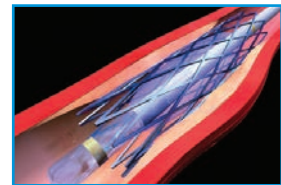
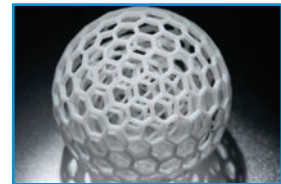
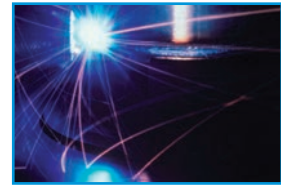




*Dedicated to the  
Science of Motion*

# CAPABILITIES IN LASER PROCESSING and MICROMACHINING

Cutting • Ablation • Marking • Micromachining  
Welding • Drilling • Scribing



## ADVANCED HIGH TECHNOLOGY MANUFACTURING SOLUTIONS FOR:

Medical Device Fabrication  
Data Storage Components and Systems  
Semiconductor Wafer and Devices  
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Automotive Parts Fabrication  
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# HIGH-THROUGHPUT LASER MANUFACTURING

Since 1970, Aerotech has been dedicated to developing solutions for the laser processing industry. We continually enhance our existing product line and invest in new developments to address the most stringent customer requirements. This results in products that offer the highest accuracy, highest throughput, and highest reliability, ultimately leading to the lowest cost of ownership for our customers.

Aerotech's broad range of motion control products means we can provide the optimal solution for your application. Our expertise includes systems for shop floor, R&D, vacuum, and cleanroom environments. Our ability to provide custom-engineered products and systems to end users, integrators, and high-volume OEMs is unmatched, and our products deliver quality, performance, flexibility, and the highest return on investment.

Aerotech's focused development has led to our state-of-the-art Automation 3200 motion controller capable of synchronizing 32 axes of motion, with advanced features such as Position Synchronized Output (PSO) for precise laser control, coordinated motion between servomotors and galvos (Nmark™ SSaM and CLS), seamless integration of PLCs, and sophisticated plotting and diagnostic utilities that enable rapid debugging of process and motion parameters.

Coupling these advanced control features with mechanics that are designed for long life and low maintenance in harsh environments provides laser machine manufacturers the means to build the best overall systems in the industry.

## Laser Processes Served:

- Cutting
- Welding
- Marking and Engraving
- Drilling
- Ablation
- Micromachining
- Cladding
- Peening



# SOLUTIONS FOR LASER CUTTING APPLICATIONS

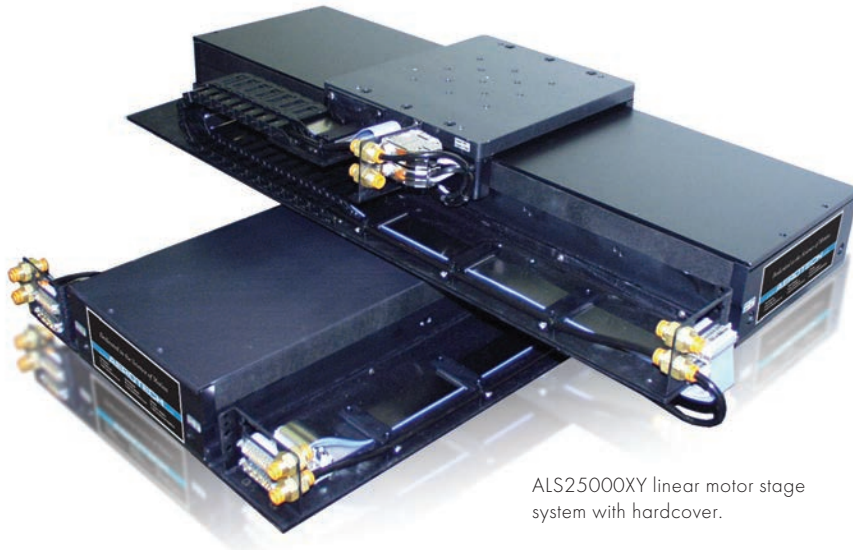
Laser cutting involves directing the focused light of a laser, which then either melts, burns, or vaporizes away material. There are numerous advantages of laser cutting over mechanical cutting, including higher cut quality, no blade wear (since it is a noncontact process), and a smaller heat-affected zone that minimizes part distortion. CO<sub>2</sub> and Nd:YAG lasers are the most popular laser selections, depending on the materials being processed. Typical applications include flat sheet processing, ceramic and diamond cutting, and tube processing.

## FLAT SHEET PROCESSING

Flat sheet processing is typically accomplished with one of two configurations: either with a moving laser over stationary material, or moving material under a stationary laser. Both have advantages, and Aerotech's products are specialized to meet the most aggressive demands of both options.

### Featuring/Recommendations:

- A3200 controller
- High performance linear motor stages (ALS5000/ALS25000 stages)
- Sealed linear-motor gantries (ASGS15000)



ALS25000XY linear motor stage system with hardcover.

### XY Linear Motor Axes

- Hardened protective covers and tensioned side-seals protect internal components
- Integrated multi-axis cable management system for simplified addition of customer cables and hoses
- Noncontact direct-drive motors for highest accuracy contouring of precision components

### Sealed Linear Motor Gantry

- Sealed design protects linear motors and encoders, allowing use in harsh environments
- Low CG of the bridge coupled with dual linear motors/encoders and stiff mounting interfaces permit micron-level dynamic accuracies on high-speed cutting applications
- Large bend radius cable management system is sized for integration of a laser's fiber delivery system for simple and seamless integration of the laser
- Mounting surfaces on the bridge structure enable attachment of optics for free-space laser delivery systems or galvo scanners



ASGS15000 sealed linear motor gantry is perfect for harsh environments.

# CERAMIC CUTTING

Lasers are ideal for cutting and drilling delicate ceramic materials without damaging the workpiece. However, additional care needs to be taken to protect against the fine debris generated. Aerotech's stages are well suited to meet the demanding requirements of ceramic processing while protecting against contamination for 24/7 worry-free operation.

## XY Linear Motor Axes

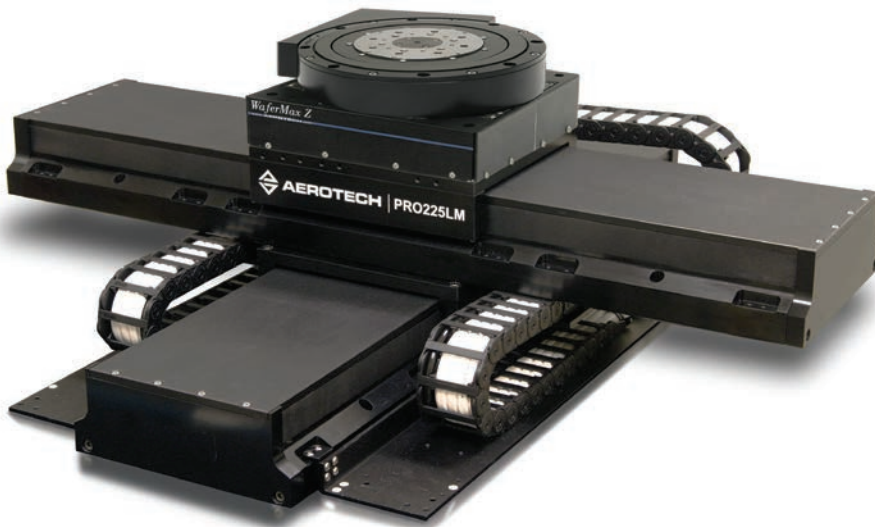
- Wide-body linear motor lower axis provides increased roll stiffness for multi-head ceramic processing, increasing effective work area
- Low angular errors allow accurate placement of part features over large areas while high dynamic stiffness holds tight tolerances on small part features
- Optional air purge, in addition to stage hard cover and side seals, keeps a positive air pressure inside the stage, protecting it against debris and fine particulates for increased system life and consistent quality



Linear-motor-driven ALS5000WB lower axis and ALS5000 upper axis in an XY configuration.

# DIAMOND CUTTING AND PROCESSING

Diamond cutting is one of the main processes involved in altering a diamond from rough stone into a valuable, faceted gem. Since diamonds are one of the hardest surfaces to cut, lasers are uniquely qualified to produce a higher yield of precise and distinctive profiles that are difficult to attain with traditional cutting methods.



## XYθ Direct-Drive Axes

- Extremely smooth velocity regulation for higher surface quality and decreased material waste
- Precise multi-axis contouring for processing complex profiles while maintaining high product yields
- Direct-drive stages for maintenance-free operation

# SOLUTIONS FOR LASER MICROMACHINING

Laser micromachining can be loosely defined as the manufacturing of parts with geometries in the 100s of microns with geometric tolerances in the 1- to 10-micron range. Working with these small feature sizes does not necessarily imply correspondingly small net part size. Large parts composed of many small features, such as stencils, can be considered for a micromachining process. Likewise, applications such as laser cutting of stents, resistor trimming, and 3D prototyping also fall into this category. Aerotech can provide a wide range of motion platforms with optimized control architectures capable of maintaining micron-level part geometries for parts ranging in size from 1 to 1000 mm.

## STENTS, HYPOTUBES, AND CYLINDRICAL MATERIAL PROCESSING

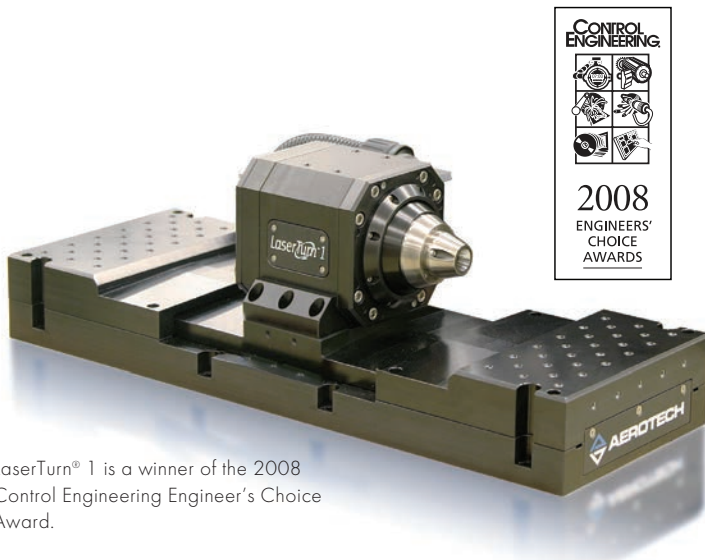
Many laser cutting and welding processes require the handling of cylindrical or bar-stock-type materials. Aerotech's extensive line of products includes component-level solutions as well as optimized, combination linear/rotary motion systems designed to automate the handling of these materials. Direct-drive technology coupled with a frictionless rotary union for collet actuation enable speeds in excess of 600 rpm for high-throughput applications. ER collets are available for precision cylindrical-gripping applications, and a 3-jaw concentric gripper is available for I.D./O.D. and odd-form profiles.

### Featuring/Recommendations:

- A3200 controller
- Integrated mechanical packages (LaserTurn® 1, LaserTurn® 2, LaserTurn® 5)
- Direct-drive, high-torque, rotary axis with integral pneumatic collet adapter or 3-jaw gripper (ACS, ACS LP)

### 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



LaserTurn® 1 is a winner of the 2008 Control Engineering Engineer's Choice Award.

