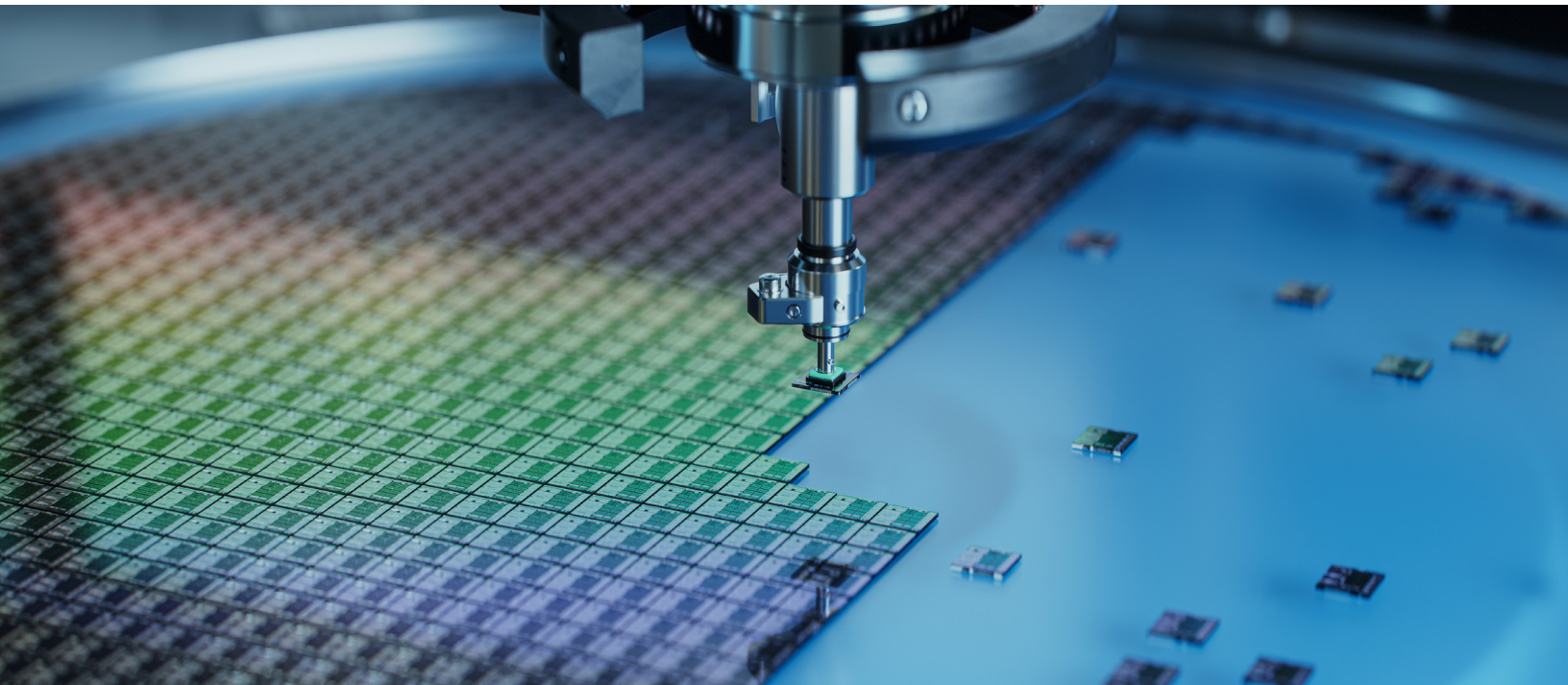# Repeatable High-Precision Positioning for Cutting-Edge Applications

When dynamic equipment calls for precise motion control with rapid response in a small envelope, linear motor positioning tables offer an effective combination of advanced features.

