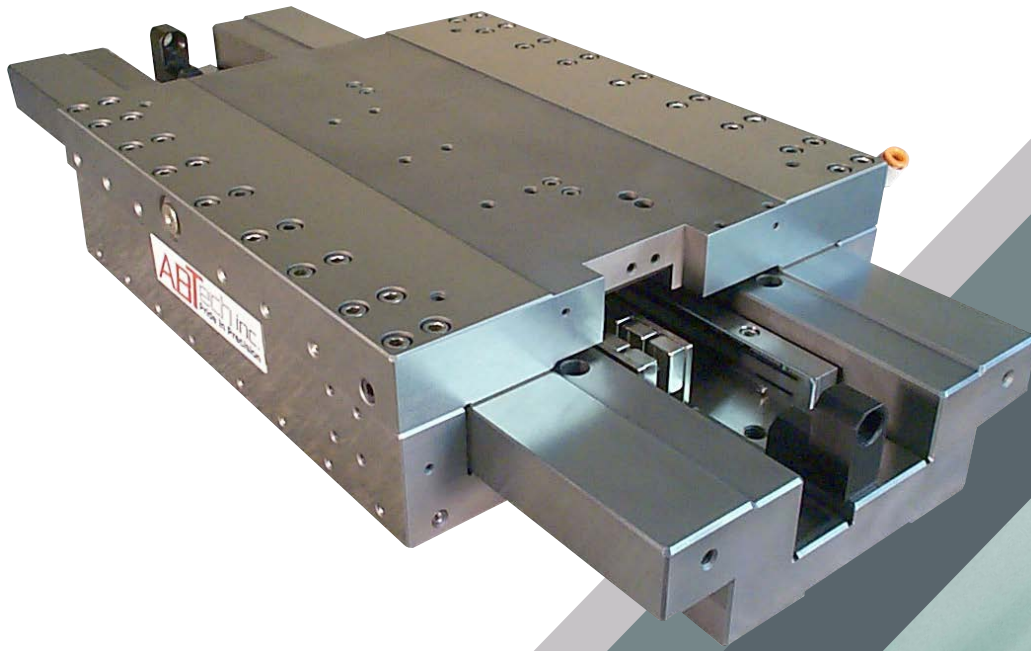


WHITEPAPER:

Selecting the Right Linear Stage

Advancing Application-Specific Precision



LINEAR STAGES

Linear stages are at the heart of precision motion control, enabling critical advancements in industries from **aerospace and optics** to **semiconductor and metrology**. Yet, not all linear stages are created equal. Depending on the application, different technologies—**air-bearing**, **oil hydrostatic**, or **mechanical linear stages**—offer distinct advantages.

In many advanced manufacturing environments, a project may have different demands and **application-specific** requirements:

- Ultra-smooth, frictionless motion for nanometer-level alignments
- Heavy-load capacity and ultimate stability for grinding or assembly
- Compact, cost-effective precision for inspection or multi-axis positioning



This paper outlines the unique benefits of each stage type, illustrating how they can be applied individually or in combination to create tailored, **application-specific** solutions.



THE ABTECH APPROACH

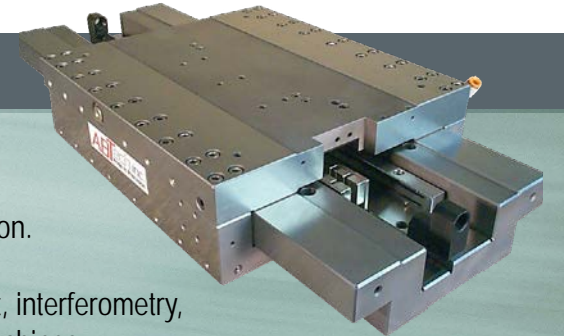
*"ABTech engineers partner with each customer to analyze their application, develop key specifications, and leverage from **ABTech's** existing portfolio to create optimal linear stage solutions."*

- Chris Abbott, ABTech Chief Operations Officer, on what sets ABTech apart

Air-Bearing Linear Stages:

Frictionless Accuracy

- **Strengths:** Sub-micron accuracy, zero wear, maintenance-free operation.
- **Ideal Applications:** Semiconductor wafer inspection, optical alignment, interferometry, surface metrology, ultra-precision machining, grinding and polishing machines.
- **Why It Matters:** In environments where even the smallest mechanical disturbance compromises performance, air-bearing stages provide unmatched smoothness and repeatability, ensuring long-term stability.



