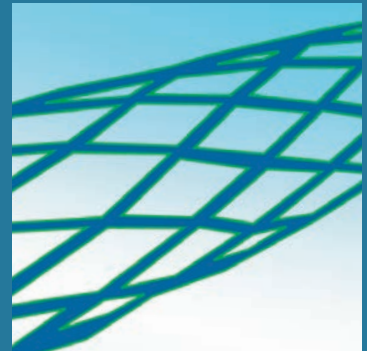
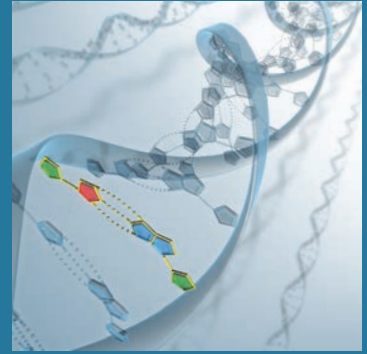




*Dedicated to the
Science of Motion*

Automation Solutions for Medical Device Manufacturing and Life Sciences

- *Stent Cutting • Cardiac Pacemaker, Defibrillator, and Neuro-Stimulation Seam-Welding Systems*
- *Guidewire, Catheter, and Hypotube Manufacturing*
- *Intraocular and Contact Lens Manufacturing*
- *DNA Sequencing • CAT Scanners • Proteomics*
- *Magnetic Resonance Scanners*
- *Oncology • Surgical Staples*
- *Retinal Inspection*



Aerotech Worldwide

United States • France • Germany • United Kingdom • Japan • China



www.aerotech.com

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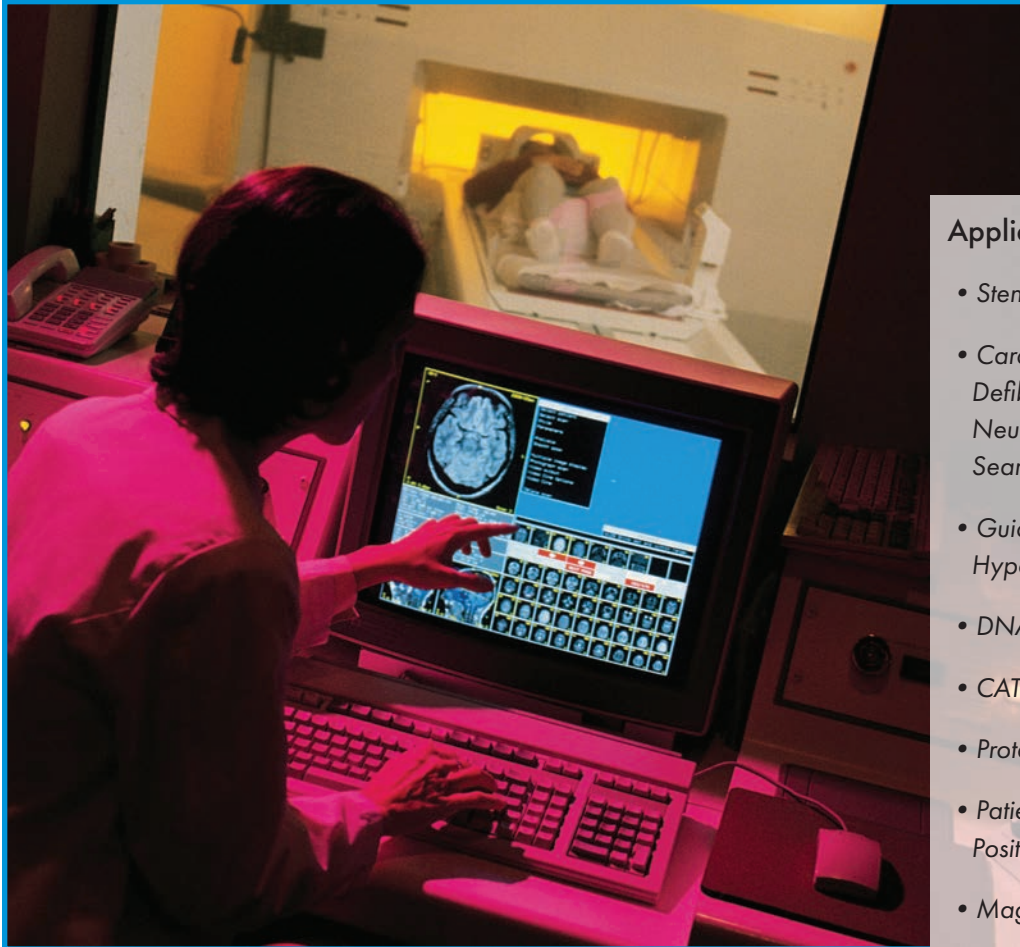
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Aerotech Success in the Medical Device Industry



Applications served:

- *Stent Cutting*
- *Cardiac Pacemaker, Defibrillator, and Neuro-Stimulation Seam-Welding Systems*
- *Guidewire, Catheter, and Hypotube Manufacturing*
- *DNA Sequencing*
- *CAT Scanners*
- *Proteomics*
- *Patient and X-Ray Source Positioning*
- *Magnetic Resonance Scanners*
- *Oncology*
- *Surgical Staples*
- *Intraocular and Contact Lens Manufacturing*
- *Retinal Inspection*

Advancements in core technologies such as electronics, software, and imaging have continued to drive the development of new medical devices and diagnostic procedures. The growing complexity of these devices and stringent FDA validation procedures require precision automation components and systems to ensure consistent, repeatable results. Likewise, the costs associated with supporting the infrastructure and integration of these systems into specialized cleanroom manufacturing environments require solutions with the highest possible output per square foot of production space while limiting maintenance and downtime.

Aerotech is uniquely positioned to meet the stringent requirements of the medical industry. Our standard motion products can be configured to meet most automation requirements, with proven reliability demonstrated by sales into the medical field since 1970. Application specific optimized solutions, such as our stent cutting and hermetic sealing solutions, are available that can demonstrate up to a 5x improvement in throughput over conventional approaches, providing a lower total cost of ownership and maximizing your return on investment.

Solutions For Stent Manufacturing

VascuLathe represents a revolutionary approach to satisfying the demanding requirements of stent manufacturing applications. The fully integrated motion system couples automated material handling functionality with high performance direct-drive linear and rotary motion capability. The integral linear-rotary design increases throughput by two to five times when compared to traditional screw-based or other manufacturing approaches, while still maintaining submicron tolerances on tight part geometries.

The increased throughput gives much needed flexibility in the extremely competitive stent-manufacturing environment. The higher throughput of the VascuLathe implies that fewer machines are required to produce an equivalent number of stents when compared to traditional manufacturing approaches, resulting in lower total labor costs and reduced floor space requirements. Alternatively, the VascuLathe can be used to meet increased and varied product demand within the existing manufacturing space, saving the costs associated with facility expansion.

- 1 Stainless roll covers protect bearings and feedback from contamination
- 2 Optional wet cutting with coolant return
- 3 Integral frictionless rotary union optimized for stent manufacture provides a lifetime of maintenance-free operation
- 4 Simplified, reliable cable management system ensures trouble-free operation
- 5 Precision ER16, ER25, or ER40 collets support 0.5 mm to 30 mm O.D. tubing, enabling the VascuLathe to support the manufacture of a wide array of peripheral, cardiovascular, and neurovascular stents
- 6 Parallel jaw gripper for automated advance of tubing material
- 7 Manual alignment fixture with precision reference surface and locating pins for rapid replacement of bushing material
- 8 Lower material centerline reduces machine height and fixture sizes giving a lower profile, more rigid system
- 9 Sophisticated machine structure facilitates easy alignment, maintenance, and operation
- 10 Threaded tooling areas located at the front and back of the VascuLathe ease integration of custom material handling features



U.S. Patent 7,038,334
U.S. Patent 7,105,956
U.S. Patent 7,420,298



Highly advanced drive technology results in



Future-proof software-only control and network architecture (FireWire®)

Special software programs assist in product changeover

The VascuLathe features Aerotech's Automation 3200 controller (A3200), a 100% digital automation platform. The A3200's advanced control architecture has special path planning functionality that automatically adjusts the cutting speed to minimize path errors in tight stent geometry, maintaining form quality throughout the part. Sophisticated laser control functions automatically adjust the laser power and repetition rate to minimize the heat-affected zone of the material as a function of the cutting speed. Specialized drive electronics are optimized for the frequent direction reversals encountered in a typical stent profile and help to further minimize following error. Advanced plotting and diagnostic tools display axis performance in real time and process monitoring functions report peak position error, path cut length, and stent cut time at the completion of each part, providing an instantaneous measure of part quality on a piece-by-piece basis.

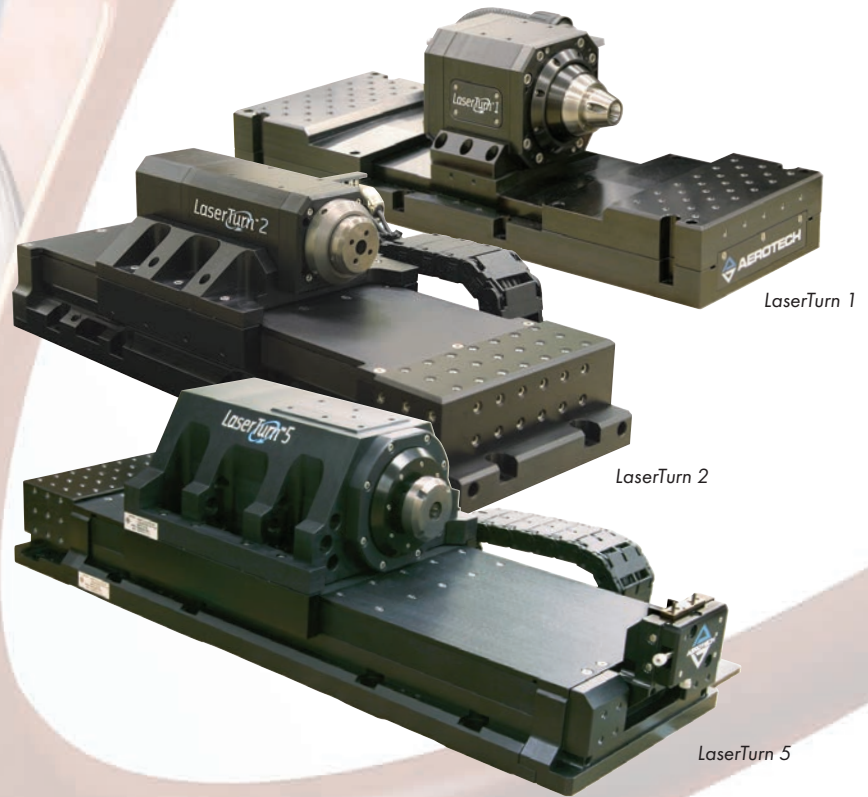


Vasculathe DS uses a dual spindle configuration to produce twice the output of the standard Vasculathe. For a 10% increase in space (approximate finished machine size) the DS provides a 100% improvement in capacity, further reducing floor space, facility, and manpower requirements. The Vasculathe DS is also very effective at increasing throughput for processes that are intrinsically slow due to laser power or material processing limitations.

Solutions For Stent Manufacturing

The LaserTurn series provide a lower cost entry point for stent manufacturing applications. The systems have similar automated material handling capabilities as the Vasculathe, but they do not supply the same level of dynamic contouring accuracy and acceleration. The LaserTurn products are targeted at lower speed cutting processes, stent inspection, and drug deposition applications.

Optional front and rear tooling platforms support attachment of specialized part fixtures. A gripper option is available for automated tube advance with a manually adjusted Y/Z bushing holder to center the material under the laser cutting head.