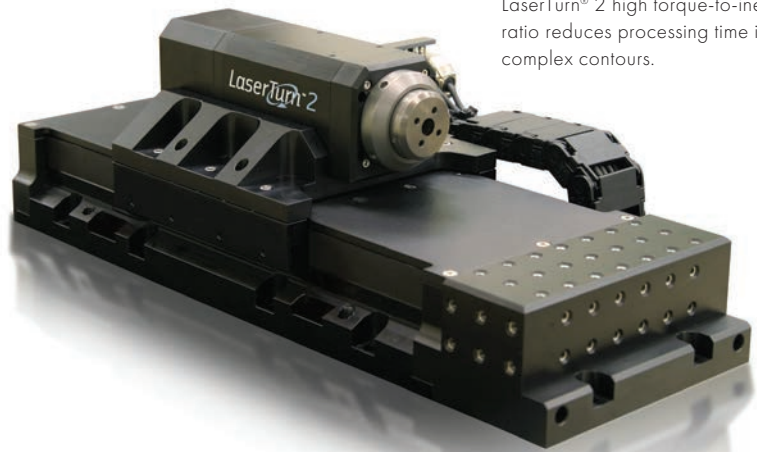
### LaserTurn® 1

- Tube capacity from 0.1 micron to 5 mm
- Combined low inertia rotary axis and low mass moving stage provides 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

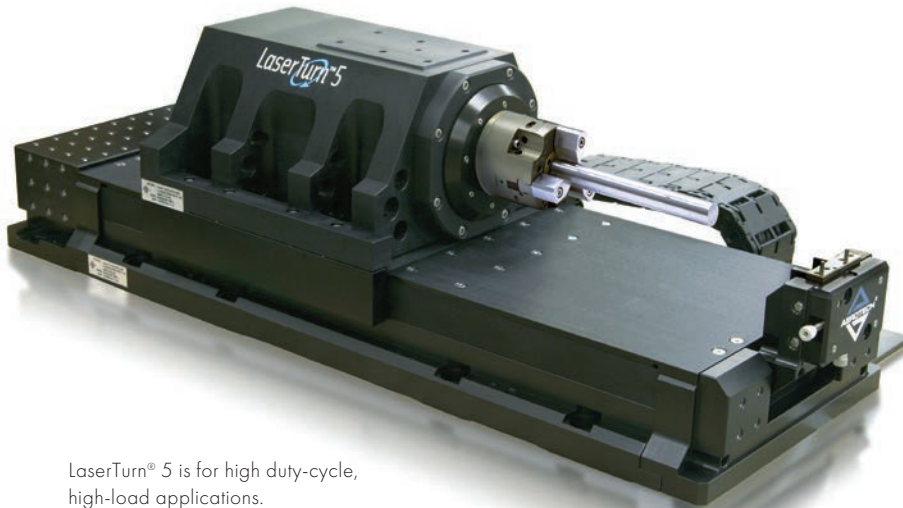
# STENTS, HYPOTUBES, AND CYLINDRICAL MATERIAL PROCESSING

## LaserTurn® 2

- Tube capacity from 0.5 micron 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® 2 high torque-to-inertia ratio reduces processing time in complex contours.



LaserTurn® 5 is for high duty-cycle, high-load applications.

## 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

## 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
- Integral mounting features support customer-supplied wet-cutting accessories
- Direct-drive brushless motor and encoder



Aerotech's CCS series rotary stages with integrated captured collet chucks provide automated material handling capability for a wide range of materials and applications.

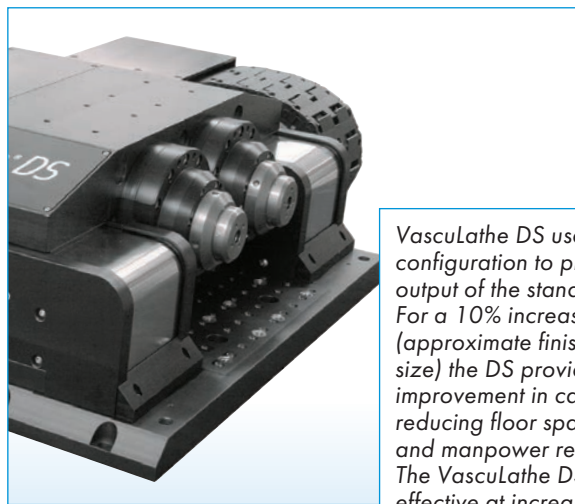
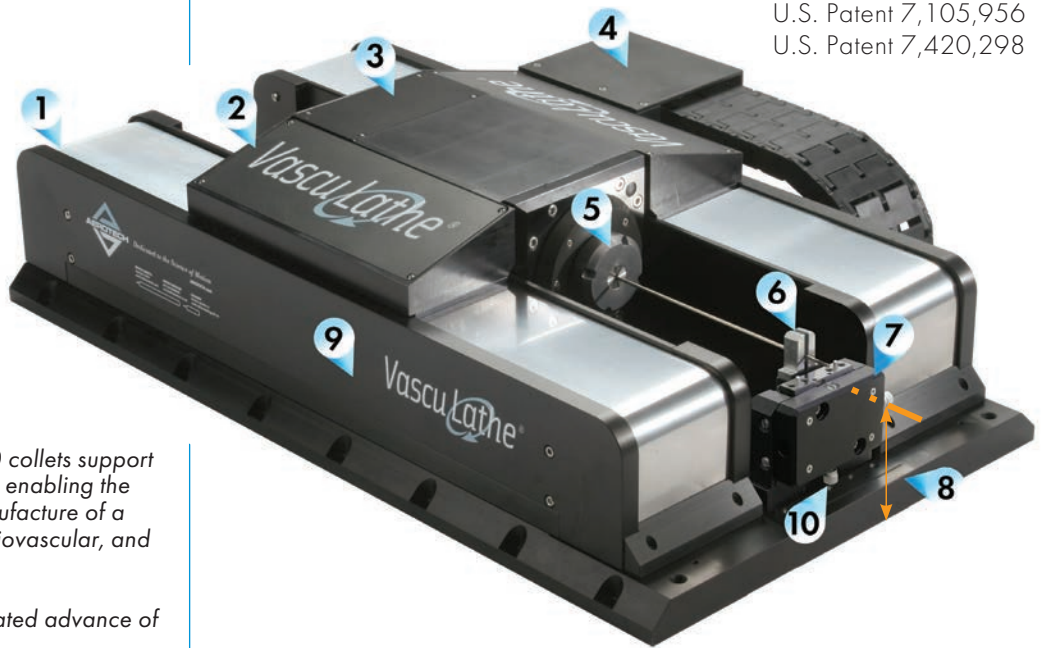
# STENTS, HYPOTUBES, AND CYLINDRICAL MATERIAL PROCESSING

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 2 to 5 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, 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.

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

- 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

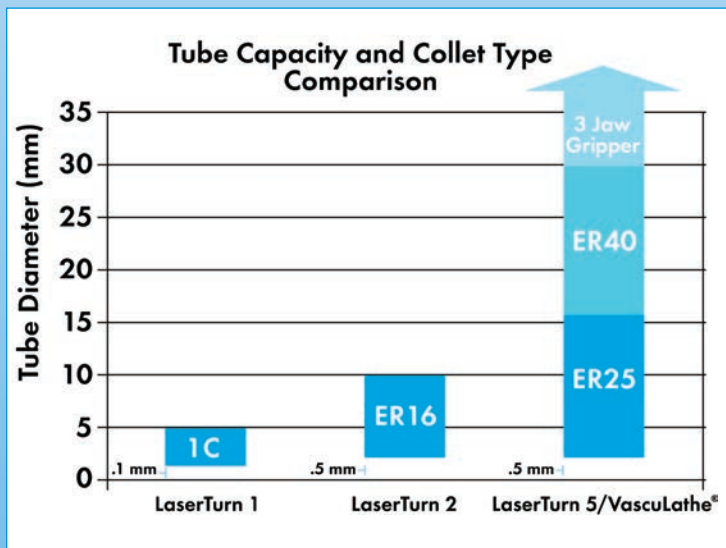
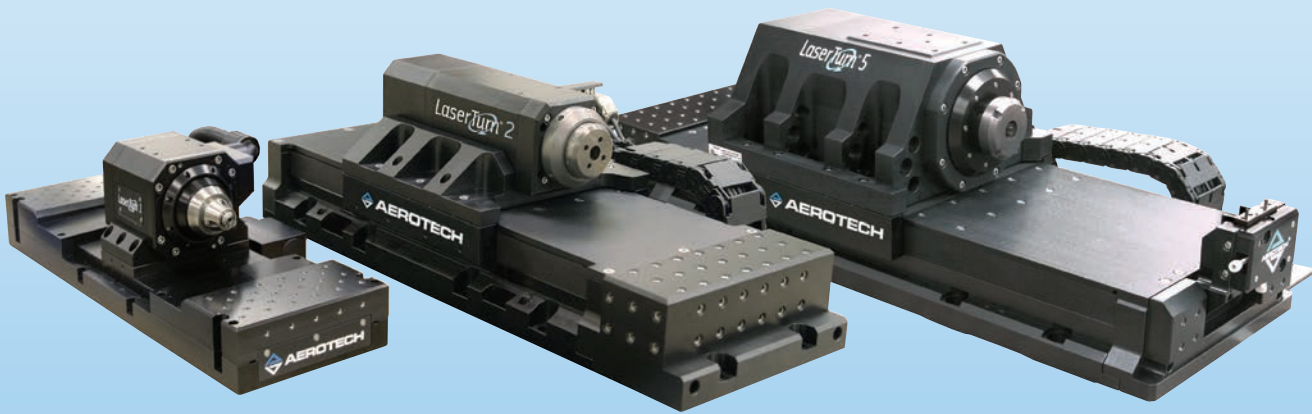
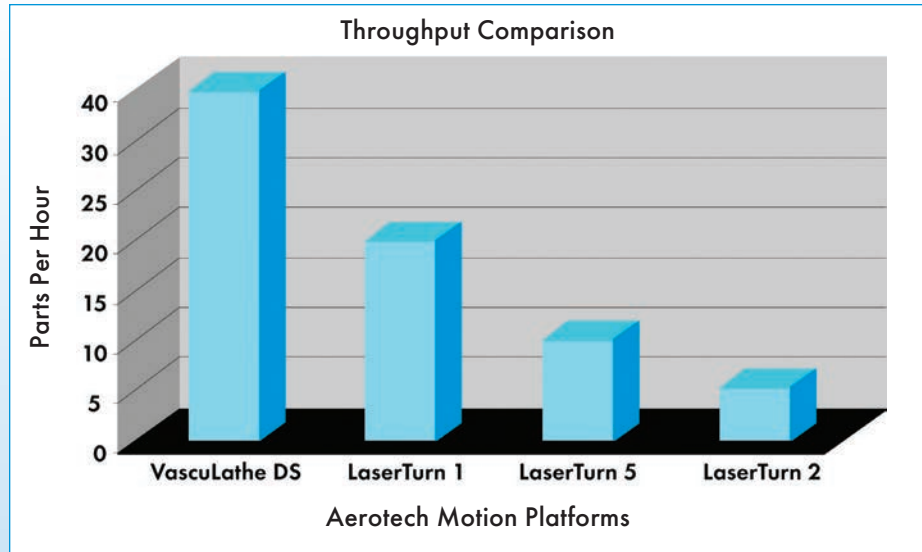


Vasculathe DS uses a dual spindle configuration to produce twice the output of the standard Vasculathe. For a 10% increase in space (approximate finished machine size) the DS provides a 100% improvement in capacity, further reducing floor space, facility, and manpower requirements. The Vasculathe DS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



# STENTS, HYPOTUBES, AND CYLINDRICAL MATERIAL PROCESSING

For a given part manufacturing tolerance, the VascuLathe produces 13 times as many parts per hour when compared to the entry-level LaserTurn 2.

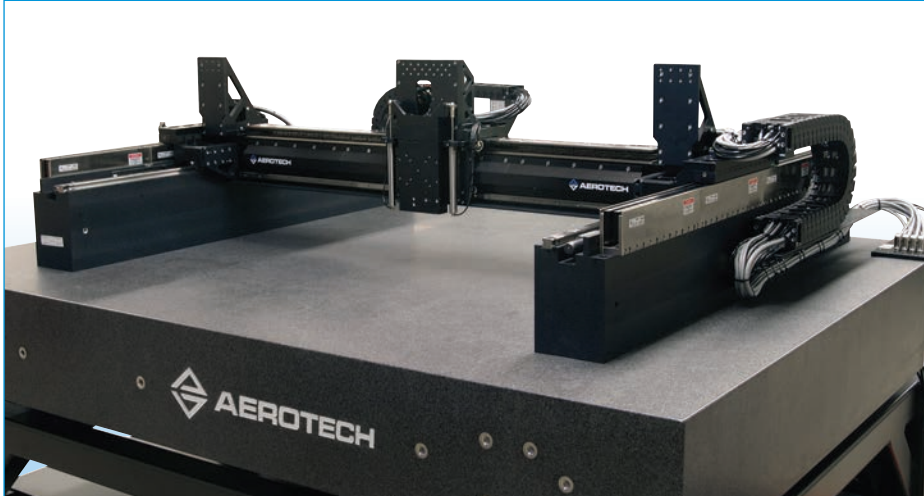


When cutting speeds and cycle times are fixed by process variables, the VascuLathe can provide a 3X improvement in contour accuracy when compared to the LaserTurn product family.