Although many suppliers of motion control devices offer miniature or high-accuracy positioning tables, they may not provide all the features today's innovative production systems demand. Linear motor-driven positioning tables are well-suited for load-carrying applications in semiconductor, LCD/OLED manufacturing and other applications that require high accuracy and fast response in a small size. In order to be sure you obtain the high precision and performance your space-constrained application needs, it is important to select a linear positioning table with the following advanced features:

- **High accuracy and repeatability.** As parts and workpieces get smaller, manufacturing equipment demands precise and repeatable running straightness and attitude accuracy to achieve nano-scale positioning. For example, an unusable semiconductor wafer can cost several hundreds of thousands of dollars. Positioning tables with an integrated optical linear encoder for feedback create a closed loop positioning system that allows for corrections when necessary, ensuring exceptionally high positioning repeatability.

- **Compact size.** Not only are machine designs getting smaller, they also require lightweight components with a low sectional height.

IKO INTERNATIONAL, INC.   91 Walsh Drive, Parsippany, NJ 07054 | 800.922.0337 | www.**ikont**.com

- **Choice of axis configurations.** Dynamic applications may call for various configuration possibilities across different axes.

- **High thrust force for fast response.** Not only should your positioning table be able to operate at high speeds, it must respond to rapid changes in motion with accuracy. High thrust forces enable faster acceleration and deceleration rates and deliver high response.

- **Stable velocity.** The table design should mitigate static friction-inducing resistance and include integrated components that help ensure smooth motion.

- **Less mechanical components.** Moving parts can create microsecond delays that can hinder accelerations and decelerations, resulting in slower cycle times and lower productivity. They also create unwanted particles. Linear motor-driven positioning tables are typically designed with fewer moving parts compared to ball screw-driven types. Consequently, linear motor-driven positioning tables generate fewer particles resulting from motion.

- **Clean.** A growing number of linear motion devices are being deployed in laboratory and cleanroom applications where particle-generating parts and certain lubricants are not permissible.

Fortunately, designers of semiconductor equipment as well as a wide range of automated manufacturing and dynamic applications can now find all these characteristics in a series of compact linear motor positioning tables. For example, IKO's NT Nano Linear Series leverages an integrated direct drive linear motor and a high-resolution linear encoder to deliver exceptional positioning accuracy. It also includes built-in, high-strength neodymium magnets whose properties deliver a large thrust force that enables high speeds, and large accelerations and decelerations for exceptional response.

Additional performance attributes include:

- Attitude accuracy of 5 arcseconds or less.

- Maximum thrust of 36N for single-axis tables.

- Maximum thrust of 70N for multi-axis tables.

- Repeatability of ±0.5 µm or ±0.1 µm.

- Running accuracy of ≤1 µm.

- Step-size resolution from 0.5 µm to 0.01 µm.
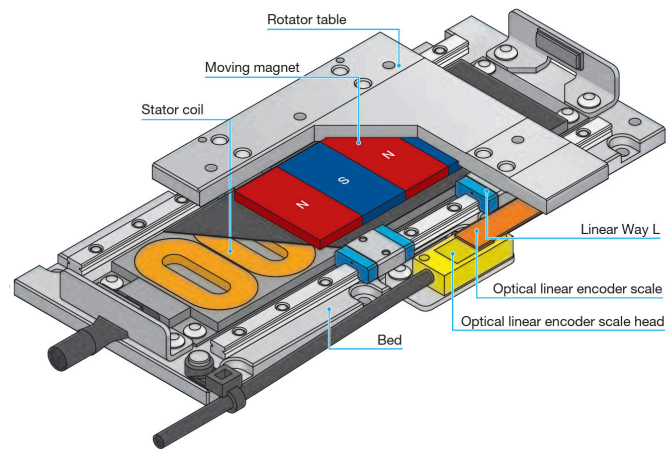
Cutaway of an IKO NT Series linear motor table with moving magnet and optical linear encoder.

The table is arranged to optimize positioning accuracy and response. Here's how: The optical linear encoder scale is mounted on the moving table, and the optical linear encoder reading head is attached to the bed. This eliminates dragging cables that could impede motion, lead to wear or generate unwanted particles that can otherwise contaminate a clean environment. The slide table has a very low mass, which enables faster acceleration and deceleration. In addition, the linear motor and high-resolution encoder can work in conjunction with an IKO linear bearing system or an IKO non-recirculating crossed roller way with an integrated rack and pinion gear set that combats cage creep.