LaserTurn 1

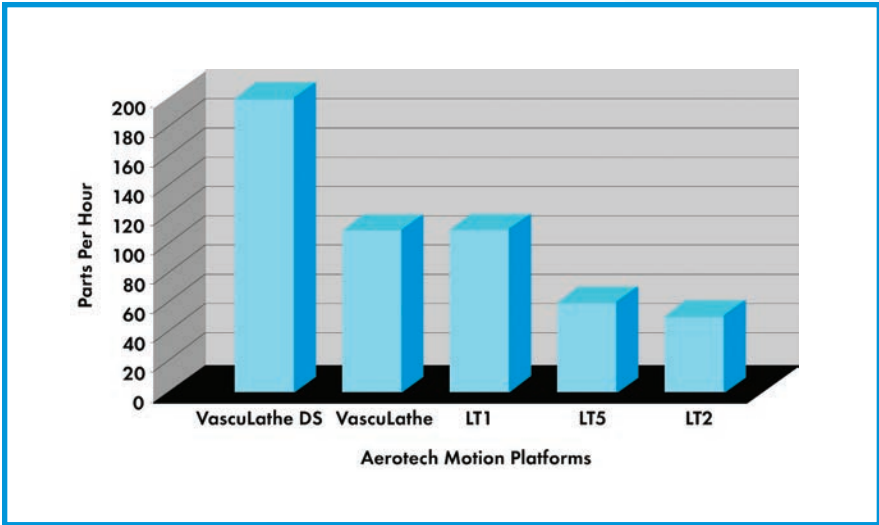
- Tube capacity from 0.1 mm to 7.9 mm
- Combined low inertia rotary axis and low mass moving stage provide the highest throughput in the LaserTurn series
- Collet system with moving taper design limits axial tube motion for unattended manufacturing of unlimited length parts
- Wet cutting option available to limit backwall and thermal damage to the material under process

LaserTurn 2

- Tube capacity from 0.5 mm to 10 mm
- Highest torque to inertia ratio in the LaserTurn series reduces processing time in complex contours
- Low TIR ER collet system minimizes mechanical positioning induced errors during the laser cutting process
- Wet cutting option available to limit backwall and thermal damage to the material under process

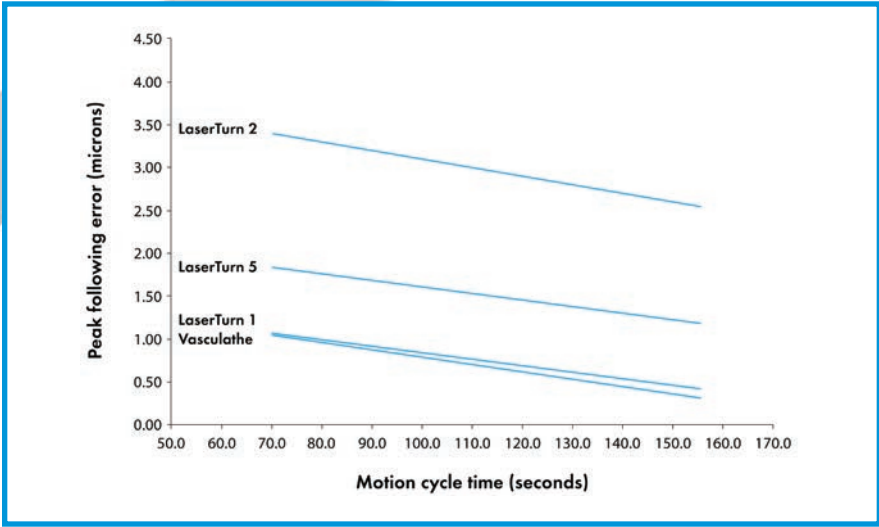
LaserTurn 5

- Interchangeable ER25 and ER40 collet system provides the widest material handling range of the LaserTurn series (0.5 mm to 30 mm)
- Optional 3-jaw gripper for inside gripping of large diameter materials or for handling odd-form components
- Largest linear motor in the LaserTurn series for high duty cycle, high load applications
- Wet cutting option available to limit backwall and thermal damage to the material under process



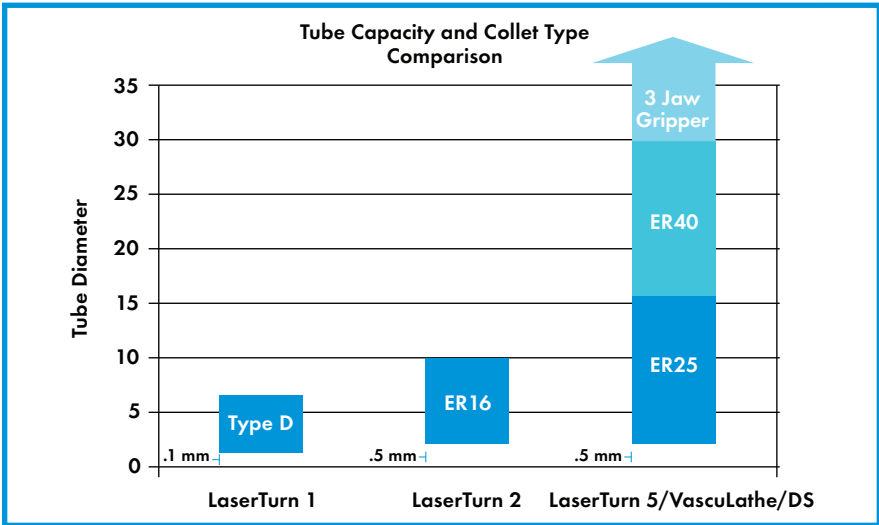
Normalized Parts Per Hour (With Equivalent Tolerance)

For a given part manufacturing tolerance the VascuLathe produces three times as many parts per hour when compared to the entry-level LaserTurn 2.



Part Accuracy Versus Cycle Time Comparison

When cutting speeds and cycle times are fixed by process variables, the VascuLathe and LaserTurn 1 can provide a 3X improvement in contour accuracy.



Configuration Options:

- Front and rear tooling platforms for easy integration of material handling
- Pneumatic activated, seal-less rotary union provides years of maintenance-free operation
- Parallel jaw gripper for automated tube advance
- Bushing alignment platform with Y/Z micrometer adjustment reduces tube TIR at the cut point

Solutions For

General Cylindrical Processing

Guidewires, Catheters, Cannulae, Hypotubes, and Endoscopes

Many medical devices and diagnostic tools are fabricated from tubular materials that can have multiple features integrated along their length. For example, a hypotube may have a skive or slot on the distal end to facilitate the placement of components such as balloon catheters, and will have a spiral or interlaced pattern cut along the length for flexibility and directional control when inserted into the body. Endoscopes have intersecting, welded, cylindrical features for camera and control ports and irrigation features for clear viewing through the device. All of these products require precise angular positioning and velocity control during the manufacturing process to ensure consistent, repeatable performance of the finished component.

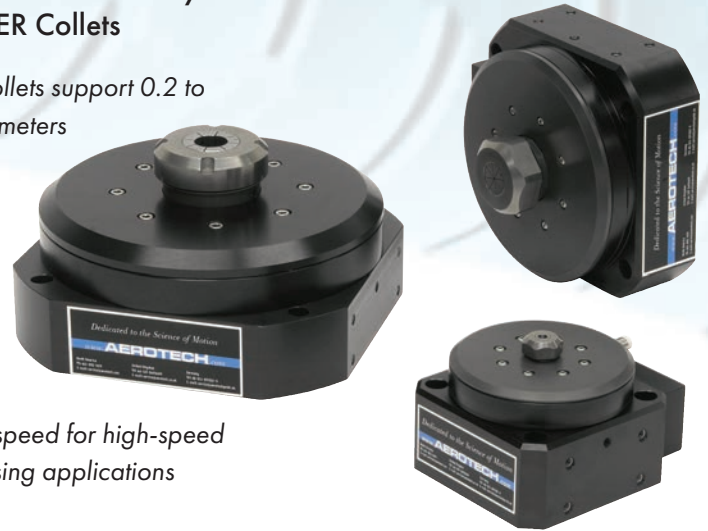
Featuring/Recommendations:

- A3200 or Ensemble motion controller
- Rotary axes with integral pneumatic collet adapters and 3-jaw grippers (ACS, ACS LP)

Low Profile, Direct-Drive Rotary Stages Feature ER Collets

- Air-activated collets support 0.2 to 30 mm tube diameters
- Direct-drive motor replaces worm-drive mechanisms for maintenance-free operation
- 600 rpm peak speed for high-speed material processing applications

ACS LP series



ACS with 3-jaw gripper

3-Jaw Grippers

- Clear aperture for product feed-through
- Optional jaw travel range to optimize gripping force or material capacity
- Custom jaw profiles can be created to grip odd-form products or set the depth of grip



LaserTurn 5 with 3-jaw gripper



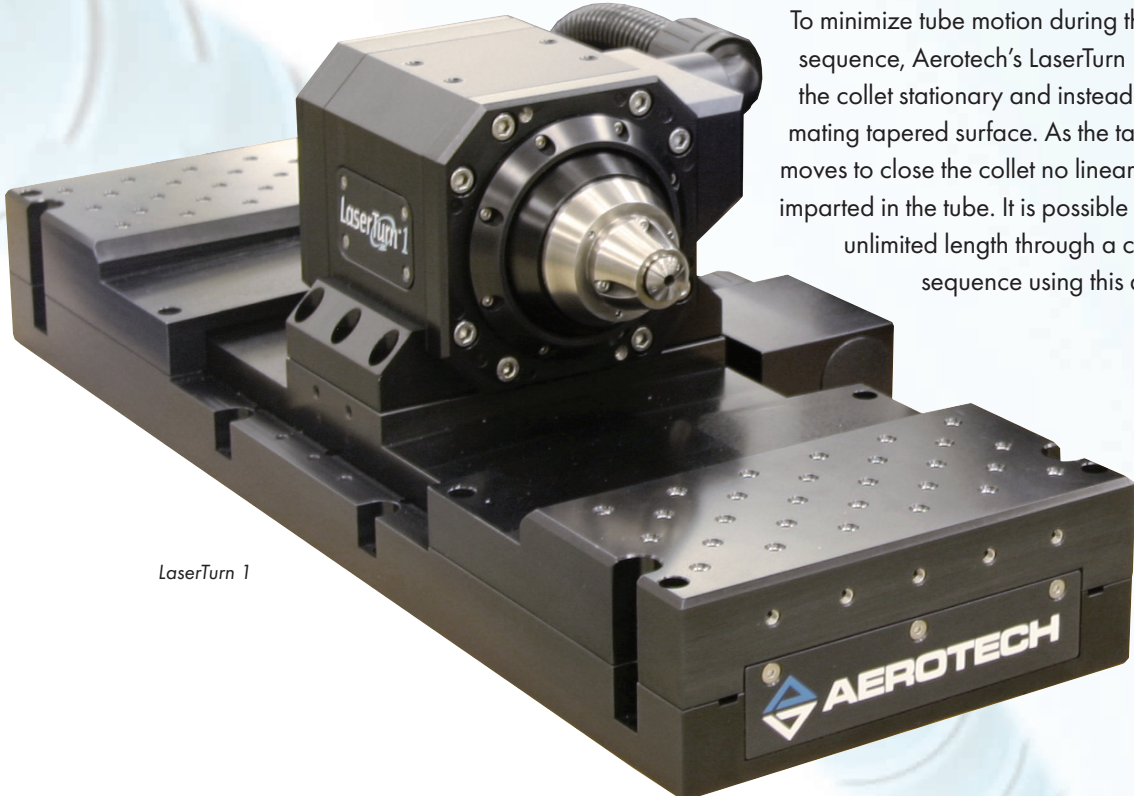
CCS Mechanical-Bearing Direct-Drive Rotary Stage

- Integral pneumatic collet chuck
- Captive collet design minimizes axial tube motion during clamp/unclamp cycles
- Clear aperture for product feed-through

Captured Collet Systems

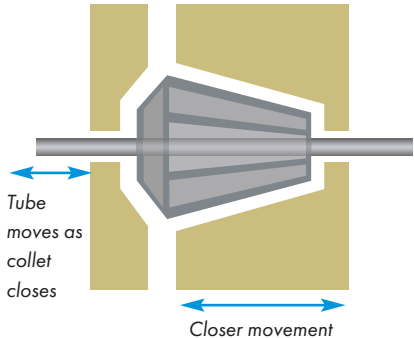
Captured collet systems have threads on the end of the collet that are used to fix the collet to the closing system. In most machine tools this type of collet is threaded into a “draw-bar” mechanism that moves the collet against a mating tapered surface to open and close the device. As the collet is closing, this motion can result in displacement of the material in process. The amount of movement varies depending on the distance the collet must close before engaging the material.

To minimize tube motion during the open/close sequence, Aerotech’s LaserTurn 1 system keeps the collet stationary and instead moves the mating tapered surface. As the tapered surface moves to close the collet no linear motion is imparted in the tube. It is possible to make parts of unlimited length through a cut-index-repeat sequence using this approach.