Maximum Continuous Cut Part Length	
LaserTurn 1	100 mm
LaserTurn 2	300 mm
LaserTurn 5	300 mm
VascuLathe	300 mm

# STENCILS AND PCB MICROMACHINING

The manufacture of stencils and PCBs presents unique challenges for a laser micromachining system. The relatively large size of the parts coupled with high feature density requires a positioning system with long travel, high rms force output, and a stiff mechanical structure to ensure micron-level form accuracy. Aerotech's AGS15000 series gantry has been optimized for stencil and other high-accuracy, high-throughput, laser machining processes. The bridge height is reduced to minimize final working height of the optics, significantly reducing parasitic error motion, and dual linear motors and linear encoders eliminate yaw errors over the full travel.



The AGS15000 series Cartesian gantry system is designed for ultra-precision, high-dynamic contouring.

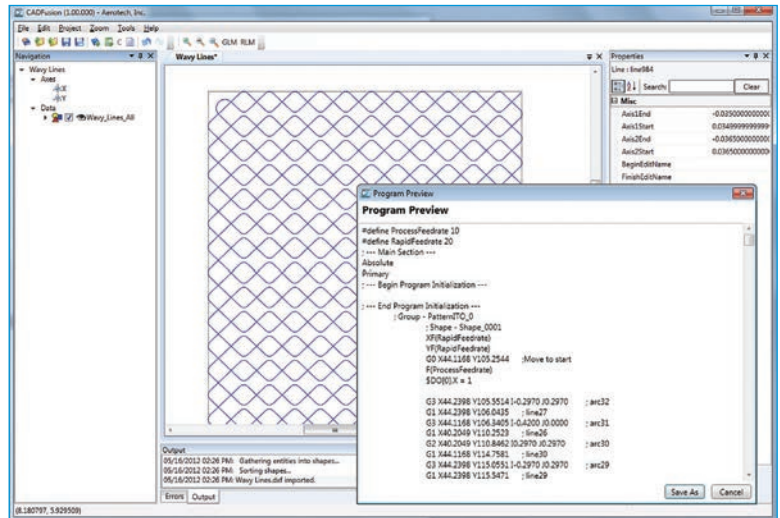
U.S. Patent 7,401,412

## AGS15000

- Bridge axis driven through its center of gravity to greatly increase the resonant frequency of the system, improving geometric tolerances of the stencil apertures
- Custom cable management systems support Z axes, autofocus height-sensing heads, and fiber-laser beam delivery

## CADfusion

CADfusion bridges the gap between part drawings and motion control. Users need only import a vector-based DXF drawing into this easy-to-use environment to see the resulting tool-path graphically on CADfusion's canvas. Part optimization is easy and intuitive with shape re-ordering, feature scaling, and rotational/translational features at your fingertips. Overall process management, including local and global feedrate control and lead in/out moves, can be automatically configured in advance so that every import file produces a consistent motion control program.



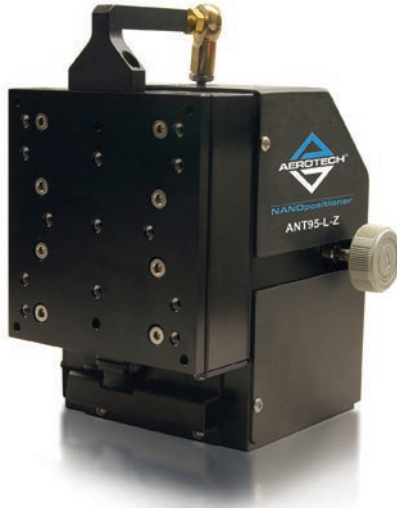
CADfusion easily imports vector-based drawing files and produces G-code motion programs.

# LASER MICROMACHINING COMPONENTS

The majority of laser micromachining applications involve components on the order of 100 x 100 x 100 mm and smaller. Aerotech offers component stages and preconfigured one- to three-axis assemblies that are well suited for these operational volumes. The recommended platforms are all direct-drive, direct-feedback devices that have the submicron resolution and accuracy required for this application space.



The ANT130-L-Z is available with 35 or 60 mm travel.



The ANT95-L-Z is available with 25 or 50 mm travel.

## ANT95-L-Z and ANT130-L-Z

- Nanometer performance in a large travel format
- High resolution (2 nm), repeatability (75 nm) and accuracy (300 nm)
- In-position stability of <2 nm
- Anti-creep crossed-roller bearings
- High dynamic performance

## ANT95-L Single-Axis Linear Stage

- Noncontact, non-cogging, frictionless direct-drive – zero backlash or hysteresis
- High resolution (1 nm), repeatability (75 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



The ANT95-L series offers 25, 50, 75 or 100 mm travel.



The ANT-20G series offers a 20° rotation angle.

## ANT-20G Goniometers

- Noncontact, non-cogging, frictionless direct-drive for zero backlash or hysteresis
- High speed (150°/s)
- High resolution (0.05 arc second)
- Excellent in-position stability
- Large angular range – 20° of travel
- Orthogonal mounting of two cradles provides rotation about the same point
- No maintenance
- Compact design

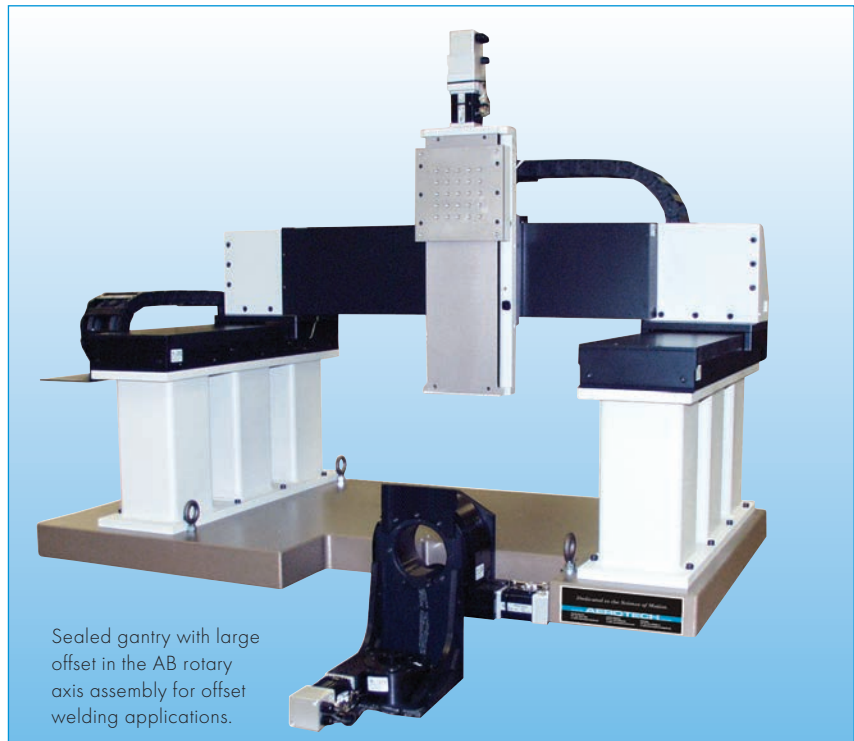
# SOLUTIONS FOR LASER WELDING

## 2D AND 3D WELDING

2D and 3D laser welding processes are used in a variety of industries for a vast array of products. Lasers provide a significant advantage in terms of throughput, speed, and weld quality. Aerotech has successfully designed and built a multitude of systems for the most demanding of these applications. The combination of our award-winning controllers and reliable mechanical components results in an edge over any competing technology.

### Precision Multi-Axis Assemblies

- Combining linear and rotary axes ensures that the laser beam delivery is perpendicular to the part, providing maximum control over quality and consistency
- Systems can be precision-aligned to maintain tight tolerances and sealed to protect your capital investment



Sealed gantry with large offset in the AB rotary axis assembly for offset welding applications.

### Multi-Axis Linear/Rotary Combinations

- Low profile, direct-drive configurations feature high resolution and a compact form factor, a combination that maximizes productivity per unit of space



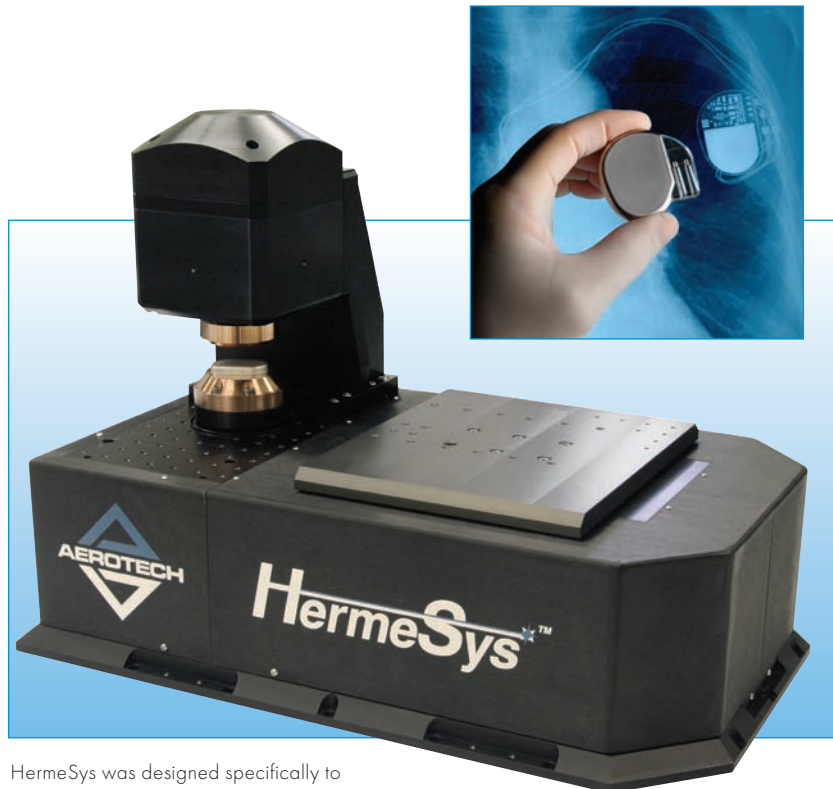
Direct-drive linear and rotary stages make up this four-axis linear/rotary combination system.

# HERMETIC SEAM WELDING

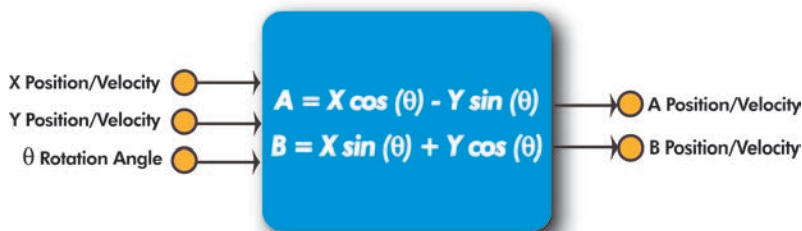
The market for implantable medical devices, such as pacemakers, defibrillators, and neurostimulators, is expanding. As technology advances, the processes required to make these devices safe and effective are becoming increasingly complex. Laser welding, in particular, has allowed the processes to keep pace with the demands of the market. Aerotech has the expertise and experience in medical device manufacturing requirements to provide an optimal solution with maximum return on investment.

## HermeSys™: A Specially Designed System for Hermetic Seam Welding

- The integrated multi-axis mechanical structure has very high stiffness, which allows high accelerations with minimal following error during the rapid starts/stops and direction changes during the welding process
- Optional dual-driven rotary clamp assembly ensures consistent contact between the half-shells during the welding process
- Three linear axes (X/Y/Z) for welding around case penetrations
- Supports laser heads from multiple vendors with various focal lengths for maximum process flexibility



HermeSys was designed specifically to improve the hermetic seam-welding process.