Oil Hydrostatic Linear Stages:

Stiffness Under Load

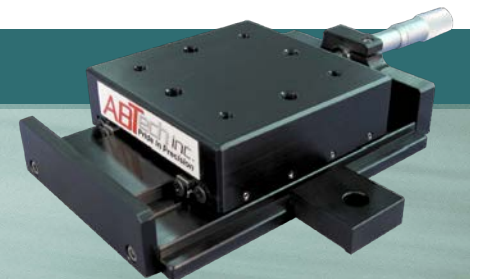
- **Strengths:** High load capacity, high stiffness, thermal stability.
- **Ideal Applications:** High-performance machining, including fly-cutting and grinding machines, heavy duty assembly and automation.
- **Why It Matters:** Oil hydrostatic designs maintain sub-micron precision even under tons of force, allowing industries to combine accuracy with productivity in demanding machining environments.



Mechanical Linear Stages:

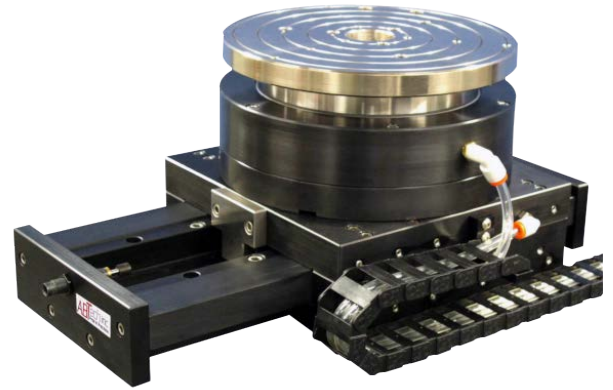
Compact Versatility

- **Strengths:** Cost-effective precision, compact footprint, high stiffness.
- **Ideal Applications:** Multi-axis inspection systems, positioning fixtures, assembly stations.
- **Why It Matters:** For inspection and light-to-medium duty tasks, mechanical stages offer repeatable accuracy at lower cost, making them an efficient choice in multi-axis configurations.



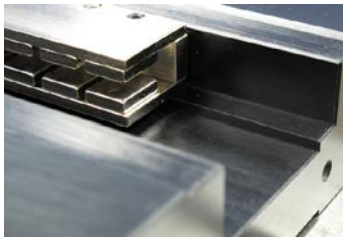
APPLICATION-SPECIFIC INTEGRATION

No single linear stage technology can address every requirement, but together they create a various options that round out **ABTech's complete toolkit**:

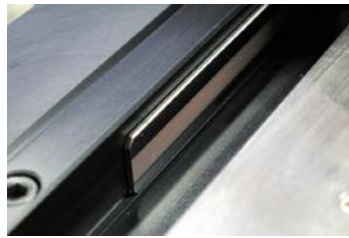


- **Air-bearing stages** deliver the smoothest motion for delicate, high-resolution measurement.
- **Oil hydrostatic stages** ensure precision is not lost under heavy forces or during aggressive machining.
- **Mechanical stages** offer reliable, cost-effective precision in compact systems.

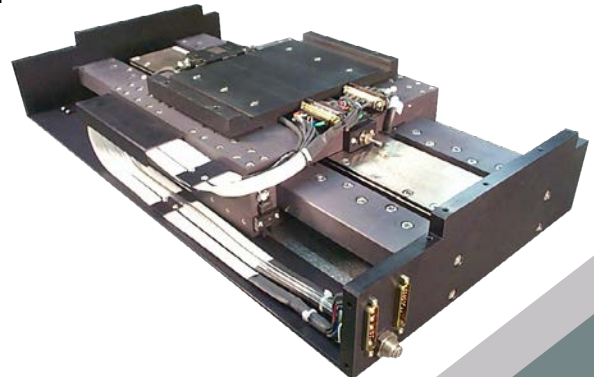
By carefully evaluating application needs—accuracy, load, footprint, and cost—engineers can integrate the right stage or combination of stages into custom solutions. The result is a motion system that is not only precise but also optimized for long-term performance and efficiency.



Motor close-up



Encoder close-up



Conclusion

Linear stages are not interchangeable components but **specialized technologies**, each excelling in a specific domain of performance. Choosing the right stage, or designing systems that leverage multiple stage types, allows manufacturers to meet the exact demands of their application.

At **ABTech**, our engineering philosophy centers on building **application-specific solutions**, using the full range of **air-bearing, oil hydrostatic, and mechanical linear stages** to achieve unmatched results.

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