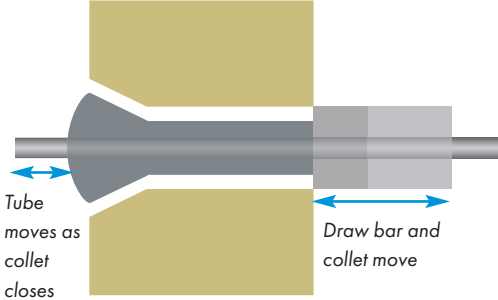


LaserTurn 1

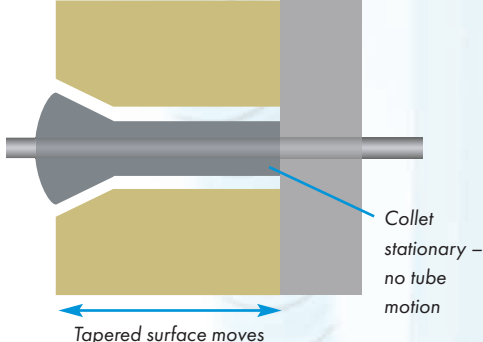
Floating ER Collet



Captured Collet with Draw Bar



Captured Collet – LaserTurn 1



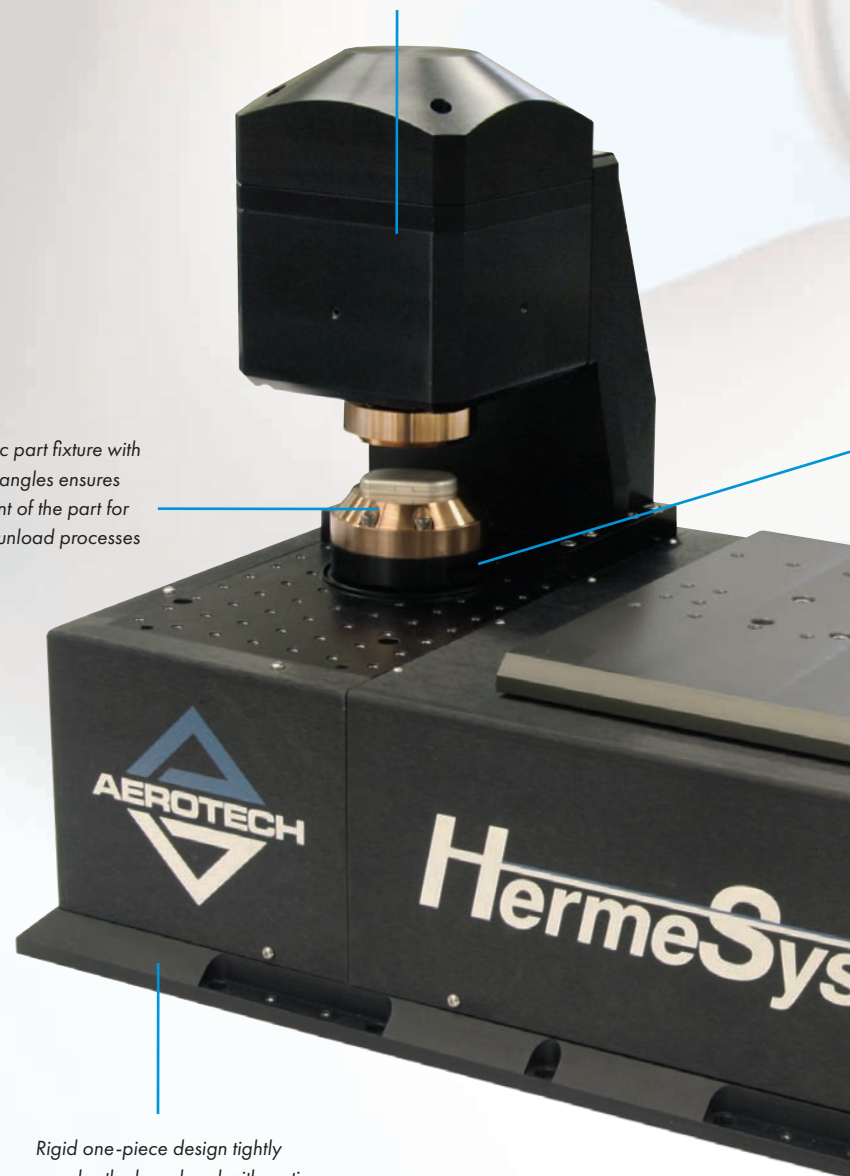
Solutions For

Hermetic Seam Welding

The ever-shrinking geometries of electronic components, coupled with advances in battery technology, have led to the development of a large array of implantable medical devices for heart rhythm management (pacemakers, defibrillators) and chronic pain relief (neuro-stimulation). These products share a common packaging technique that consists of a titanium half-shell enclosure joined together with a hermetic seam weld. The integrity of the weld is crucial to ensure the long-term reliability of the device and to protect the patient from contamination. Traditional approaches to the welding process have utilized standard rotary and linear motion devices coupled with complicated post-processing software to create the weld path. Aerotech's HermeSys is a holistic design that optimizes all aspects of the hermetic seam-welding process. Specialized mechanics are used to accurately position the device during the welding process. Onboard kinematics allows the programming of weld geometry in part space for rapid optimization of process parameters on the machine (no post-processing required). And finally, a reference design is available for an automated material handling system to ensure that the part load/unload cycle can keep pace with the optimized welding process.

Optional dual-drive rotary assembly with pneumatic clamp ensures consistent part engagement during the welding process

Optional kinematic part fixture with wide acceptance angles ensures precision alignment of the part for automated load/unload processes



Rigid one-piece design tightly couples the laser head with motion to eliminate weld path errors induced by differential motion in the optics

Alternate configurations provide maximum flexibility when integrating with existing material handling systems

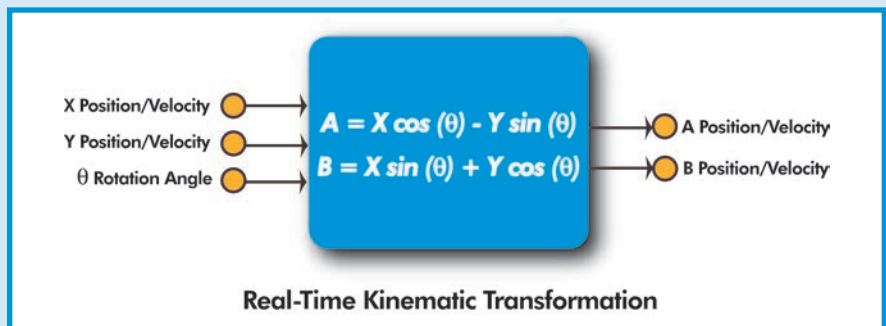


Split axis configuration consisting of Z/rotary and X/Y stage assemblies allows for higher acceleration, throughput, and weld accuracy

Multiple mounting locations for the X/Y stage assembly support a wide range of focal lengths



Complex Programming Made Easy



Real-Time Kinematics

Real-time kinematics removes the need for complex post-processing tools to create multi-axis laser weld paths. The weld profile is programmed in linear/arc segments or points on a cubic spline interpolated path. Part geometry and welding speeds can be optimized on the machine without re-posting the weld

Visit the Aerotech website for a video demonstration of real-time kinematics.

Solutions For

Intraocular (IOL) and Contact Lens Manufacturing

LensPRO Series –
Increasing Part Quality and
System Accuracy

Good

LensPRO-100

- Passive isolation
- Mechanical bearing
- Spherical and Aspherical
- Based on ALS2200 series stages

Ideal solution for cost sensitive applications

Better

LensPRO-200

- Spherical, aspherical and toric profiles
- Air isolation
- Based on ALS5000CR series stages

Part quality that exceeds competitive air-bearing solutions

Best

LensPRO-300

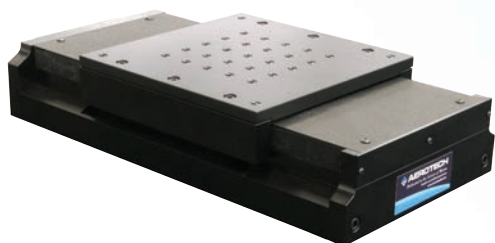
- Air-bearing slides
- Spherical, aspherical, toric and diffractive profiles
- Air isolation
- Based on ABL1500 series stages

Part quality comparable to competitive hydrostatic bearings

- 1 Networked open control platform allows for easy expansion
- 2 Standard commercial PC technology running latest Windows® software
- 3 Lens profile manager software creates programs in easily editable G-code programs
- 4 T-slot tool mounting interface allows for flexible tool placement and addition of custom tooling
- 5 Toric milling/drilling spindle, LVDT and fixed tool posts support a wide range of lens geometries
- 6 Closed loop air-bearing spindle with unique bearing configuration greatly improves surface finish
- 7 Granite mounting surface with passive or air isolation provides a stable platform for lathing process



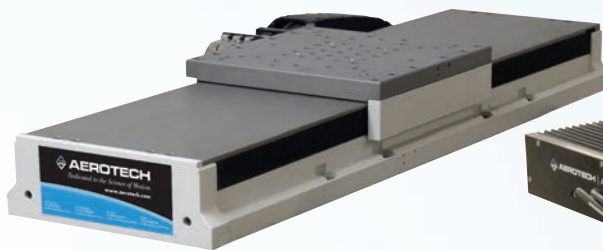
Component Solutions



Good

ALS2200

- Smooth, reliable crossed-roller bearings capable of making lenses with minimal polishing times
- Compact size reduces machine footprint in space-constrained cleanroom environments
- The ideal stage solution for high volume, low-cost lens turning platforms



Better

ALS5000CR

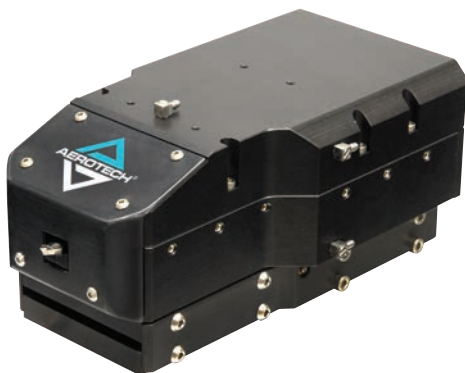
- High-precision crossed-roller bearing stage capable of producing polish-free surfaces
- Large tabletop easily accommodates multiple tools and measurement devices
- Larger stage cross-section provides adequate stiffness for toric lens profiling



Best

ABL1500

- Air-bearing stage completely eliminates mechanical noise sources for the best possible lens quality
- Friction-free bearing allows for small step sizes making it the ideal platform for diffractive lens manufacturing
- The high-accuracy linear encoder operating at picometer resolution minimizes profile errors when turning complex lens profiles



Toric Lens Generator

- Oscillating tool post designed specifically for toric lens profile
- 4 mm of total travel has adequate travel for the most complex profiles
- Compact drive technology can be mounted inside the lathe machine base
- Non-proprietary, open programming language allows for complete customization of the lens surface profile
- Significant cost and space savings over competitive solutions

Solutions For Next Generation DNA Sequencing

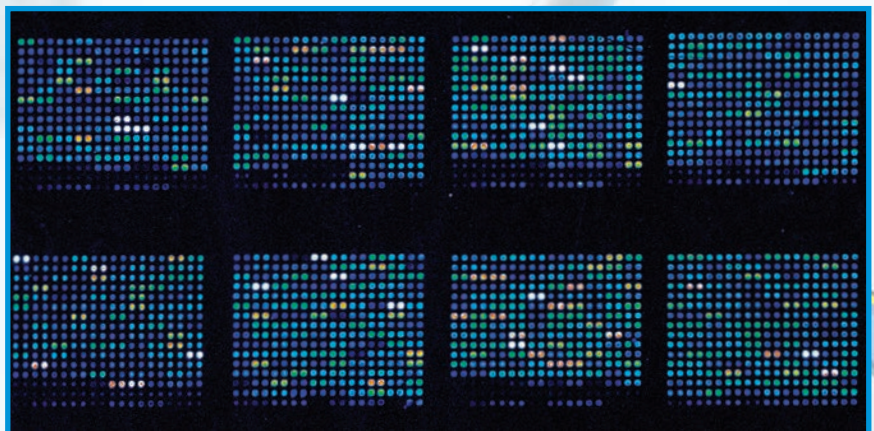
Historically DNA and other reactive-agent-based analysis procedures have used low-end positioning devices such as stepper motors and belt drives to distribute solutions into low-density well plates. As the industry has progressed to higher density plates with smaller sample sizes, more sophisticated motion control technology has been required to increase the efficiency and reduce the costs of the test procedure. Likewise, newer luminance analysis tools with extremely sensitive detector technology have placed more stringent requirements on the motion platform in terms of positioning accuracy, velocity stability, and flatness of travel. As a single-source manufacturer of high-end motion control equipment, Aerotech is uniquely positioned to provide solutions for the latest generation of lab automation tools.

Featuring/Recommendations:

- A3200 controller
- Linear motor gantries (AGS 1000)
- Low-profile, linear motor, mechanical and air-bearing stages (ABL1000, ANT130-L)

ABL1000 Linear Stages

- *Sub-micron flatness maintains focus over full travel*
- *Noncontact bearing allows for excellent velocity stability to improve image quality*
- *Picometer-level resolution allows for precise positioning on sub-micron probe densities*



Sub-micron sample density requires higher precision capabilities



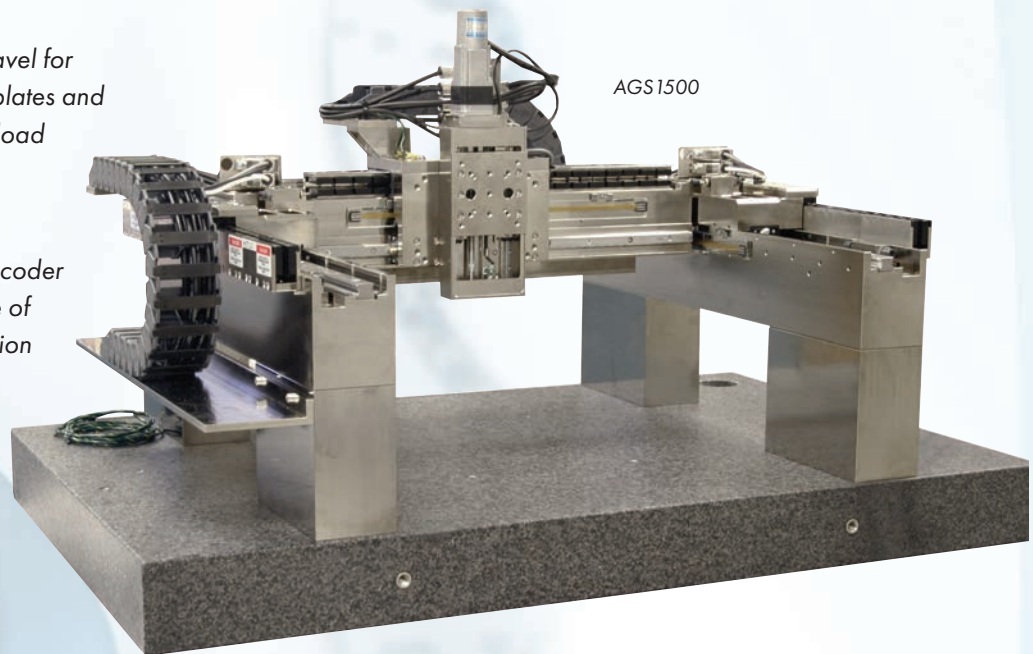
ANT130-XY

ANT Series Stages

- Crossed-roller bearings have excellent in-position stability for point-to-point image acquisition applications
- Multiple lengths and stage widths provide a wide selection of products for different sample sizes
- Nanometer-level step sizes enable tight probe spacing