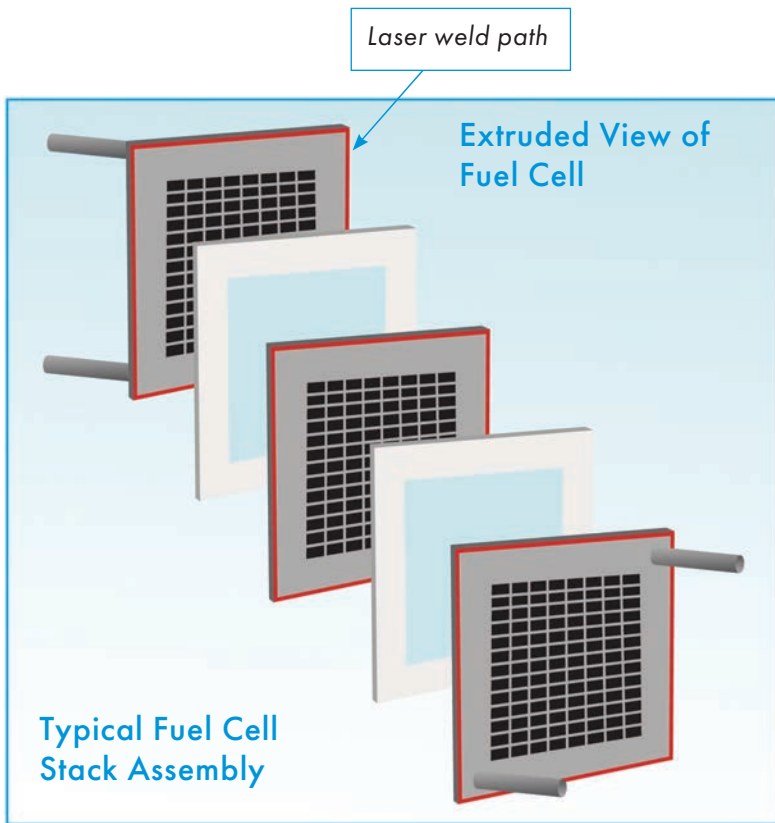
Real-Time Kinematic Transformation

## Real-Time Kinematics in Aerotech's A3200 Controller

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

# FUEL CELL WELDING

Fuel cells are poised to become a significant part of the global transition to renewable energy sources. Their potential is particularly promising for automotive applications, but the requirements for economic production of fuel cells are not trivial. Laser welding is one of the key technologies in the development of this production process. Aerotech has the answers to these challenges.

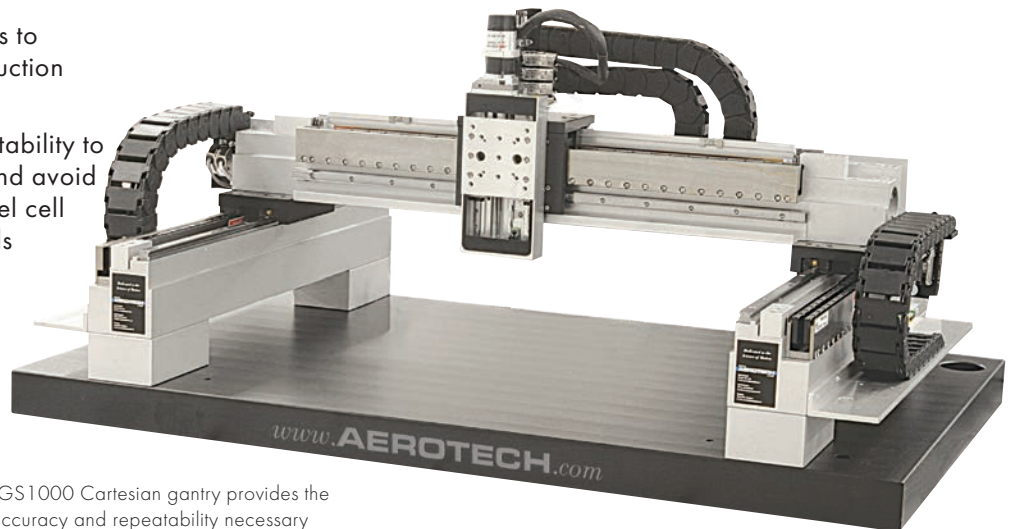


## Aerotech Controllers

- Position Synchronized Output (PSO) for precision laser programming and control on the weld paths in the fuel cell stacks
- Extensive component and application-level diagnostics for easy optimization, such as part path vector error measurement for path program optimization to avoid cumulative errors

## Aerotech Linear Motor Gantries

- High speed of up to 1 m/s to achieve economical production throughput
- High accuracy and repeatability to maintain tight tolerance and avoid cumulative errors in the fuel cell stacks at those high speeds



The AGS1000 Cartesian gantry provides the high accuracy and repeatability necessary for fuel cell welding applications.

# REMOTE LASER WELDING

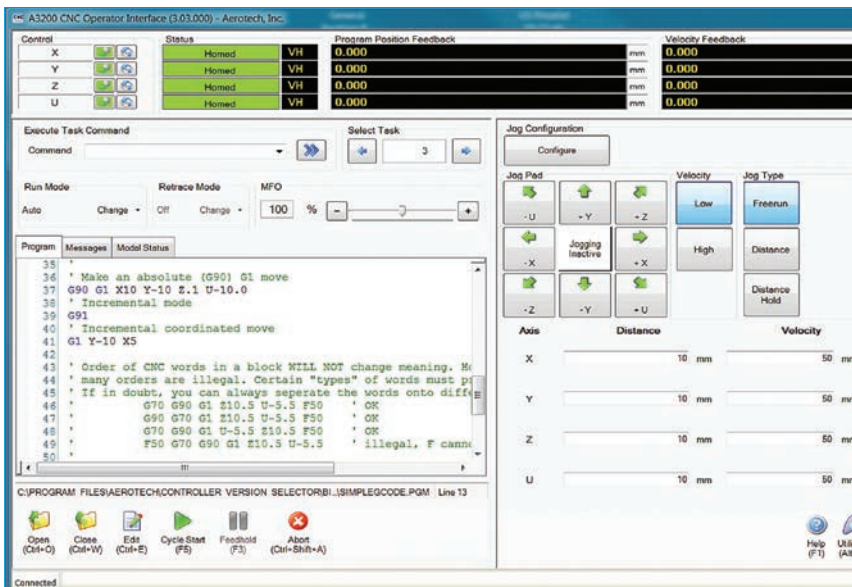
Remote laser welding involves scanning a fixed-focus laser beam over a workpiece from a distance using a mirror mounted on a gimbal. Since minimal setup time is required to position the laser, and the beam may be quickly scanned over a large area with minimal motion, cycle time is significantly reduced.

## AMG LP Series Direct-Drive Gimbals

- High-accuracy angular positioning and high stiffness for precise, repeatable pointing
- Direct drive, brushless servomotors result in zero backlash and arc-second accuracy
- Cog-free design for outstanding velocity stability
- Continuous 360° rotation of azimuth and elevation including built-in slip ring for unlimited application flexibility
- Large mirror capacity well suited for high-power laser applications



AMG LP (Low Profile) gimbals provide precise angular motion with the high performance customers expect from Aerotech products.



## A3200 Controller

Utilizing transformation functions in Aerotech's A3200 controller to transform rotational motion into X/Y Cartesian space allows for simplified programming in linear dimensions or import from CAD drawings.

# SOLUTIONS FOR LASER DRILLING

Nd:Yag and Q-Switched lasers are typically used in laser drilling applications. Laser drilling is usually accomplished using one of two methods: either with percussion laser drilling or trepanning the beam. While percussion drilling is often a faster process, trepanning the beam results in a lower heat-affected zone and allows for complex hole geometries. In both cases, precise contouring of the motion axes is required to maintain tolerances.

## Featuring/Recommendations:

- A3200 controller
- High-performance linear motor stages (ALS5000/ALS5000WB)
- Direct drive, high-torque rotary tilt axis (ADRT)
- Direct drive, low-profile rotary axis (ADR)

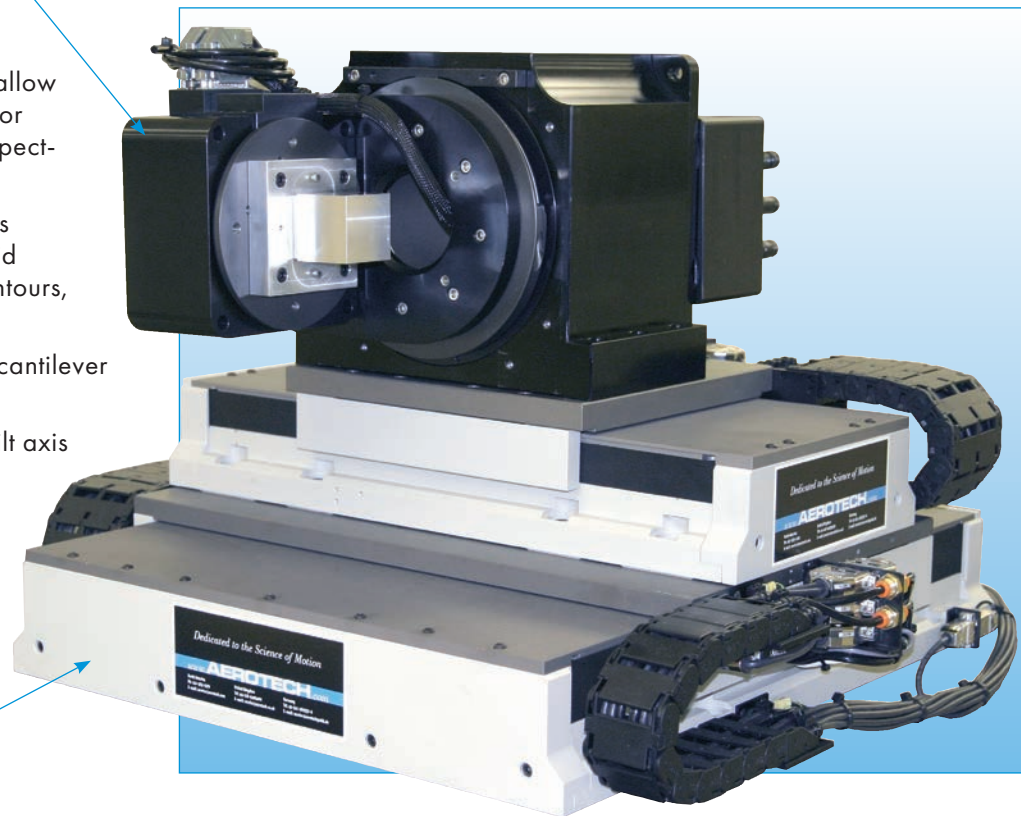
## 3D Hole Drilling for Turbines and Fuel Injectors

Turbine blade and fuel injector hole-drilling requires a complex multi-axis motion platform to ensure the correct orientation and shape of the hole relative to the surface of the part. Depending on the size of the part and required feature accuracy, platforms can be set up as a 5-axis gantry system or split-axis configuration with X/Y/A/B on the machine base and a bridge-mounted Z axis.

ADR160 direct-drive rotary stage

- High resolution direct-drive axes allow micron-level dynamic tolerances for drilling complex contour, deep aspect-ratio holes
- Powerful, noncontact linear motors enable high accelerations for rapid direction reversals of complex contours, increasing throughput
- Wide-body lower axis minimizes cantilever load effects
- Increased bearing separation of tilt axis allows for greater system stiffness and improved part tolerances
- Counterbalanced, direct-drive tilt/rotary axes allow arc-second precision positioning of the part in 3D space

ALS5000 wide-body linear motor stage



Aerotech's direct-drive linear and rotary stages offer the accuracy, speed, and resolution required for today's laser drilling applications.



# SOLUTIONS FOR LASER ABLATION

Ultra-fast lasers and excimer lasers are traditionally used in applications where material ablation is required. Ablation is an athermal process where the photon energy of the light is sufficient to break the chemical bonds at the atomic level, converting the material directly from a solid into a plasma. The time duration of the pulse for ultra-fast lasers is shorter than the heat diffusion time in the material, which results in no thermal damage, recasting, or heat-affected zone. The short pulse duration also produces material removal rates that are quite low (nanometers per pulse) when compared to microsecond-regime IR lasers. This small depth of ablation per pulse can be used to create 3D structures on a nanometer scale.

