion dollars at manufacturing facilities in Yamagata, Japan, and in Vietnam and adding a 366,000 square foot facility in India. This will increase THK production by an additional 30 percent once all expansions are fully in place. To enable increased production while maintaining a high standard of precision and accuracy associated with their products, THK is also automating processes at existing facilities, including at their U.S. manufacturing plant in Ohio. To assist in meeting customer demand for linear motion products, THK has further invested in research and development of its industry-leading LM components as well as in human resources. The company has grown from around 9,000 employees in 2014 to over 13,000 in 2017.

According to Statistics MRC, the Global Linear Motion Systems Market is expected to grow significantly through 2026. Factors for this growth include rising revenue from replacement activities, a high demand for linear motion systems in the automotive industry and the rapid industrialization in emerging countries. However, lack of effective product differentiation is one of the major factors hampering the market growth.

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Linear motion systems consist of linear rail, rail tables, guides, and actuators, sliders, which help the manufacturing facility to continuously transfer products in a conveyor belt, or push it across for packaging. By application, linear motion systems find significance across different applications in material handling such as palletizing, packaging, pick and place, sorting, and the transportation of goods. The deployment of linear motion systems in this application delivers agility and seamless processing, thereby reducing maintenance requirements.

By geography, Asia Pacific is expected to grow at a significant rate due to rise in industrialization in the emerging countries like China, India, Taiwan and South Korea. Further, the demand for linear motion systems is supported by the development in automation solutions and robotics in this region. These emerging technologies will determine how successful rolling guide applications will be in the future. **PTE**

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