Linear Motor Gantries

- Speeds in excess of 2 m/s enable high speed well-plate screening applications
- Gantries provide long travel for loading of multiple well-plates and easy access for load/unload operations
- Direct-drive linear motor technology and linear encoder feedback mean a lifetime of maintenance-free operation
- An optional high-speed Z axis is available for rapid material deposition and inspection



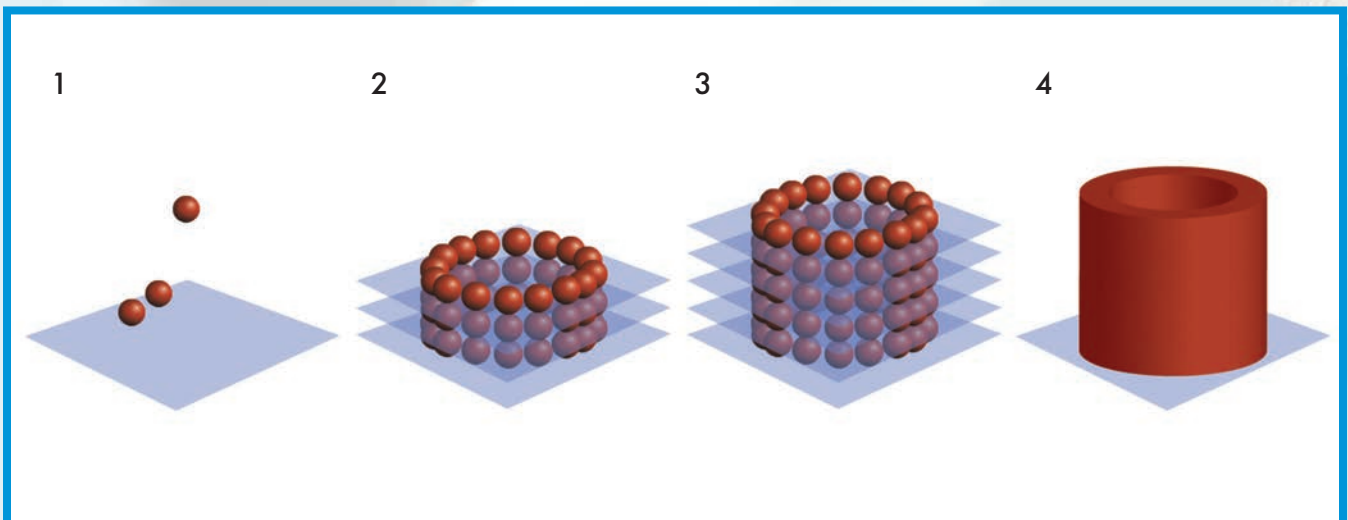
AGS1500

Solutions For Bio Printing

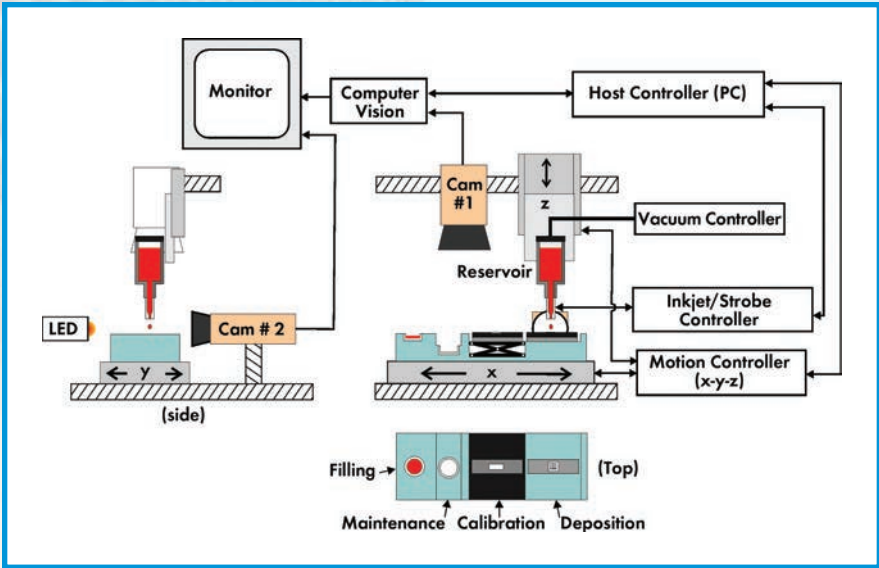
Bio printing, also known as tissue engineering, is an exciting new process that is being used to manufacture functioning tissue for implantation in the human body. The process is similar to additive 3D manufacturing technologies that have been used in rapid-prototyping machines where structures are built layer-by-layer. For bio-printing applications the material being deposited consists of biological cells that fuse together to form tissues that can be implanted in the body. The process can be used to manufacture blood vessels, bone, teeth, and ultimately entire replacement organs.



Aerotech motion products are already being used in a variety of additive manufacturing applications. This application, at The Wake Forest Institute for Regenerative Medicine, shows a 3D printer that can construct nose scaffolding – simultaneously embedding it with cells that will later grow into tissue.



The bio printing process consists of building 3D objects in layers. Cells deposited next to each other fuse together to form the desired tissue. Aerotech's Position Synchronized Output (PSO) capability ensures uniform tissue density with sub-micron placement accuracy during the deposition process.



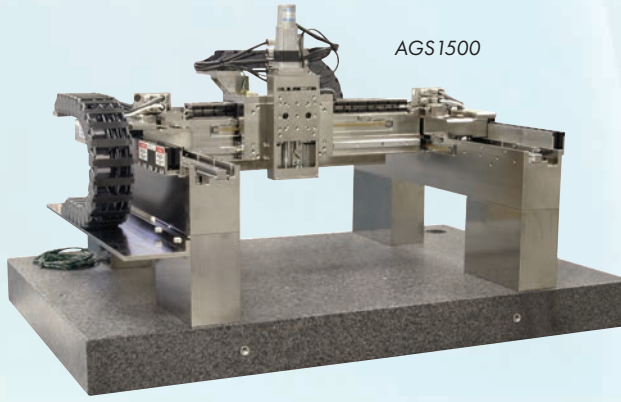
Aerotech Technology in Bio Printing

- Cartesian X/Y/Z actuator to position dispensing head
- Flow and temperature control to regulate material dispense rate and viscosity
- Advanced motion profiling capabilities allow for easy realization of complex part geometries

Aerotech can provide numerous key components for an automated CAD-to-tissue generation platform. (Photo courtesy of Lee E. Weiss, Ph.D., The Robotics Institute, Carnegie Mellon University, Pittsburgh, Pennsylvania)



Compact, high-precision X/Y stages minimize machine footprint while providing sub-micron placement accuracy



Gantry configuration provides maximum flexibility for integration of printing substrates



Multi-axis machine controller



Stand-alone multi-axis motion controller

PC and stand-alone control solutions provide multiple price/performance points.

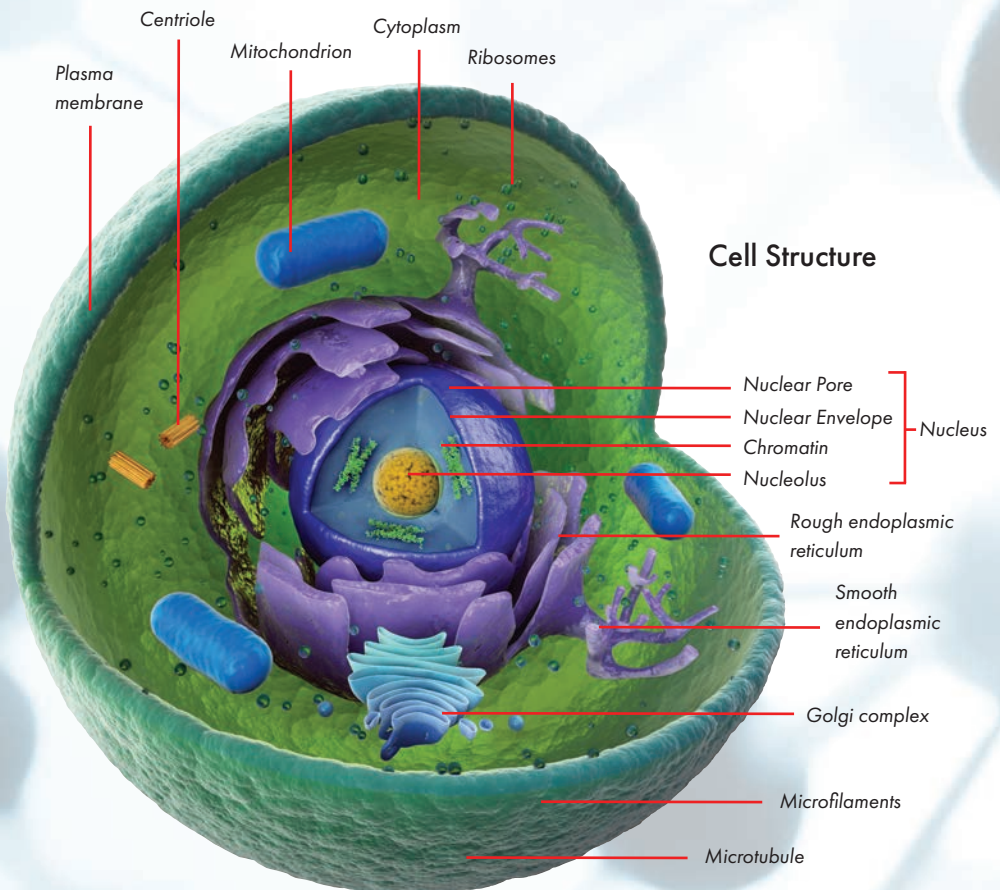
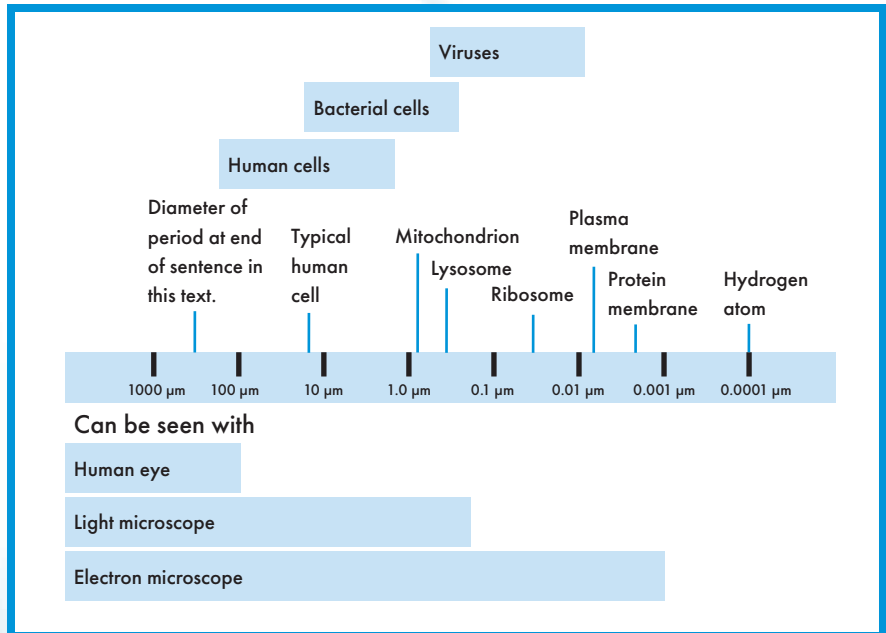
Solutions For

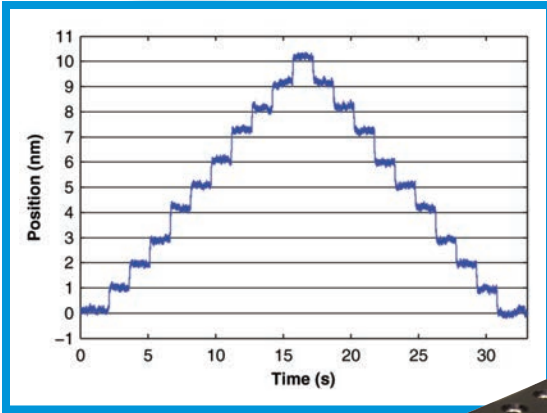
Molecular-Level Life Sciences

Life happens at the sub-micron level. Observing and manipulating biological processes in applications such as micro-robotic cell manipulation, DNA sequencing, and microscopy therefore require motion on the sub-micron level. Some of these molecular-scale processes must also be capable of moving in the tens of millimeters to access multiple sites within a given sample or within an array of samples. Aerotech's line of nanopositioning stages, with their nanometer-level step sizes coupled with millimeter travel ranges, are ideally suited for these applications. A comprehensive line of linear, rotary, and vertical displacement stages are available to create complex multi-dimensional motion platforms for the analysis and manipulation of cellular features and processes.