Excimer lasers also work through an ablation process. However, the beam profile is square or rectangular as opposed to the circular pattern typical of ultra-fast lasers. The excimer beam is passed through a mask that clips the beam energy into a pattern defined by the geometry of the mask. This masking technique makes it easy to ablate complex patterns. Feature sizes projected onto the material through the mask can be adjusted by defocusing the laser, and it is possible to build complex three-dimensional patterns in materials using multiple masks and the defocusing technique.

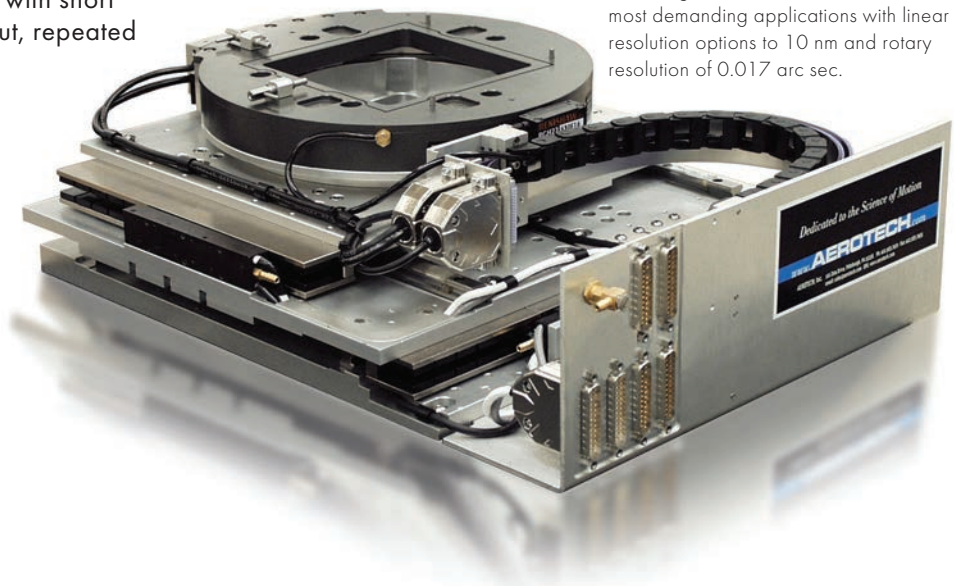
## X/Y/Rotary Mask Alignment Platform

- Low profile X/Y/Rotary combination eases integration into existing optical systems while reducing pitch/roll induced positioning errors
- Large, clear 120 mm aperture allows for exposure of large features or placement of multiple beam profiles on a single mask
- Direct-drive linear motor stage has excellent velocity regulation for moving mask applications
- Very stiff mechanical structure with short settling time for high throughput, repeated move and expose sequences

## Featuring/Recommendations:

- A3200 controller
- High-performance linear motor, open-frame stages (ALS3600)
- Direct drive, open-aperture rotary axis (ADRT)
- Direct drive, low-profile rotary axis (ADRS)

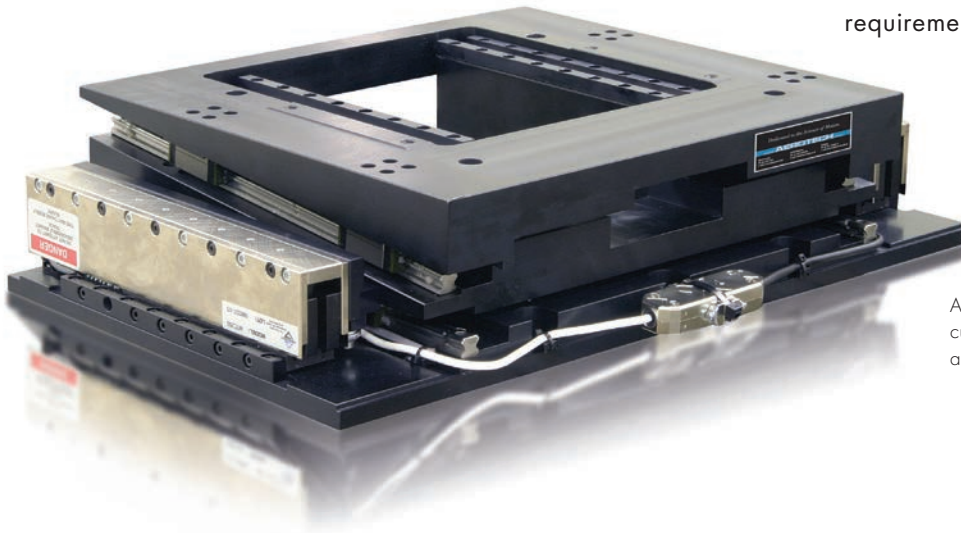
MaskAlign can meet the needs of even the most demanding applications with linear resolution options to 10 nm and rotary resolution of 0.017 arc sec.



# SOLUTIONS FOR LASER ABLATION

## Custom Large-Profile Z-Lift Stage

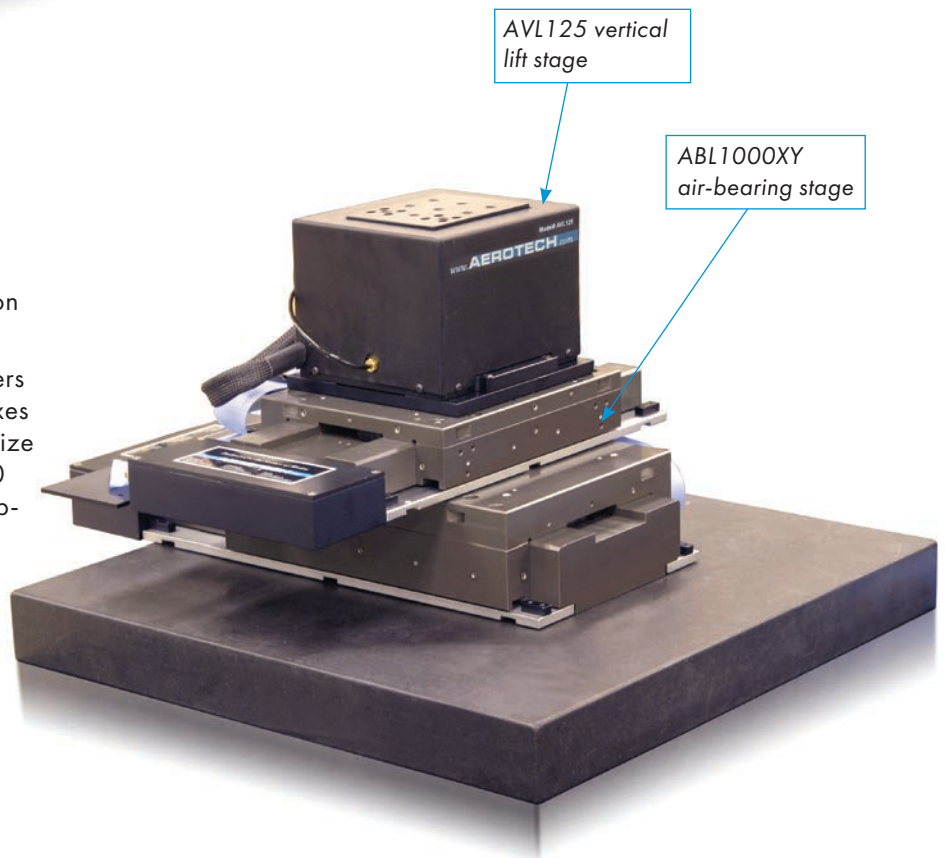
- Large-aperture Z stage provides a stable platform for focal adjustment
- High-speed linear motors allow for fast focal plane changes to quickly modify mask aspect ratios for 2D and 3D applications
- Standard and custom solutions available to suit most any focal plane adjustment requirements



Aerotech can manufacture a custom system to meet your exact application requirements.

## 3D Ultra-Fast Laser Processing

- High-resolution (4.5 nm) lift stage to precisely set focal position in ablation applications
- X/Y air bearings with extremely flat travel maintain consistent focal position over the operating envelope
- Direct-drive linear motors and encoders coupled with the air-bearing linear axes are capable of extremely small step size (10 nm) over large travel areas (100 mm) for the accurate placement of sub-micron part features



# MASK AND MEMORY REPAIR

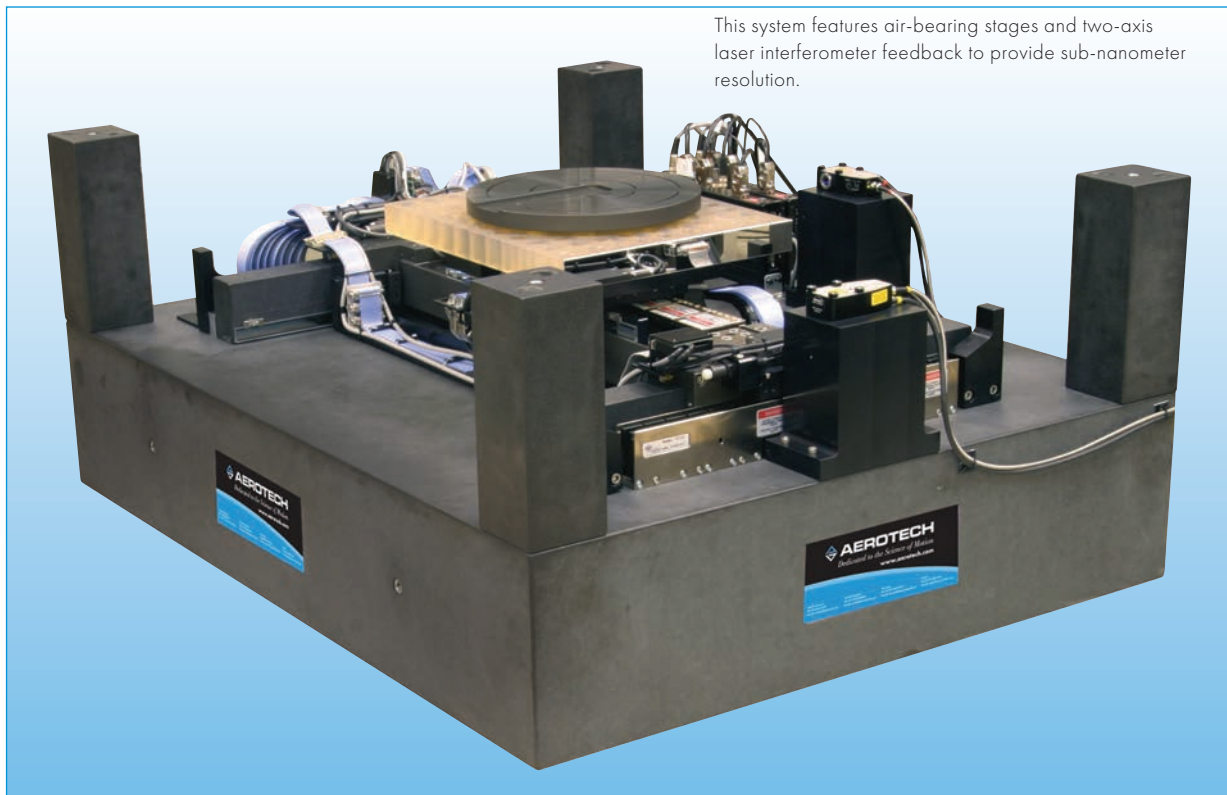
Laser ablation is ideal for the repair of photomasks used in lithography processes as well as the repair of defects in finished semiconductor devices. The increasing density and complexity of the patterns used in modern semiconductor manufacturing processes require precise control of the laser firing position. Precise focal position must also be maintained to limit the variation in spot size. Aerotech's Position Synchronized Output feature ensures that the laser is triggered in the precise location required to ablate the part defects. Firing can be triggered on the fly from an array of positions that represent part defects found during the inspection process. Planar air-bearing stages are used to position the part because their low working height minimizes Abbe errors at the work point, and flat travel minimizes variations of focal position. Two-axis laser interferometer feedback ensures direct measurement of the part location with sub-nanometer resolution.