The family comes in a variety of sizes, including units that are particularly suited for ultra-compact applications. For example, the smallest standard unit — the NT...V Series — is only 38 millimeters wide with an 11-elimimeter sectional height and a 62-millimeter overall length that allows for a 10-millimeter stroke. To maximize thrust, two NT...V Series units can be arranged in parallel along with a single driver, which also minimizes table delay and flame torsion for stable attitude and positioning accuracy at a lower cost than a two-axis synchronization system. Axis configuration options include horizontal, vertical with spring balance, X-Y or an integrated Y-Z axis. Additionally, single-axis tables can be combined to achieve custom multi-axis solutions.

Application Successes

In semiconductor manufacturing, for example, complex chip designs and nanometer-scale processes make defect detection and proper wafer placement increasingly challenging. Although cutting-edge optical and X-ray components are invaluable in addressing these wafer inspection challenges, imprecise positioning can cause measurement results to vary. However, a properly specified linear motor positioning table can deliver reproducible running accuracy and excellent speed stability.
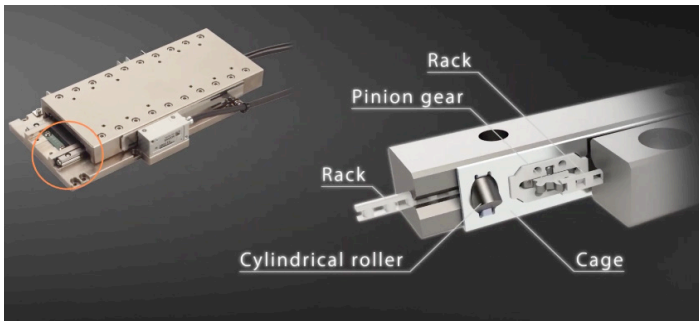
An anti-cage creep crossed roller way is used as a table guide to provide high attitude and running accuracy for optical components used in wafer inspection systems.
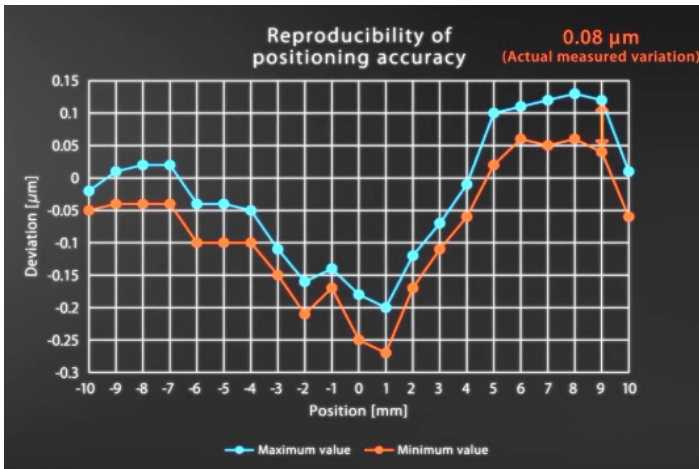
The NT...H Series linear positioning table offers a positioning accuracy of 1 µm or less, and when tested to a maximum measured variation in three bi-direction strokes, exhibited 0.08 µm reproducibility of positioning accuracy.

An NT...H Series linear positioning table, designed with IKO CRWG Series anti-cage creep crossed roller bearings acting as the moving table guide, can be used horizontally as the moving part of the optical inspection system. The CRWG limited stroke linear motion guide is characterized by cylindrical rollers arranged orthogonally to accommodate loads in all directions to provide high rigidity, minimal friction and quiet motion. This combination — with 5-arcsecond attitude accuracy, ≤1 µm running straightness and ±0.1 µm repeatability — is more than capable of handling even the slightest attitude changes that often occur in optical inspection systems associated with semiconductor manufacturing equipment.