Cell penetration requires sub-micron probe positioning to control depth of penetration to minimize damage to the underlying cellular structure





ANT95-50-L-PLUS 1 nm step plot



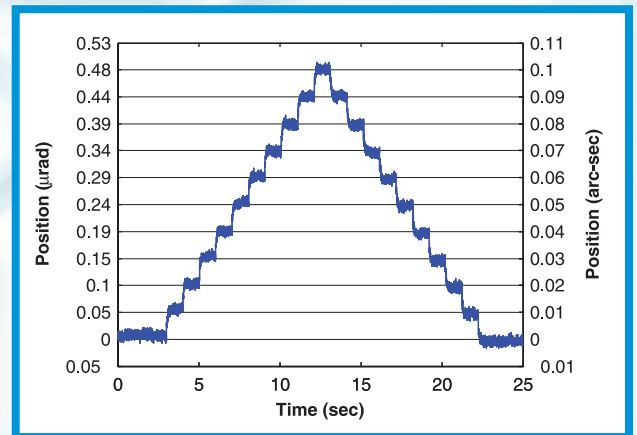
The ANT95-L series offers
25 or 50 mm travel

ANT95-L Single-Axis Linear Stage

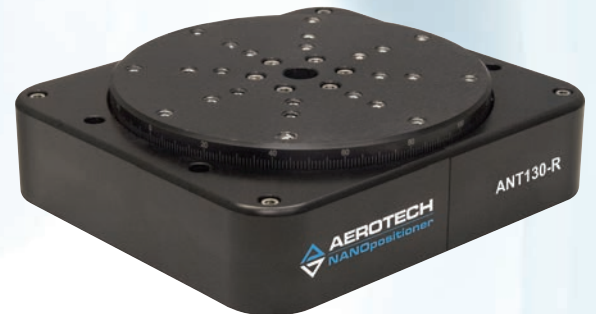
- Noncontact, non-cogging, frictionless direct-drive – zero backlash or hysteresis
- High resolution (1 nm), repeatability (50 nm), and accuracy (250 nm)
- In-position stability of <1 nm
- Anti-creep crossed-roller bearings
- High dynamic performance
- Available in X, XY, XYZ, and many other combinations

ANT95-R and ANT130-R Rotary Stages

- High resolution (0.01 arc sec)
- High performance in large travels
- Outstanding error motion specifications
- 0.005 arc-second in-position stability
- 5 arc-second accuracy
- 1.5 arc-second bi-directional repeatability
- Multi-axis configurations



ANT95-R 0.01 arc-sec step plot



Visit Aerotech's website for a complete listing of all our nano Motion Technology products.

Solutions For

Medical Devices, Oncology and Imaging

Many complex medical devices require a variety of motors and other motion components for an array of tasks. Reliability and ease of integration are key to effectively building the highest quality machines as required in the medical industry. Aerotech offers a wide range of standard motors that can be selected to best fit your application.



Slotless Motors for Imaging and Diagnostic Equipment

- High inertia slotless configuration more closely matches performance characteristics of traditional brush motor technology
- Excellent velocity stability for patient movement or positioning of diagnostic/treatment sources
- Brushless design ensures a lifetime of maintenance-free operation
- Slotless, brushless stator provides zero cogging torque

Frameless Torque Motors

- Five frame sizes to fit most applications
- Frameless design for easy integration into OEM machines
- Slotless stator and high-pole-count rotor provide zero cogging for exceptional velocity and position control
- Up to 116 Nm of peak torque and 29 Nm of continuous torque

Brushless Linear Motors

- Advanced design yields 49% greater continuous output than comparative models
- Zero-cogging allows smooth velocity and position control
- Symmetrical mounting pattern allows tracks to be mounted end-to-end for unlimited travel
- Optional air cooling for greater rms force
- Up to 4252 N of peak force and 1063 N of continuous force

Brushless Rotary Motors

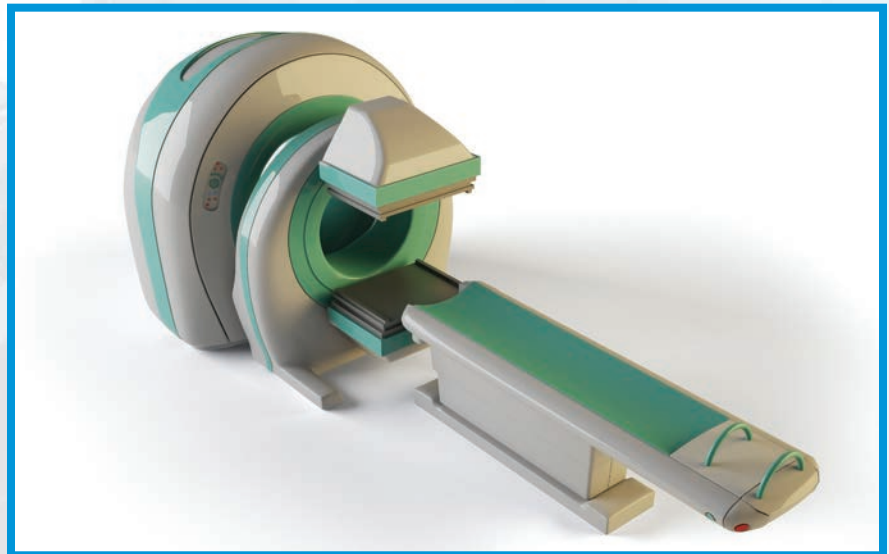
- Standard NEMA sizes ensure portability with existing mechanical interfaces
- Frameless torque motors for integration into custom rotary actuators
- Slotted and slotless designs allow optimization for torque capacity or velocity ripple
- Multiple frame sizes to fit almost any application



LINAC (Linear Accelerator) systems direct a shaped beam of radiation at a tumor from different angles to minimize damage to surrounding tissue. Aerotech motors and controllers are used to provide precise positioning of the patient relative to the radiation source.

- *Low-cogging-torque brushless motors are ideal for patient movement, LINAC source, or computed tomography source/sensor*
- *Optional absolute rotary encoder for power-on identification of system orientation*
- *Custom linear positioning systems can be designed to meet space and performance constraints*

Computed Tomography (CT) scanners rotate an X-ray source and imaging system at high speeds to generate 3D images of the body. Aerotech controllers and motors are used to ensure tight correlation of the patient position relative to the image acquisition locations to improve final image quality.



Soloist[®]

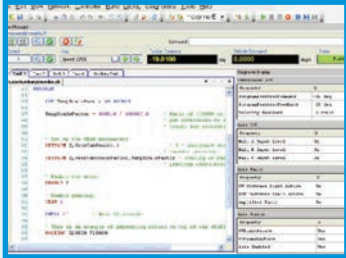


Stand-alone, single-axis motion controller

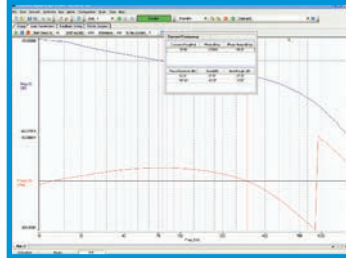
- *Single-axis control with multi-tasking programming environment greatly simplifies motion and safety-related programming functions*
- *Distributed control architecture with ethernet or USB interface minimizes wiring complexity*
- *DC input option allows for "battery backup" powered operation to safely move patient in the event of primary AC power loss*

Control Solutions

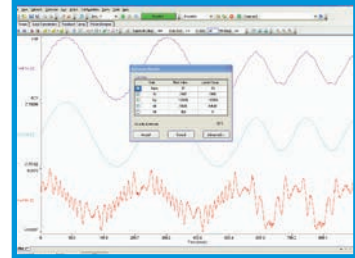
Common Software Platform: Tools, Powerful Programming Environment, Calculators, Diagnostics



Diagnostics – Easily debug your system



Loop Transmission – Quickly set up system



Autotune – Shortens development time

- High Performance
- Flexible
- Advanced Control Technology
- Networked
- Scalable
- Lowest Cost of Ownership

Award-Winning Controllers



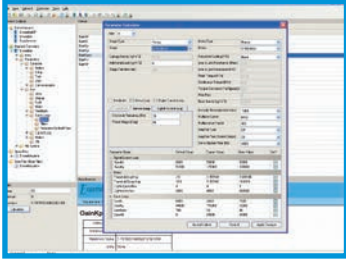
Automation 3200

- Software-based multi-axis machine controller
- 1 to 32 axes of coordinated motion
- PC-based
- Up to 32 tasks
- RS-274 G-code

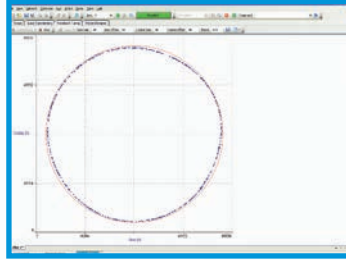
- Advanced features for demanding applications
- Scanner control for marking
- Tightly integrated laser functionality
- Retrofit package
- Brushless, brush, or stepper motors

Accessories

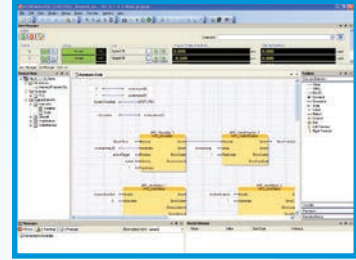




PID Calculator – Optimize system performance



Encoder Tuning – Minimize development cost



Motion PAC – Optional IEC 61131-3 programming environment

Ensemble

- Stand-alone 1- to 10-axis controller
- Up to 4 tasks
- Versatile, cost-effective, coordinated motion
- PWM or linear drives (10-150 A peak)
- Brushless, brush, or stepper motors
- Desktop or panel mount
- .NET, Managed C++, LabVIEW®, or AeroBasic™

Soloist

- Elegant, economical, single-axis controller
- Stand-alone
- PWM or linear drives (10-150 A peak)
- .NET, C#, VB.NET®, LabVIEW®, or AeroBasic™
- Ethernet, USB
- Brushless, brush, or stepper motors

Linear and Rotary Servomotors



Network Connectivity

- Ethernet/IP™
- Modbus®/TCP
- Ethernet TCP/IP
- USB
- RS-232
- GPIB

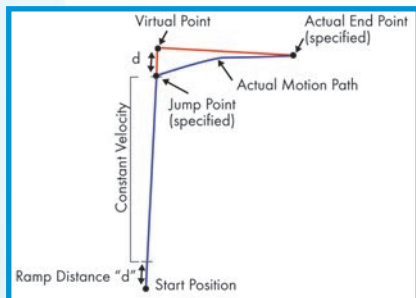


Control Solutions

Standard Controls

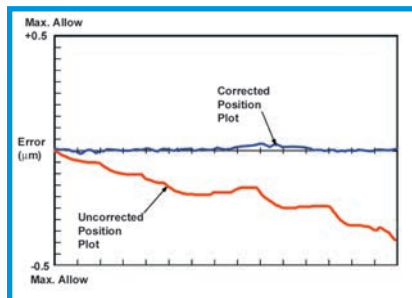
Aerotech controllers offer the broadest array of programming interfaces and core motion capabilities of any automation system available today. Aerotech controllers have the programming flexibility and capability to meet the requirements of the most demanding motion applications of OEMs and end-users alike.

Slice Move



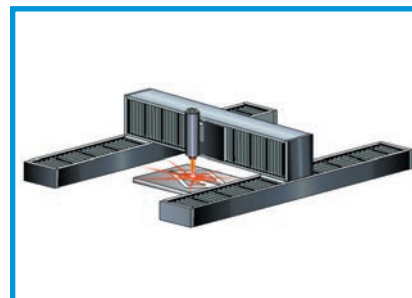
Increase scanning throughput by blending step and scan into a contoured move

Axis Calibration



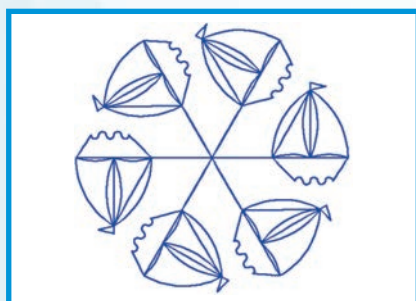
Compensate for repeatable mechanical errors in a positioning system

Gantry Mode



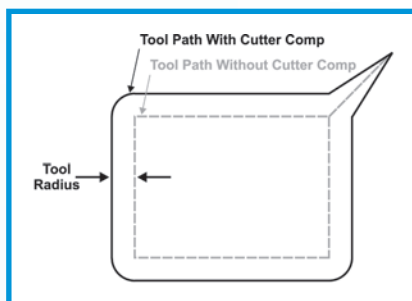
Complex gantry control is reduced to a few simple commands to handle dual motor and/or dual feedback configurations

Parts Rotation



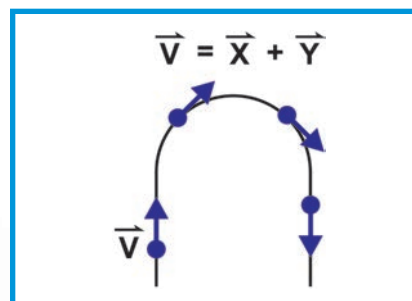
Use when a two-dimensional part must be repeated in different orientations without translating the part program many times over

Cutter Compensation



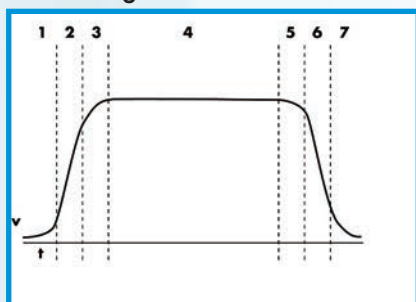
Also known as tool radius compensation, this feature automatically adjusts the path to allow for the radius of a cutting tool

Velocity Profiling



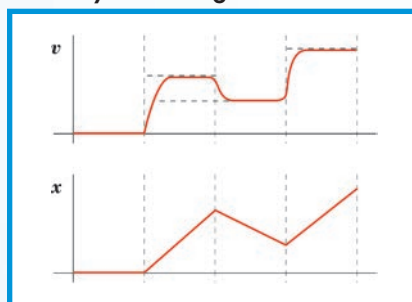
Maintains a constant vector velocity along the programmed path