## Featuring/Recommendations:

- A3200 motion controller
- Position Synchronized Output
- ABL9000 planar air-bearing with interferometer feedback

## Planar X/Y Air-Bearing with Laser Interferometer Feedback

- Planar X/Y air-bearing configuration maintains focal position with extremely flat travel characteristics
- Excellent straightness for repeatable raster scanning operations
- 2D planar laser interferometer feedback directly measures part displacement with sub-nanometer resolution
- Optional precision multi-zone vacuum chuck supports different material sizes



# SOLUTIONS FOR LASER SEMICONDUCTOR PROCESSING

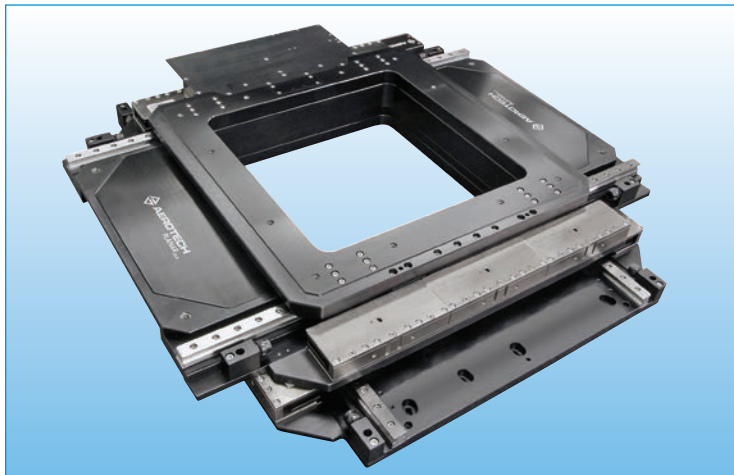
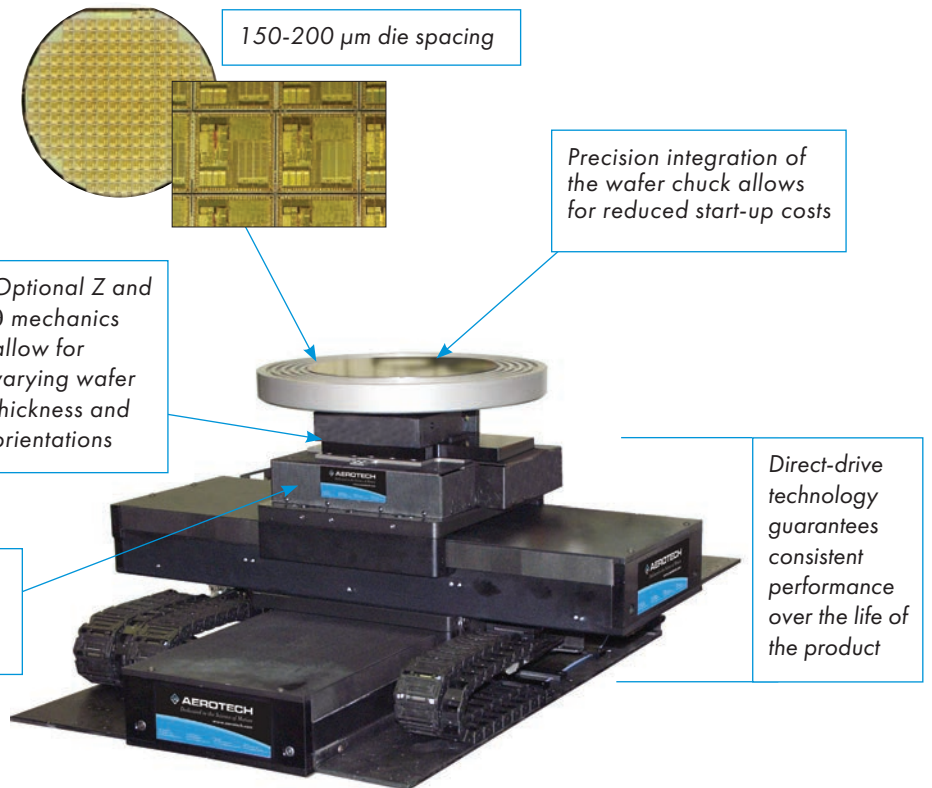
Semiconductors are present in nearly every modern electronic device. Developing techniques to maximize yield and minimize cost during manufacturing is essential to remain competitive and successful in today's marketplace. Lasers have added flexibility during the semiconductor manufacturing process and, coupled with Aerotech's leading-edge motion developments, will allow your process to remain at the forefront of innovation and efficiency.

## WAFER SINGULATION

Wafer singulation (dicing) involves separating the individual silicon chips from a wafer following the processing of the wafer. Singulation with a laser has distinct advantages over a mechanical dicing saw due to the smaller width of the cut, minimized cracking, and reduced heat-affected zone, all of which increase the usable process area of the costly wafer.

### XYZ $\theta$ Linear Motor Axes

- High accuracy, minimized dynamic yaw, and excellent dynamic straightness allow narrow streets for wafer dicing
- Optional Z and  $\theta$  mechanics allow for varying wafer thickness and orientations; scalable mechanics allow handling of multiple wafer sizes



Planar<sub>DIA</sub> Open Frame, XY, Direct-Drive, Mechanical-Bearing Stage

### Open-Frame Linear Motor Axes

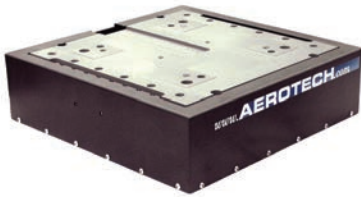
- Large aperture allows for operations on the top and bottom of the substrate
- Minimized planar flatness eliminates the need for autofocus
- Exceptional geometrical tolerances and inherent orthogonality ensure high tolerances are maintained at high speeds

# FLAT-PANEL DISPLAY MANUFACTURING

Flat-panel display manufacturing applications present several challenges for motion systems, including optimizing the dynamic characteristics of the system while accommodating increasingly longer travels. To meet these demands, Aerotech has applied our patented technologies to design systems ideally suited for flat-panel display applications.

## Planar Air-Bearing

- Optimized dynamic straightness and yaw characteristics to ensure scan-line parallelism throughout full travel
- Granite reference ensures optimal flatness
- Simplified integration of additional process related systems onto custom bridge structures
- Scalable mechanics can accommodate various panel sizes
- Optional direct-drive rotary stage provides high accuracy rotational motion for fiducial alignment
- Optional high-stiffness Z axis provides focus adjustment to accommodate panel thickness variations while minimizing angular errors induced during XY turns



### AVL1000

Optional high-stiffness Z axis provides focus adjustment to accommodate panel thickness variations while at the same time minimizing angular errors induced during XY turns.



### ARA1000

Optional direct-drive rotary stage provides highly accurate rotational motion for fiducial/pattern alignment.



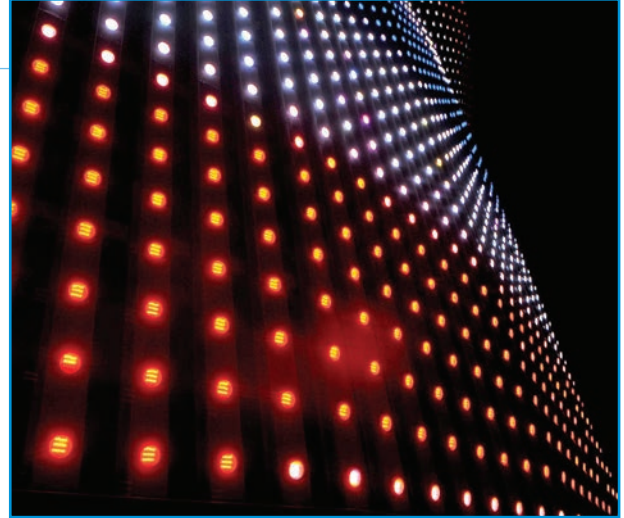
This gantry-style FPD inspection station features a travel of 1800 x 800 x 200 mm.

# SOLUTIONS FOR LASER SCRIBING

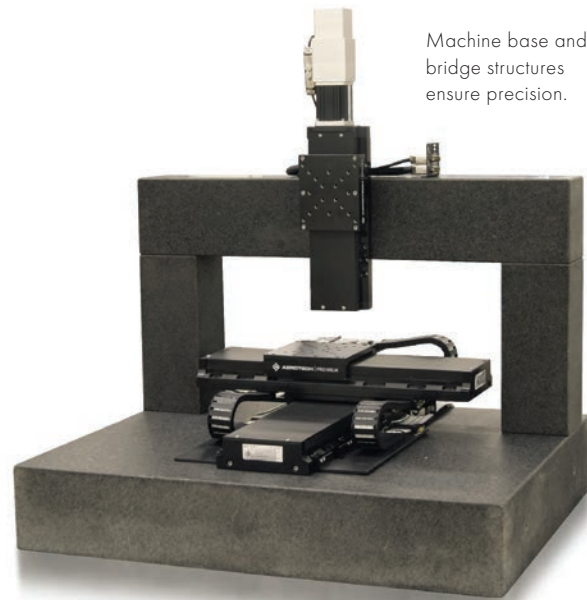
Laser scribing is the process of ablating and removing thin film-materials in a variety of patterns. Lasers offer a number of advantages over mechanical scribing including higher precision processing, greater control during the patterning, smaller kerf width, and quicker processing speeds. Aerotech systems are engineered to take advantage of these capabilities.

## LED SCRIBING

LEDs continue to be utilized in an increasing range of applications including backlighting of electronic devices such as mobile phones, televisions and tablet PCs, automobiles and general lighting. Improving throughput and yield through manufacturing efficiencies will be vital to reduce product cost.



Machine base and bridge structures ensure precision.



Open-frame designs allow dual-sided scribing.

- Various travels and configurations available
- Excellent dynamic straightness allows high yield even when narrow street widths are required
- High precision combined with high speed in special scribe operations
- Tightly coordinated control of stages and laser ensures uniform spot overlapping
- Various direct-drive rotary options for precision wafer alignment and accurate dual-direction scribing
- Optional machine base and bridge structure ensure precision alignment and system-level performance
- Optional open-frame designs for dual-sided scribing

# SOLUTIONS FOR LASER MARKING

Laser marking applications use high-speed rotational mirror assemblies, typically referred to as scanners, to direct a laser onto a workpiece. The technology is deployed in a wide array of applications due to its low cost and high speed.

Scanner resolution and accuracy is fixed over the full angular travel of the mirrors. As the field of view of the scanner increases, the effective marking resolution and accuracy decreases. In many applications the scanner is combined with traditional linear or rotary servo axes to mark regions larger than the field of view. The marking sequence consists of a movement by the servo stage followed by a marking operation with the scanner. Using this approach, repetitive marking patterns that fit within a single field of view can be distributed over a large area.

## PCB MARKING

PCB marking applications involve the writing of barcodes, symbols, and other character-type data. Multiple PCBs are grouped in pallets and presented to the machine for marking. The small size of the features being marked requires a correspondingly small field of view to ensure legible results. The scanner must be moved over the pallets with an X/Y positioning system to access all the regions to be marked.

### Cartesius Standard Duty

- Cartesian gantry configuration eases integration of conveyor systems for automated marking processes
- High-pitch screw option supports speeds in excess of 1000 mm/s for maximum throughput
- Multiple system configurations optimized for various load capacities
- Optional Z axis (shown) for automated focal adjustment



The Cartesius gantry is available in both standard duty (shown) and heavy duty versions to match your application.