Here are some examples of successful applications using NT Nano Linear positioning tables:

- **Hard disk drive manufacturing.** Manufacturing a single hard disk drive can involve thousands of complicated steps for a complete assembly build, not including extensive quality control measures, to ensure precise, error-free production. One of the world's largest hard disk drive (HDD) manufacturers designed an NT Nano Linear table into an inspection system to focus a camera that detects manufacturing errors that would otherwise lower yields.

Because the manufacturer wanted a means to operate the table in a vertical axis with the same carrying mass capability as the horizontal plane, we outfitted the left side of the table with a special balancing spring so they could change the X-Y axis to a Z, if needed. We also furnished the built-in linear guide's slide unit with a pre-packaged soft, lithium soap-thickened, light-viscosity synthetic hydrocarbon grease at the rolling element for long-lasting clean lubrication.

The result: a highly precise, yet compact positioning table that's an integral part of the HDD production system, customized for vertical use, low maintenance and optimal performance in an application that can't tolerate inaccuracy or any type of disruption.
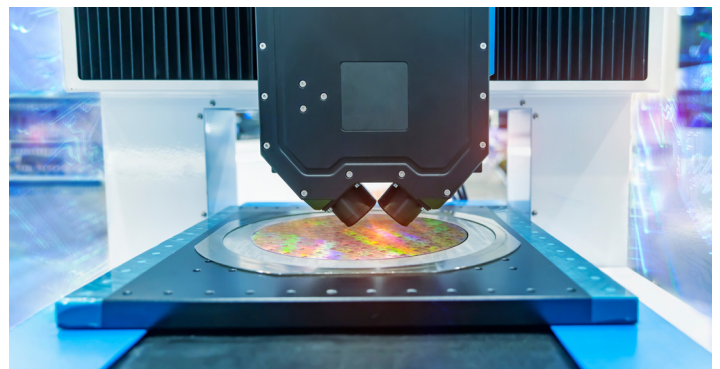
NT Nano Linear positioning tables deliver reproducible running accuracy and excellent speed stability for optical wafer inspection equipment.

- **Wafer inspection system.** Because ruined wafers come with a high cost, a leading manufacturer of wafer defect inspection and metrology equipment uses an NT Nano Linear positioning stage to manipulate optical and X-ray components inside a new system that measures register marks on wafers so they can be stacked and precisely aligned. The optics inspect the wafers for critical dimensions and film thickness while also identifying potentially damaging defects before the deposition and etching processes. An NT55V Nano Linear positioning table met their requirements and is now performing optimally in the field. In fact, the customer is considering two IKO linear components for a redesign of this successful inspection tool.

- **Other Applications.** NT Nano Linear positioning tables are well-suited for any industrial or laboratory positioning applications requiring high-precision within a confined space, such as:

  - **LCD manufacturing.** Many of the same techniques used in semiconductor manufacturing are used to manufacture LCDs and present the same high-precision motion control requirements. Precise positioning is essential when laminating glasses or films to LCD panels.

  - **Pick-and-place assembly.** The NT Nano Linear Series' exceptionally high thrust force specifications enable the rapid accelerations and rapid decelerations that are critical for pick-and-place operations. Monitoring software programs the NT Nano Linear unit to manage changing operation patterns and strokes. Ultra-thin designs are also achievable per the series' low section height.

  - **Micro machining.** Micro-level parts production requires the sub-micron-level accuracy that NT Nano Series positioning tables provide.

  - **Medical.** The NT Nano Series has been used in cell collection equipment in the pharmaceutical industry, laser scanners for refractive surgeries as well as various medical robots.

LCD manufacturing and pick-and-place systems are ideal applications for precision linear motor positioning tables.

Demanding Applications Require Advanced Features

Today's automated and dynamic applications demand increasingly advanced features and capabilities like high speed, fast cycle times and response, repeatability, running straightness, velocity stability, space savings and more. IKO International's NT Nano Linear Series positioning tables deliver all these features to ensure you attain the most precise linear motion possible for your space-limited, high-performance application.

For more information about IKO International's NT Nano Linear Series direct drive motor positioning tables, visit www.ikont.com.