Seven Segment Acceleration



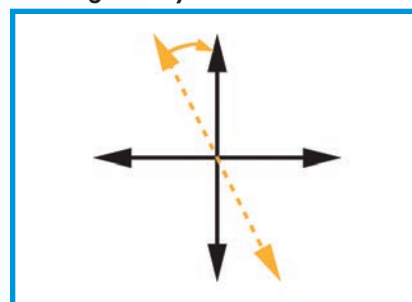
Specify the acceleration profile in seven segments, providing precise control over system motion

Velocity Blending



The velocity changes to the next velocity command, acceleration limited, without stopping

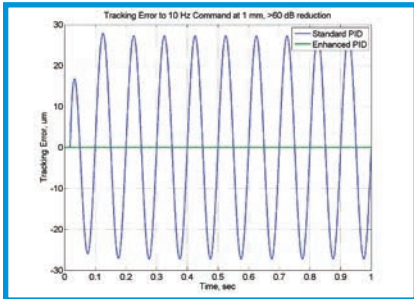
Orthogonality Correction



Improve X-Y planar accuracy by simply entering the known orthogonality error and the controller will compensate

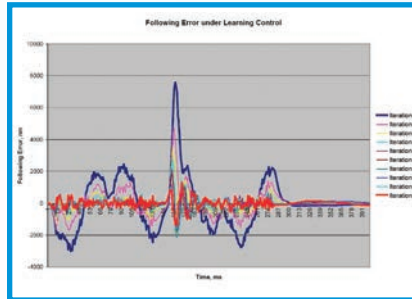
Advanced Controls

Harmonic Cancellation



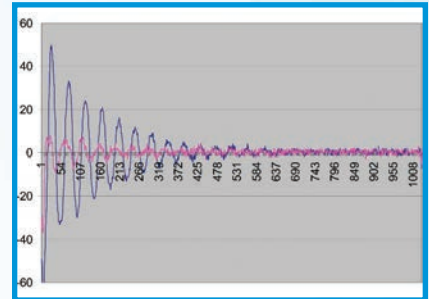
Reduce position error on periodic trajectories and reject periodic disturbances

Iterative Learning Control



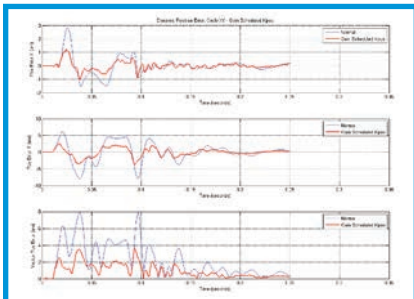
Reduce following error on repeated move sequences that can be learned and optimized

ETM



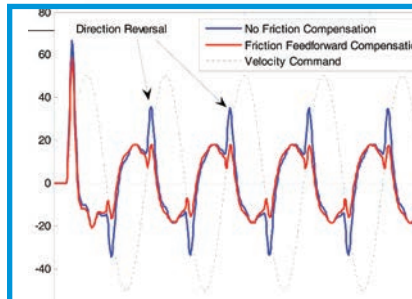
Increase rate stability and decrease settle times in the presence of vibration

Directional Gain Scheduling



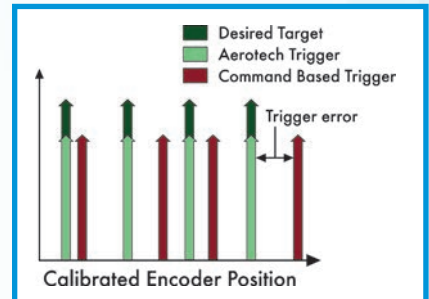
Decrease settle-time and increase in-position stability

Friction Compensation



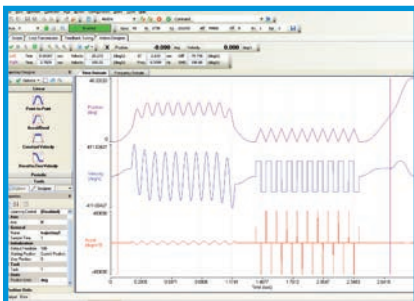
Reduce settle time and reduce error at direction reversals

Position Synchronized Output



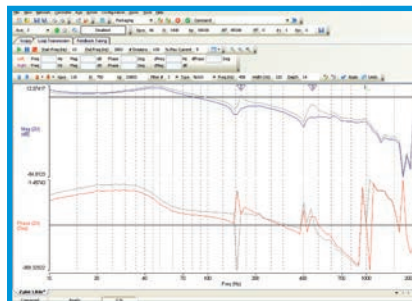
Trigger external events precisely at desired position while in motion

Motion Designer



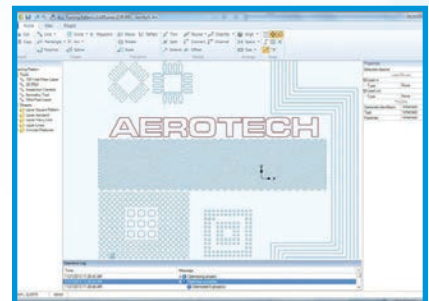
Graphical trajectory generation and data analysis

Loop Transmission



Tuning and diagnostic utility that greatly enhances system performance

CAD Fusion



Aerotech's CAD Fusion software enables users to quickly and easily convert DXF/DWG drawings into AeroBasic motion programs that can be run on a number of Aerotech control systems.

MotionPAC – PLC Integrated With Motion

- 30% to 50% reduction in development time
- High-performance motion fully integrated with standard PLC environment
- Easy-to-use diagnostics and tools
- Standards & flexibility: IEC 61131-3, .NET, PLCopen, PC-based
- Integrated with the A3200 motion controller

Program in IEC 61131-3: LD, FBD, ST

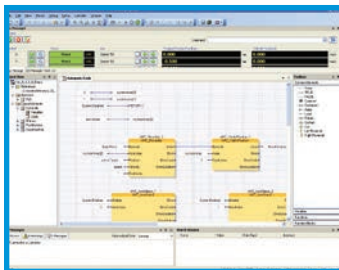
The screenshot displays the A3200 MotionPAC software interface. At the top, the 'Axis Manager' window shows control parameters for axes Y and X, including status (Homed, Homing), speed, and feedback values. Below this, the 'MainSequence_LD Code' window shows a ladder logic program with various motion blocks such as 'Enable_Axes', 'Home_Axes', 'Run_Cycle', and 'M2_Timer'. The 'I/O Manager' window at the bottom left shows the status of digital inputs and outputs for Axis Y. The 'Tag database' window on the right lists various motion blocks and their parameters. Several callout boxes highlight key features: 'Define hardware' points to the Axis Manager; 'Online mode displays all Tag values' points to the feedback values; 'Create libraries' points to the Project View; 'Axis manager' points to the Axis Manager window; 'Standard LD' points to the ladder logic program; 'LD, FBD or ST programs' points to the MainSequence_LD Code; 'Combine LD and FD on same program' points to the M2_Timer block; 'Completely integrated motion blocks' points to the motion blocks in the ladder logic; and 'Tag database' points to the Tag database window.

Integrated Automation: MotionPAC



HMI

- Program selection and run
- Jog panel
- Machine control
- Customizable buttons
- Axis manager



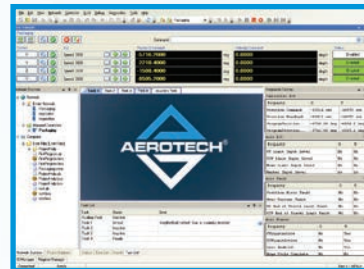
MotionPAC

- IEC 61131-3
- PLCopen
- Aerotech motion blocks
- Axis manager
- Extensive development & debug environment
- Simulate program



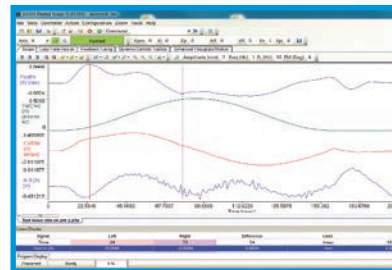
I/O & Data Acquisition

- High-speed data acquisition synchronized with motion & PLC
- High-speed registration
- Position Synchronized Output
- Machine interlocks
- Fieldbus I/O



Motion Composer

- Axis manager
- Low-level motion diagnostics
- Motion programming
- Advanced control algorithms



Scope

- Signal capture & analysis
- Autotuning
- Loop transmission
- Encoder tuning
- Advanced controls



Central Machine Tag Database

- Tags available in all applications by name
- Define both local or global machine Tags
- Define Tags in I/O definition, ST, LD, FBD or motion program

Advanced System Controls

Linear Servo Amps for High Accuracy and Ultra-Low Jitter Operation

Aerotech's linear servo amplifiers are for motion control applications that require high accuracy drives with no PWM switching noise and zero deadband. Because the linear servo amplifiers have no PWM switching noise, they do not induce electrical noise into sensitive electrical measurement devices.

Improved Dynamic Tracking Accuracy

Aerotech's linear amplifiers have no dead band or cross over distortion as the current changes direction. This results in a significant decrease in position error during direction reversal. With linear amplifier technology it is possible to maintain micron level dynamic positioning tolerances without having to reduce speed on small arcs and circular part features.

Linear Amplifier Advantages

- No switching noise
- Zero dead-band
- $\pm 40\text{ V}$, $\pm 60\text{ V}$, and $\pm 80\text{ V}$ output voltage
- Peak output current up to 20 amps
- Continuous output current up to 10 amps
- Software selectable power amplifier bandwidth



Ensemble HLe



Soloist HLe



Ndrive HLe



Soloist ML



Npaq



Ensemble CL

PWM Amplifiers, 10 A - 150 A Output

Aerotech PWM digital servo amplifiers are capable of controlling brushless, DC brush, and stepper motors over a wide range of operating voltages and currents. Based on a common architecture, these amplifiers perform both current- and position-loop closures digitally.

The use of high-performance double-precision processors allows these drives to generate ultra-smooth motion profiles. Servo system response is optimized with the use of up to eight second-order loop-shaping filters, precise time-aligned feed-forward and other proprietary techniques with loop closure rates up to 20 kHz.

The PWM family is offered in a number of highly efficient versions. The MP is a low power, small footprint PWM drive ideal for space-sensitive applications. The CP is a medium-power PWM drive capable of running directly from AC mains voltage and is optimized for cost-sensitive applications. The HPe is the highest performance PWM drive providing a host of features not available on the other PWM drives, and is available in output current ranges from 10 A to 150 A peak.

Options for Aerotech PWM amplifiers include integral encoder interpolation, one- to three-axis Position Synchronized Output (PSO), automatic brake control, digital and analog I/O expansion, absolute encoder interface, and one- or two-channel resolver interfaces. An optional dedicated Ethernet port is available on the HPe drives for connection to third-party I/O expansion devices.



Soloist CP

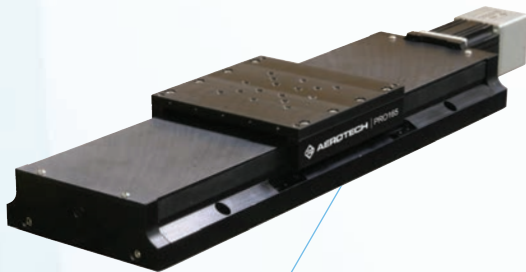
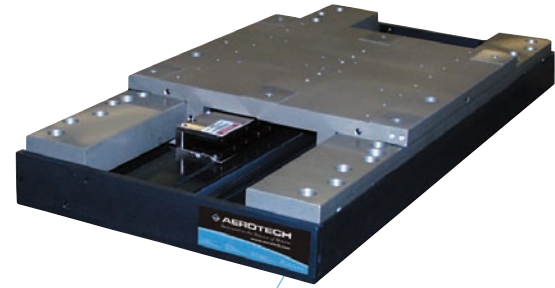
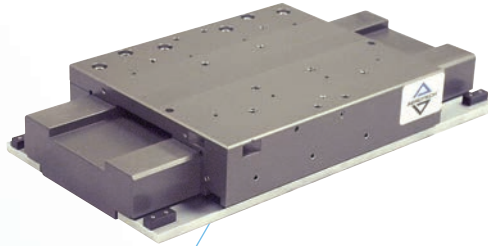


Ensemble MP



Ndrive HPe

Linear Stages and Gantries



PRO LM Series

- Direct-drive linear motor for zero-cogging, high-performance motion
- External mounting features for quick system assembly
- Hard-cover and side-seal design for years of maintenance-free operation
- High accuracy linear encoder option for applications that require excellent velocity regulation
- Multiple frame sizes and travel lengths provide system configuration flexibility

PRO Series

- Side-seal design with hard cover for debris protection
- Long-life linear motion guide bearing system
- Available with brushless, DC brush, or stepper motors
- Choice of ball screws for speeds up to 1400 mm/s

ABL1000

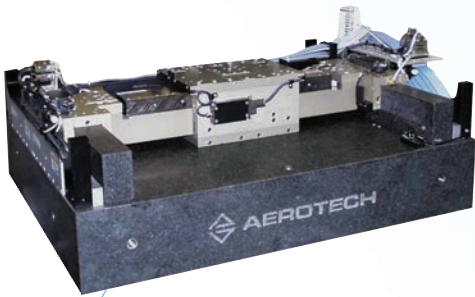
- Noncontact air-bearing technology with magnetic preload yields a small footprint for space-constrained applications
- Excellent flatness of motion for small focal depth systems
- Optimized for single axis or short travel X/Y configurations