# Nmark GCL High-Performance Galvo Control



## Nmark GCL Features

- Micro-amp/degree and sin/cos primary feedback inputs
- Two channels of 40 MHz line driver quadrature encoder inputs for marking on the fly or IFOV
- Eight optically-isolated digital inputs (5/24 V)
- Eight optically-isolated digital outputs, sinking or sourcing (5/24 V)
- Four 16-bit differential analog inputs
- Three 16-bit analog outputs
- Eight digital inputs
- Two digital outputs
- Three optically-isolated laser outputs
- Three differential laser outputs
- Three FireWire® ports
- Dedicated 5-24 V emergency stop sense input
- Internal power supply
- 5 VDC, 500 mA user output power for encoder
- Laser outputs configurable as sinking or sourcing

# AGV GALVANOMETER



## AGV Specifications

Mechanical Specifications		AGV-10HP	AGV-14HP	AGV-20HP
Beam Aperture		10 mm	14 mm	20 mm
Maximum Scan Angle (Optical)		±20°		
Beam Displacement		13.0 mm	18.00 mm	25.1 mm
Resolution		0.05 µrad (>23 bit)	0.03 µrad (>24 bit)	0.03 µrad (>24 bit)
Environment	Operating	0 to 50°C; 90% RH maximum (no condensation)		
	Storage	-20 to 60°C; 90% RH maximum (no condensation)		
Material		Aluminum (Black Anodize Base/Blue Powder Coat Cover)		
MTBF (Mean Time Between Failure)		20,000 hours		

Electrical Specifications		AGV-10HP	AGV-14HP	AGV-20HP
Drive System		Brushless Direct-Drive Galvano Motor		
Feedback		Noncontact Rotary Encoder		



- Expand scanner field-of-view without sacrificing effective pixel resolution
- Mark long vectors with one continuous pass
- Draw large-scale graphics without stitching multiple exposures
- Mark on a tube or other irregularly shaped object without manually repositioning
- Single programming environment for both scanner and servo axes minimizes application complexity
- Laser firing based on real-time scanner position

## Continuing Excellence in Combined Scanner/Servo Motion

Aerotech's Nmark CLS closed-loop scanner module for the Automation 3200 motion platform allows direct control of galvo scanner servo motion for marking parts of unlimited size and complexity. The 100% digital scanner control removes the need for programmable delays in the marking sequence, and allows laser firing (PSO) based on real-time scanner positional feedback.

## Infinite Scanner Field of View (IFoV)

Scanners have been used with servo axes to mark objects that exceed the operating envelope of the scanner. Applications were previously implemented using a move and expose sequence where the scanner would mark the part and the servo would reposition the part for a subsequent marking operation. This approach has limitations when a feature being marked exceeds the field-of-view of the scanner. Small angular and linear offsets in the servo axes produce discontinuities in the features that cross the boundary between adjacent marking fields. By combining the servo and scanner control into a single platform, it is now possible to mark large features with continuous motion of the servo axis and simultaneous marking by the scanner.

## Making the Difficult Easy

Direct, coordinated control of scanner and servo axes in one integrated software environment eliminates the programming overhead associated with interfacing two separate control systems, resulting in reduced implementation time and increased marking efficiency. Scanner motion can be combined with rotary axis motion to mark on the face or edge of cylindrical profiles. Rectangular bitmaps that exceed the scanner field-of-view width can be marked in one continuous operation. Complex operations comprised of many small features distributed across a large area can be marked in a continuous fashion with a significant reduction in processing time.

## Full Featured I/O

Nmark CLS has support for CO<sup>2</sup> and YAG lasers with specialized functions such as first-pulse suppression and tickle frequency outputs. Control signals can be configured as sinking or sourcing, 5-24 VDC, allowing for easy interface to many different laser manufacturers. General purpose analog and digital I/O is also provided for control or monitoring functions such as laser power, door interlocks, pump operation, and material handling. Two high-speed encoder inputs are available for synchronization with moving material applications (marking on the fly).

## Design Choices

10, 14 and 20 mm apertures with standard F-Theta lens interfaces provide maximum application flexibility. The AGV can be configured to accommodate 1064, 532, and 355 nm wavelengths with others available. Furthermore, a variety of focal lengths are available as standard, with correction files provided to remove lens distortion effects.

- Optical feedback device offers outstanding thermal stability
- Industry-best resolution of >24 bits when used with Aerotech's Nmark CLS controller
- Wide range of apertures and focal lengths
- Many choices of mirror surface treatments for a variety of laser wavelengths

# SOLUTIONS FOR GENERAL LASER PROCESSING

Advanced laser processes demand an equally advanced set of mechanical components to meet today's demanding specifications. Aerotech's robust, complete line of linear and rotary stages is designed to take on all environments and applications. Aerotech mechanical systems will outperform any other in laboratory, production, vacuum, and cleanroom environments.

## Available options on linear and rotary stages:

- Direct drive or ball screw
- Vacuum preparation
- Mechanical bearing or air bearing
- Cleanroom assembly and preparation

## PRO SERIES LINEAR STAGES

The PRO Series is designed to operate in demanding production environments. Four different models with multiple base widths are available to provide maximum flexibility for a wide range of manufacturing applications. Many models of the PRO Series are stocked in the Aerotech Fast Delivery Service program, allowing for shipment in 1-2 weeks or less for time-critical applications.

### Key PRO Series features include:

- External mounting features for quick system assembly
- Hardcover design with side seals provides years of maintenance-free operation
- Multiple frame sizes and large travel selection supports a wide range of load requirements
- NEMA motor interface allows for the attachment of standard brush, brushless, and stepper motors



The PRO Series consists of the PRO115, PRO165, PRO225, and PRO280 (not shown). These hardcover, side-sealed stages are well-suited for many different laser processing applications.



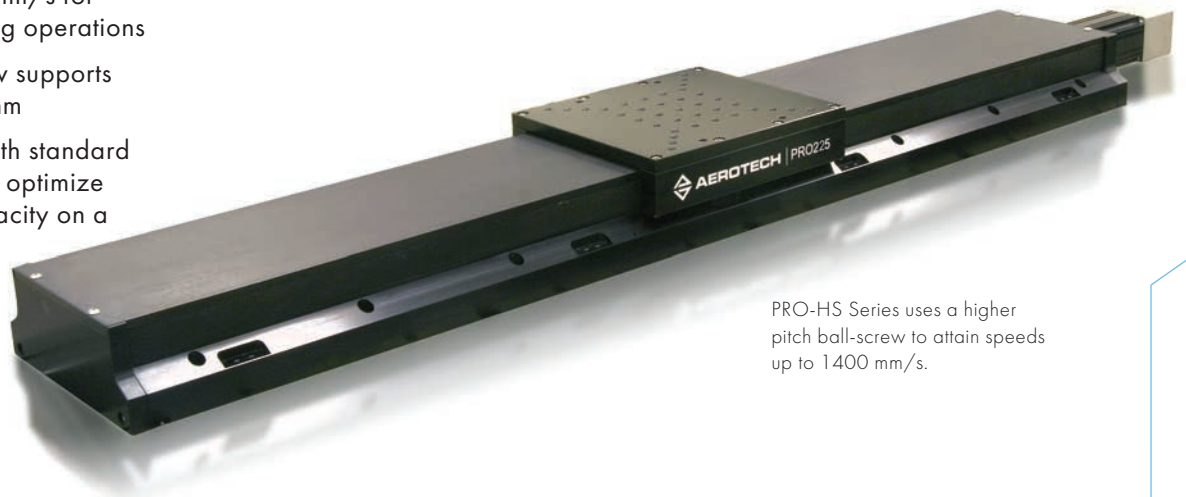
The PRO Series is available in a large range of travels, with many models part of the Aerotech Fast Delivery Service program.

## PRO Series XY

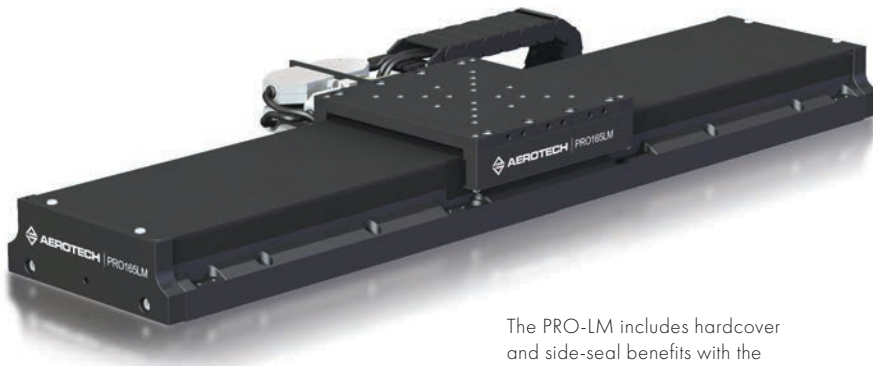
- Micron-level accuracy and repeatability matches up well with YAG-based laser processing applications
- 5 mm/rev screw suitable for vertical axis applications
- Foldback option available for space-constrained applications

## PRO-HS Series

- Higher pitch ball-screw allows for speeds up to 1400 mm/s for high-speed machining operations
- Large diameter screw supports travels up to 1500 mm
- Can be combined with standard PRO Series stages to optimize speed and load capacity on a per-axis basis



PRO-HS Series uses a higher pitch ball-screw to attain speeds up to 1400 mm/s.

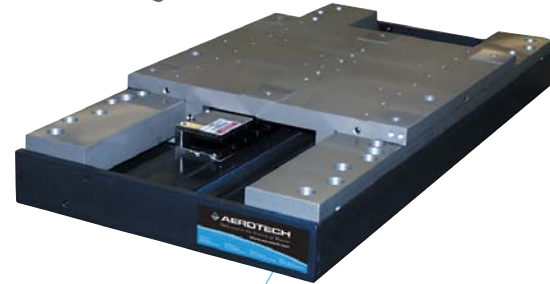
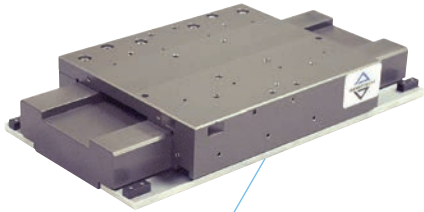
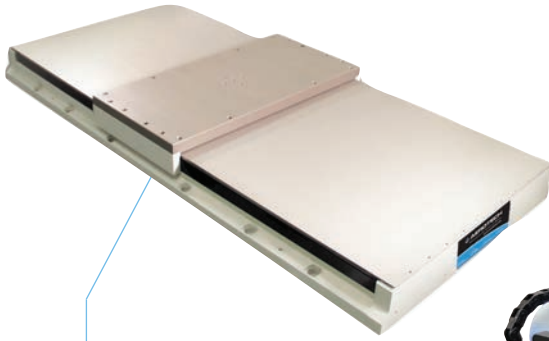


The PRO-LM includes hardcover and side-seal benefits with the higher speed and accuracy available from a linear motor.