ABL1500

- Full air preload for increased roll stiffness and higher load carrying capability
- Two frame sizes allow for increased load carrying capacity in X/Y configurations
- Optional high-accuracy encoder for improved velocity stability

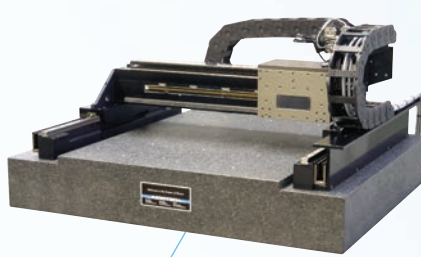
ABL8000

- Active air-bearing preload on all surfaces provides high stiffness for heavy loads
- Wide footprint ideally suited for X/Y applications
- Choice of standard, high accuracy, and laser interferometer feedback devices



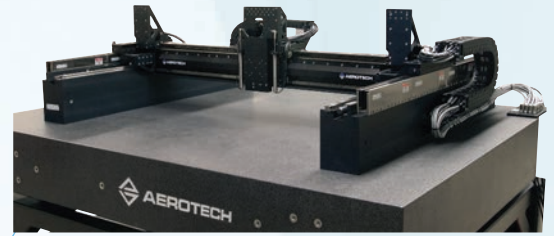
ABL9000

- Full air preload on all surfaces for increased roll stiffness and load carrying capacity
- Co-planar X/Y axes reduce working height to minimize roll and pitch errors
- Exceptional straightness characteristics for high-accuracy laser scribing applications



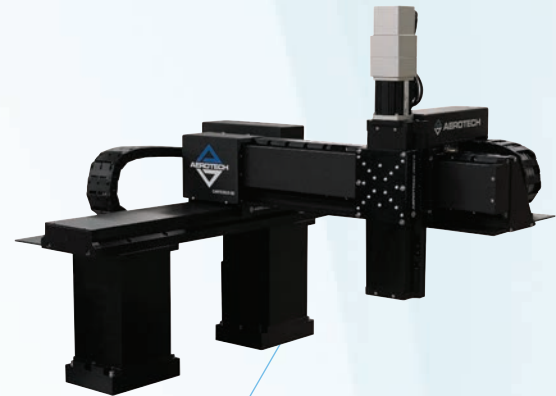
AGS1000

- Compact design minimizes floor space
- Well-suited for marking “move and expose” operations
- CMS expandable to integrate fiber-laser beam delivery
- Optional machine base and risers ease system integration



AGS10000

- Large format gantry with high force linear motors well-suited for laser cutting and welding applications
- Stacked X/Y configuration provides clearance for laser optics and material handling within the operating envelope
- Scalable cable management system allows for integration of focus axis and fiber-laser beam delivery



AGS15000

- Planar X/Y design improves system stiffness to minimize contour errors in high-speed cutting and welding processes
- Planar design easily supports the integration of components for “flying optics” applications
- Scalable cable management system allows for integration of focus axis and fiber-laser beam delivery

Cartesius

- T-style gantry allows for clear access on the side of the machine for material load/unload operations
- Standard configurations include left- and right-handed, XY, XYZ, and XZ systems
- Multiple stage widths available to optimize footprint and load capacity for a wide range of applications

Rotary Stages



ADRS

- Ultra-low profile minimizes working height
- Cog-free slotless motor design for outstanding velocity stability
- Direct-coupled encoder for accurate measurement of table position
- Multiple frame sizes for application flexibility

ADRT

- Large diameter, clear-aperture for product feed-through or laser beam delivery
- Wide bearing separation for improved moment load capability
- Outstanding wobble and runout characteristics
- Four different frame sizes with multiple stack heights provide a wide range of load carrying capabilities and output torques

ASRT

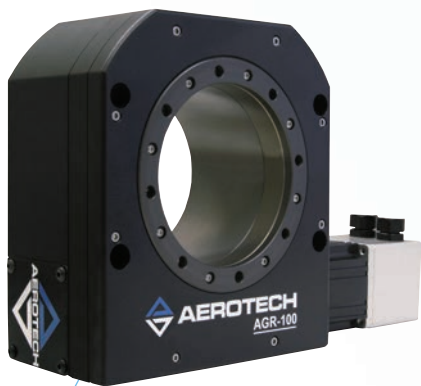
- IP66: Totally protected against dust and water jets from any direction
- Direct-drive motor provides rapid precision motion with no gear backlash
- Low-friction seal minimizes direction reversal hysteresis to allow small, precise positioning
- Continuous or limited travel
- Axial load capacity up to 175 kg
- Excellent accuracy and repeatability

ACS/ACS LP

- Integral pneumatic ER collet holder or 3-jaw chuck for automated material handling
- Clear aperture for product feed-through
- Normally-open or normally-closed gripper options for fail-safe material holding
- Frictionless rotary union provides a lifetime of maintenance-free operation

ALAR

- Direct-drive, large-aperture rotary stage eases integration of laser beam delivery or custom part fixtures
- Limited-travel versions available to support specialized machine configurations
- Large bearings provide high payload and moment load capability
- Five different aperture sizes ranging from 100 mm to 325 mm for maximum flexibility

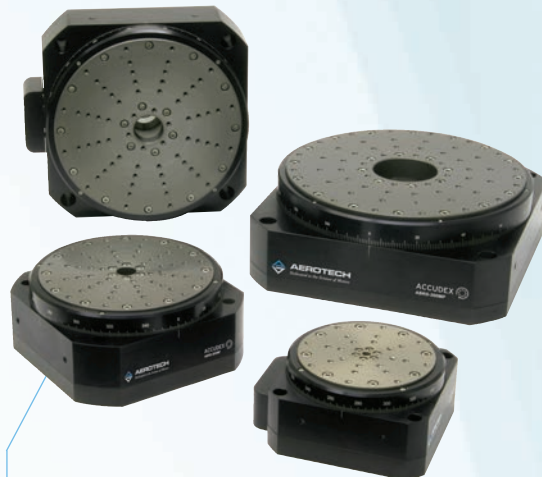


AGR

- Gear-driven rotary stage with large aperture eases integration of laser beam delivery or custom part fixtures
- Direct-coupled output encoder for improved positioning accuracy
- Innovative preloading design lengthens worm-gear life
- Range of gearing options and aperture sizes provides configuration flexibility

ALAG

- Large format, gear-driven goniometer supports loads up to 1500 lb
- Two frame sizes with either 1300 mm or 300 mm radius for system configuration flexibility
- Direct feedback encoder option for high-accuracy applications
- Standard NEMA motor mount supports brush, brushless, and stepper motors



ABRS

- Low profile air-bearing minimizes stack-up related errors in multi-axis systems
- Zero cogging, direct-drive motor for ultra-smooth velocity regulation
- Large air-bearing surfaces provide high stiffness and load capacity with excellent axial and radial error motions
- Clear aperture for product feed-through

ABRT

- Fully constrained rotary air-bearing design for high-moment-load applications
- Large diameter clear aperture for product feed-through
- Zero cogging, direct-drive motor for ultra-smooth velocity regulation
- Three different frame sizes for system configuration flexibility

Aerotech at a Glance



Corporate Headquarters • Pittsburgh, PA • USA



Aerotech
United Kingdom



Aerotech
Germany



Aerotech
Japan

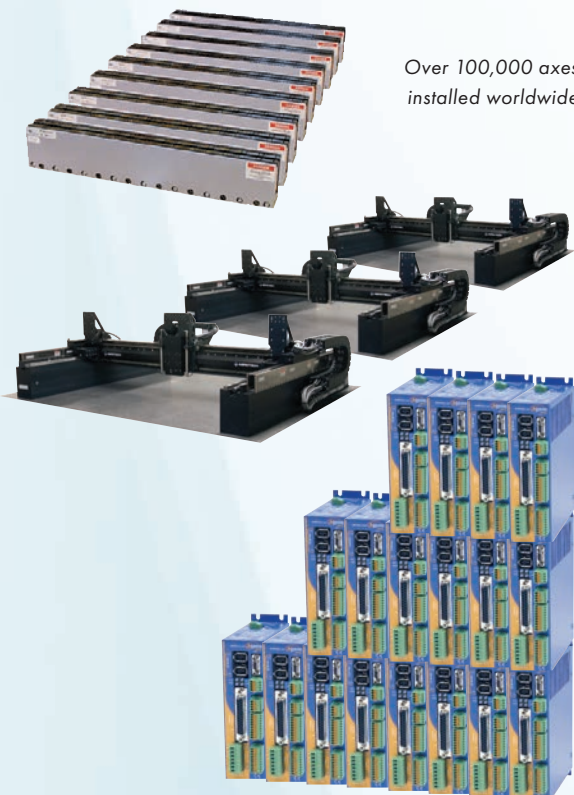


Aerotech
China



Aerotech Taiwan

High Volume Manufacturing



Over 100,000 axes
installed worldwide

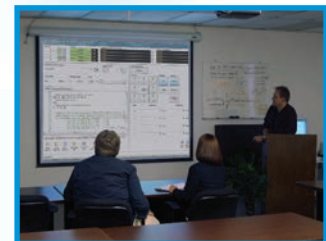
Worldwide Service and Support



Worldwide startup
service and on-site
training

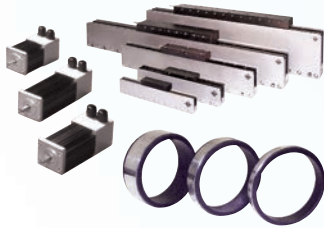


Fully equipped on-site
training facilities

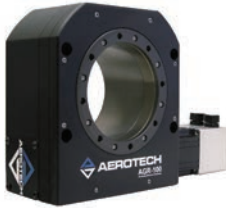


Technically Superior Components

Highest performance brushless linear and rotary motors



AGR rotary stage



PRO series linear-motor stage



Ndrive



A3200



Npaq

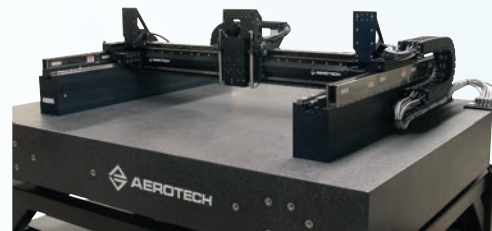
Award-winning Automation 3200 1-32 axis motion, vision, PLC, robotics, and I/O platform

High Performance Sub-Assemblies

XYAB subsystem for high dynamic accuracy positioning in laser drilling and micromachining applications



LaserTurn 5 high-speed cylindrical laser cutting system



Highest throughput linear motor Cartesian gantry systems

Best-in-Class Subsystems



Highly integrated motion subsystems with machine base, display, and packaged electronics



Custom-engineered vacuum- and cleanroom-compatible systems

Production-proven, large format air-bearing systems for flat panel and semiconductor applications

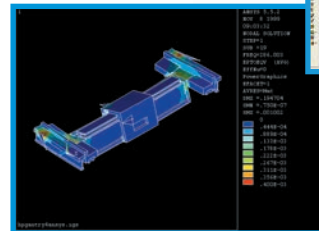
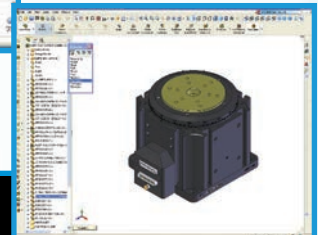


Comprehensive Technical Support Services



Custom software application support

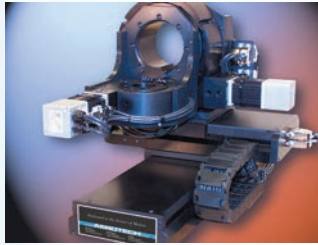
3D models to facilitate faster and more accurate system layout



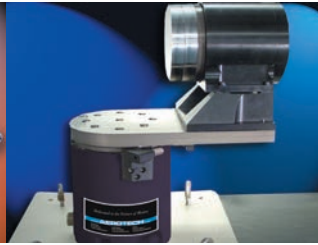
Advanced analytical techniques for optimization of system geometry

Engineered Systems

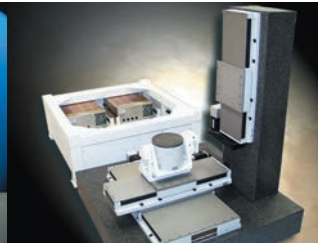
Aerotech engineers and manufactures specialty high-performance subsystems. Our highly-trained staff of experienced software and hardware engineers enables our customers to get to production readiness faster. Aerotech provides real-time collaborative support — either at your facility, at our facility, or on the web.



Advanced Laser Machining



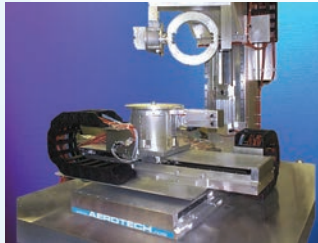
Discrete Part Milling Machine



Rapid Prototyping



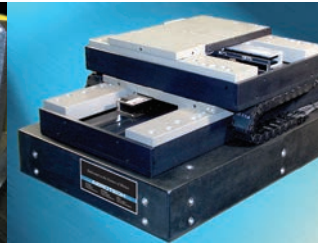
Advanced Pick-Place-Inspect Station



Ion Beam Profiling in Vacuum



Precision Optical Production



High-Precision Air Bearings



Liquid-Cooled, Vacuum-Prepped System



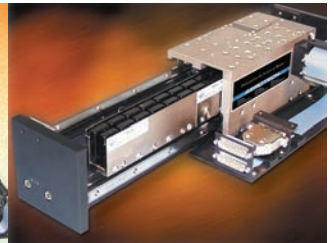
High Volume Production Inspection Station



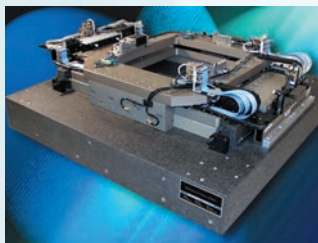
4-Axis Coordinate Measuring Machine



Electronic Inspection



High-Speed Optical Indexer



Patterned Media Inspection



Printhead Inspection Station



High-Accuracy Laser Machining



Optical Lens Fabricating

Awards and Recognition



2013 Golden Mousetrap
Finalist Product – Planar_{DL}



2012 Control Engineering
Engineers' Choice Award
Finalist Product – MotionPAC



2011 Control Engineering
Engineers' Choice Award
– ANT130-XY



Design News 2010
Golden Mousetrap Winner –
ANT130-XY



Design News
2009 Golden Mousetrap Finalist Product –
LaserTurn[®] 1, AGS15000, ANT95-XY



2008 Control Engineering
Engineers' Choice Award
– LaserTurn[®] 1



Semiconductor International
2008 Editors' Choice Best Product –
Ensemble[™]



Design News
2008 Golden Mousetrap Finalist Product –
Nmark[™] SSaM



Semiconductor International
2007 Editors' Choice Best Product –
WaferMax T[™]



EuroAsia IC
2006 Industry Award –
WaferMax Z[™]



Product Design and Development
2002 Top 50 Product –
Automation 3200



Design News 2002
Best Product Nominee –
Automation 3200



Aandrijftechniek
2002 Award –
FiberMax[®]



Lightwave NFOEC 2002
Attendees' Choice Award –
FiberMax[®]

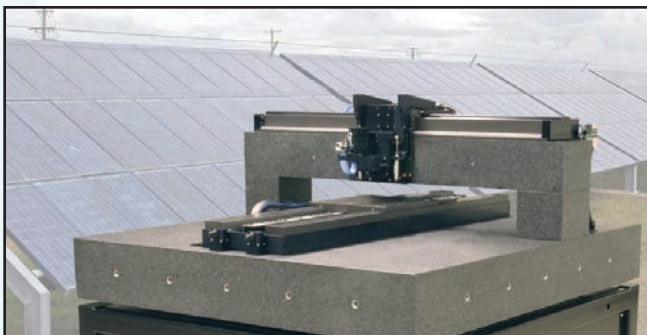


Lightwave OFC 2001
Attendees' Choice Award –
FiberAlign[®] 130



Machine Design Excellence in
Manufacturing Technology –
Slides/Ways 1998 and 2000

Capabilities in Other Markets

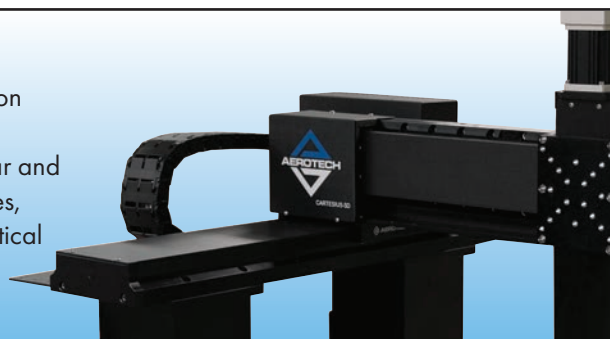


Photovoltaic, Fuel Cell and Alternative Energy

Extensive application experience and a broad array of motion products make Aerotech the perfect partner for your photovoltaic (solar cell), fuel cell and other alternative energy manufacturing and testing platforms. Our worldwide operation has engineered and manufactured a multitude of motion platforms for these markets and we continue to provide innovative solutions.

General Automation

Since 1970 Aerotech has been a manufacturer of top-quality automation products. The breadth of our product line, including automated nanopositioners, planar air-bearing systems, high-speed gantries, linear and rotary and lift stages, brushless linear and rotary servomotors and drives, single- and multi-axis motion controllers, goniometers and gimbals/optical mounts makes Aerotech unique among motion control manufacturers. Aerotech is *Dedicated to the Science of Motion*.

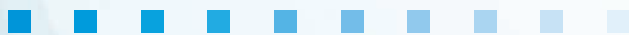


Control Systems

Aerotech motion controllers, motors and drives are utilized in our own positioning systems and by end users and OEMs worldwide. From our Automation 3200 software-based motion controller that can control up to 32 axes, to the Soloist single-axis servo controller, to the Ensemble multi-axis stand-alone motion controller, we provide a variety of options to suit your application.

Laser Processing

Aerotech has extensive experience in providing motion components and subsystems for laser processes such as cutting, welding, marking, etching and micromachining. These processes are the key to advancing technology in markets such as photovoltaic manufacturing, aerospace and medical device manufacturing.



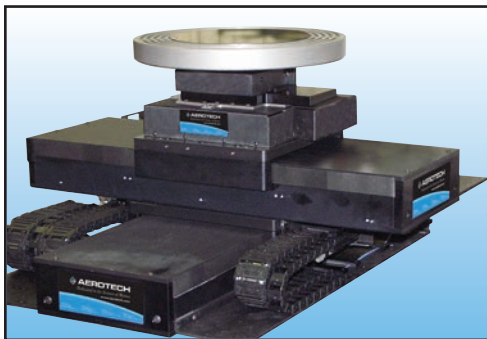
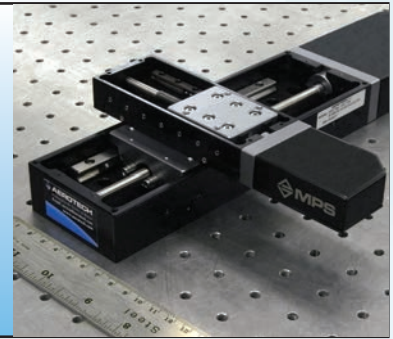


Military and Aerospace

Aerotech has manufactured thousands of high-accuracy systems including many for high vacuum (10^{-6} torr) and cleanroom environments. Our equipment is used for testing electro-optic systems, high-performance laser processing, materials testing and manufacturing, target tracking, satellite sensor calibration and verification, inertial guidance testing, scanning, optical pointing, repeatability and life-cycle testing for quality control. Custom systems are available with minimal development time.

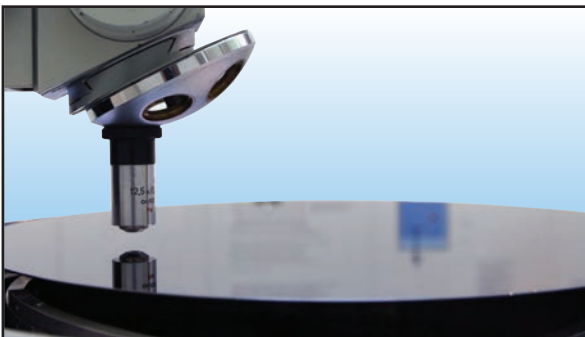
Government and Educational Research and Development

The breadth of Aerotech's product line offers solutions for the wide-ranging requirements of academic and government R&D. Our nanopositioners provide the accuracy required not only for photonics experiments, but also for micro- and nanomachining workstations. Aerotech's multi-axis rotary positioners and gimbals offer the high precision needed for defense, satellite and space science research. Unique applications call for unique solutions, and Aerotech can provide custom-engineered systems to meet your needs.



Electronics Manufacturing and Assembly

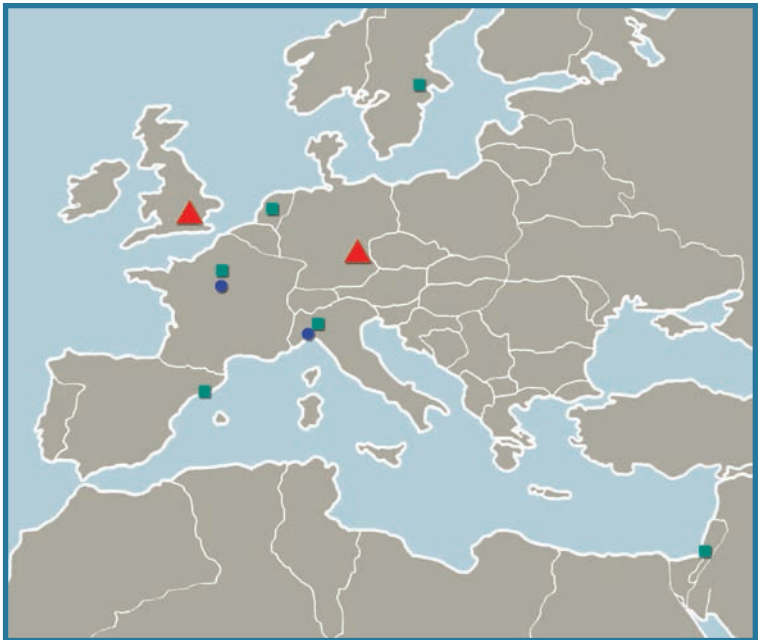
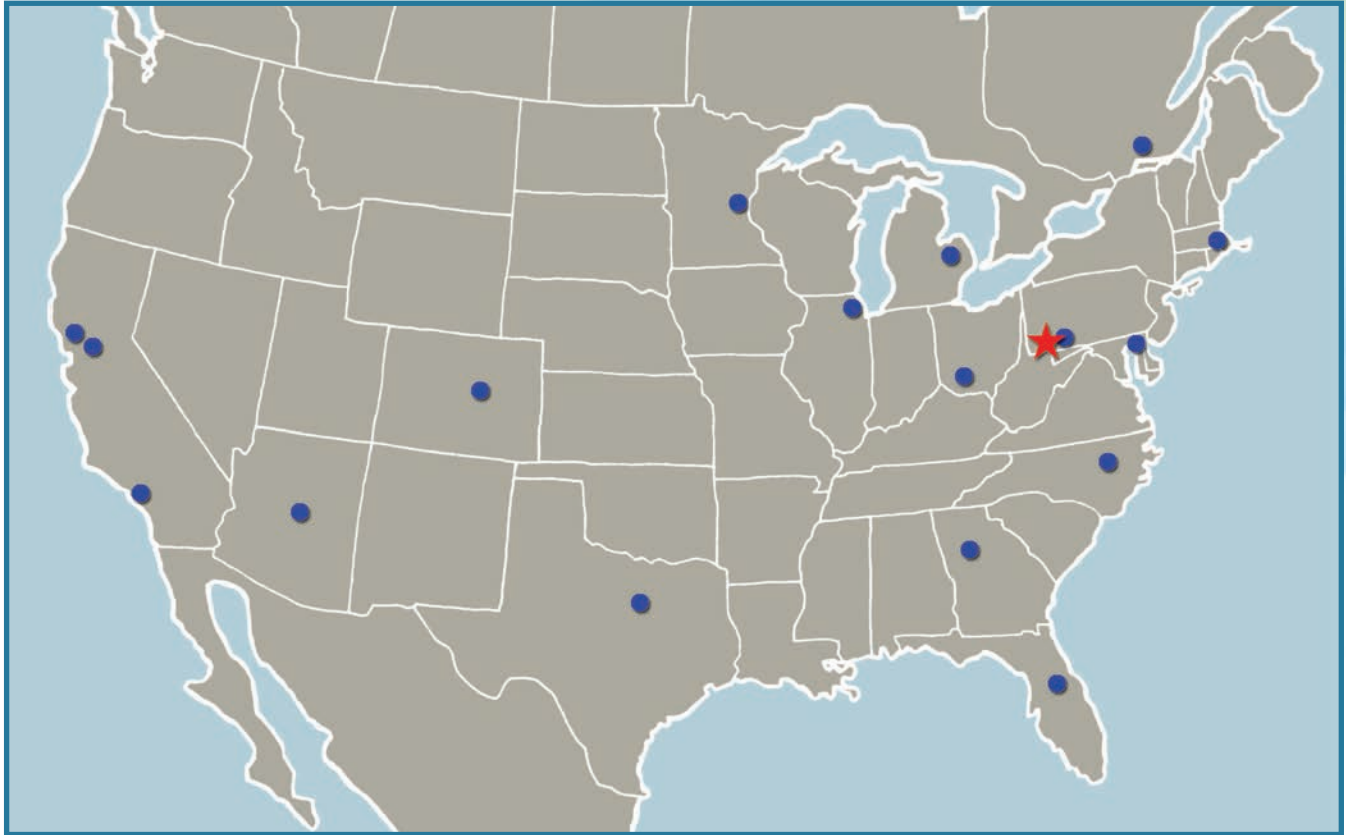
Speed, accuracy and reliability are the key requirements for pick-and-place machines, stencil cutting machines, printed circuit board assembly and other electronic manufacturing and assembly equipment. Since 1970 Aerotech has exceeded the most stringent criteria used to judge electronic manufacturing and assembly equipment, and we continue to raise the standard with our advanced motion technologies by addressing industry-specific challenges in pick-and-place machines, stencil cutting machines and printed circuit board assembly systems.



Test and Inspection

Aerotech is involved in test and inspection across a wide array of industries with applications including CMMs, ultrasonic, eddy current, x-ray, optical, and electronic. All of these applications rely on Aerotech products' unmatched precision, accuracy, and durability. Optical inspection solutions range from high-end linear-motor-driven models packaged with all control elements in an optimized machine base, to modular systems specifically designed for cost-sensitive applications.

Aerotech's Worldwide Sales and Service Locations



★ - Aerotech Headquarters ● - Direct Field Sales Office ▲ - Aerotech Subsidiary ■ - Representative

www.aerotech.com