## PRO-LM Series

- Direct-drive linear motor with linear encoder provides higher top speed and acceleration than the PRO-HS series with improved positioning accuracy
- No ball-screw-related critical speed limitation allows for maximum velocity across the full travel range
- Standard cable management configurations ease the assembly of multi-axis systems
- Multiple frame sizes for maximum system configuration flexibility

# LINEAR STAGES AND GANTRIES



## ALS Series

- External mounting features for quick system assembly
- Hardcover and side-seal design for years of maintenance-free operation
- Stiffer bearings than the PRO series allow for increased load capacity
- High accuracy linear encoder option for applications that require excellent velocity regulation
- Multiple frame sizes and travel lengths provide system configuration flexibility

## 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

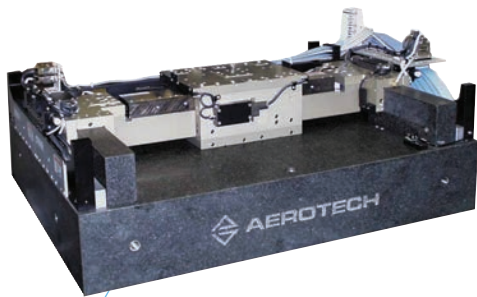
- Full air preload for increased roll stiffness and higher load carrying capability
- Two frame sizes allow for increased load carrying capacity in X/Y configurations
- Optional high-accuracy encoder for improved velocity stability

## ABL2000

- Wide cross-section magnetic preload air-bearing allows for higher loads than the ABL1000 series
- Proprietary manufacturing techniques result in excellent pitch, roll, and yaw characteristics
- Optimized cable management system for years of maintenance-free operation

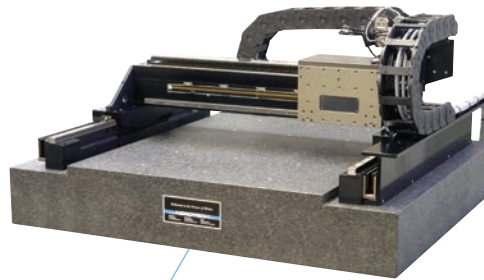
## ABL8000

- 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



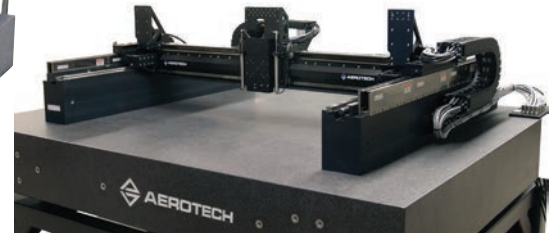
### ABL9000

- 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



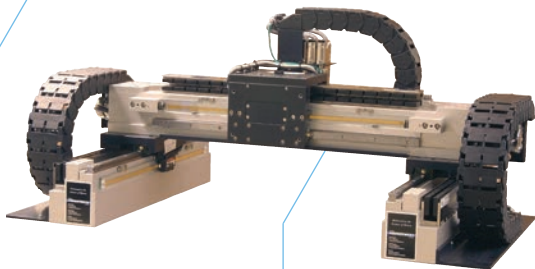
### AGS1000

- 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



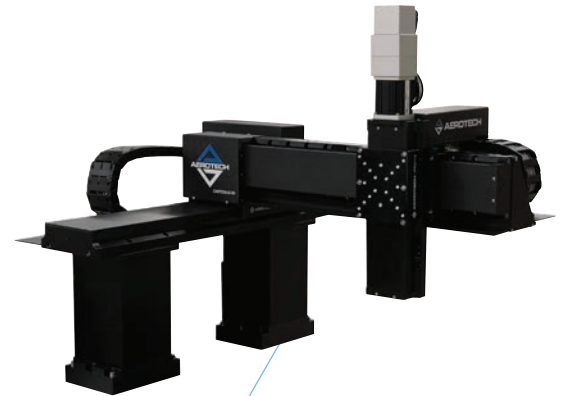
### AGS10000

- 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

our complete product lines.

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# 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

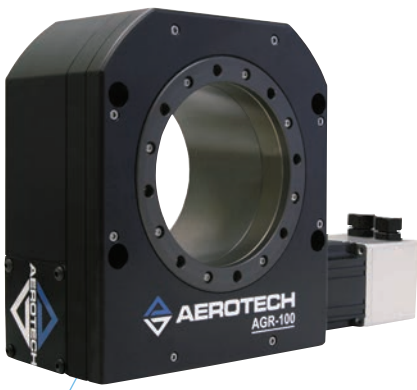
- Large diameter clear aperture for product feed-through or laser beam delivery
- Wide bearing separation for improved moment load capability
- Outstanding wobble and runout characteristics
- Four different frame sizes with multiple stack heights provide a wide range of load carrying capabilities and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

## ACS

- 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

## CCS

- Integral pneumatic collet chuck
- Captive collet design minimizes axial tube motion during clamp/unclamp cycles
- Clear aperture for product feed-through
- Integral mounting features support customer-supplied wet-cutting accessories
- Direct-drive brushless motor and encoder

## 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

our complete product lines.

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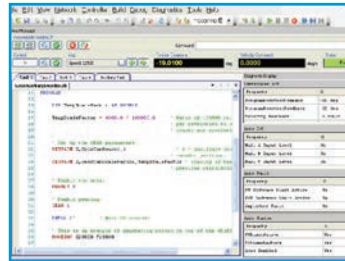
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 Aerotech Taiwan: Ph: +886 (0)2 8751 6690 • Email: sales@aerotech.tw

# SOLUTIONS FOR CONTROLS

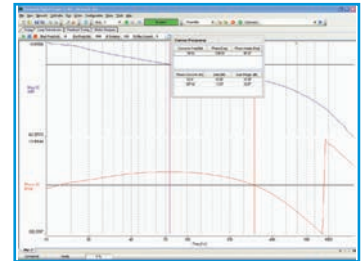
## SOFTWARE

Use the libraries and SDK to develop your own front-end and applications with .NET, C#, C++, and LabVIEW®.

- Easy setup with calculators and Autotune routine
- Use state-of-the-art IDE for developing your motion program
- Second-to-none diagnostics toolkit
- Conditional 2D error plotting



Diagnostics



Loop Transmission

## CONTROLLERS

### Automation 3200

- Up to 32 tasks
- PC-based
- RS-274 G-code
- Advanced features for demanding applications
- 1 to 32 axes of coordinated motion
- Scanner control for marking
- Tightly integrated laser functionality
- Retrofit package

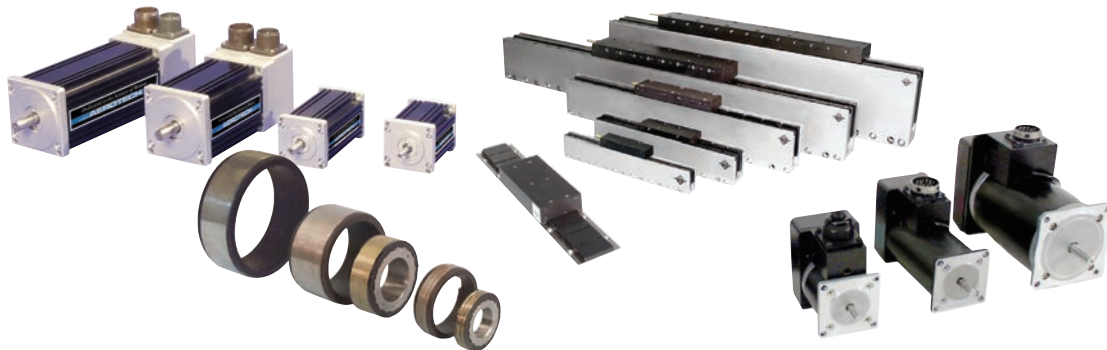


### Ensemble

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



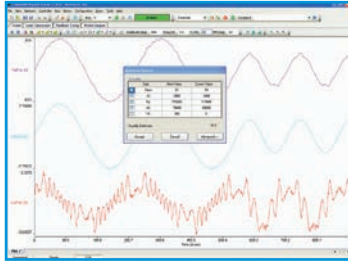
### Linear and Rotary Servomotors



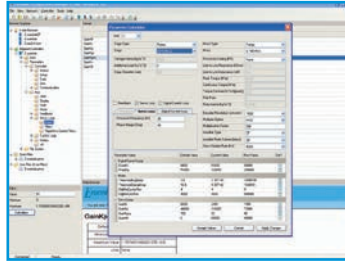


# CONFIGURE YOUR AUTOMATION SOLUTION WITH AEROTECH

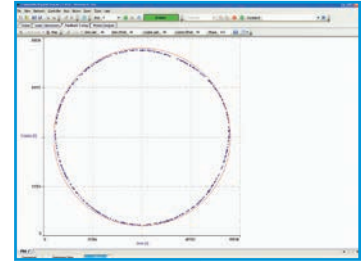
- Scalable
- Flexible
- Easy to use
- Lowest cost of ownership



Autotune



PID Calculator



Encoder Tuning



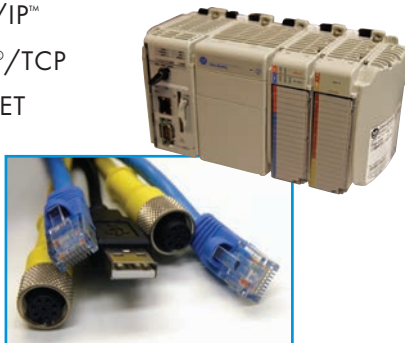
## Soloist

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



## Network Connectivity

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



## Accessories



# SOLUTIONS FOR ADVANCED LASER CONTROL

Hermetic welding, micromachining, and ablation require precise control and spacing of laser pulses on the material being processed to provide consistent quality. When using a fixed-frequency laser, this is complicated by the need for constant velocity, severely limiting processing speeds when faced with complicated geometries. Aerotech's PSO solves this problem.

- Aerotech's Position Synchronized Output (PSO) feature coordinates your motion subsystem with laser firing to produce the highest quality parts and minimize cycle time
- Fully configurable to interface with lasers equipped with externally synchronized control, including CO<sub>2</sub>, YAG, and excimer fiber lasers
- PSO functionality includes several easily programmed operation modes

## APPLICATIONS

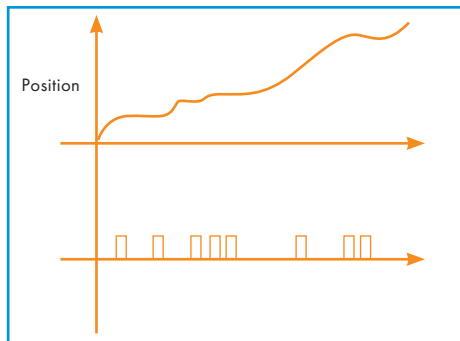
### Manufacturing

- Stents
- Hermetic Welding
- Turbine Blade Holes
- Flat Panel Manufacturing
- Fuel Injector Drilling
- Grayscale Marking
- High-Speed Data Acquisition
- Camera Trigger
- Sensor Trigger
- Non-Destructive Tests

### Benefits

- Consistent cuts and welds without burn spots
- Consistent process independent of velocity and acceleration

## FIRING MODES

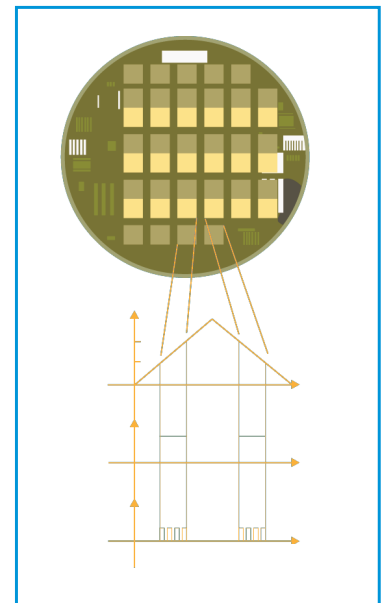


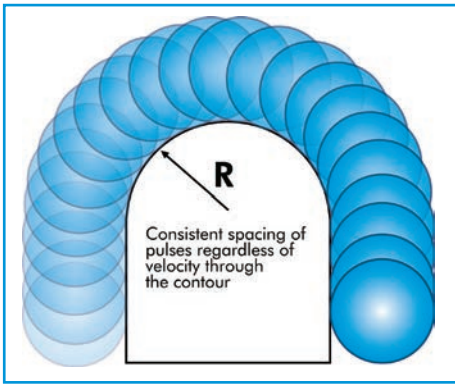
### Array-Based Firing

- PSO fire points are defined in an array based on position
- Applications include grayscale marking of materials where each pixel has differing frequency and power characteristics, and processing of different materials in the same set of motion commands

### Windowing

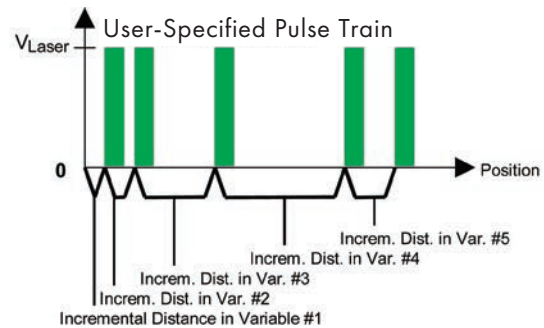
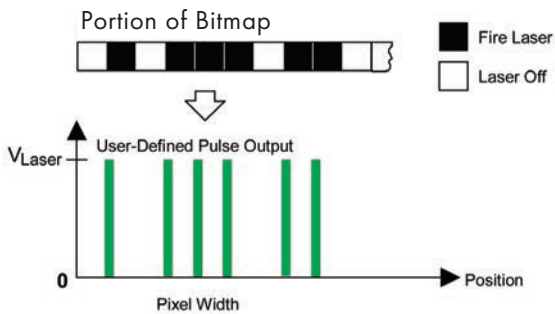
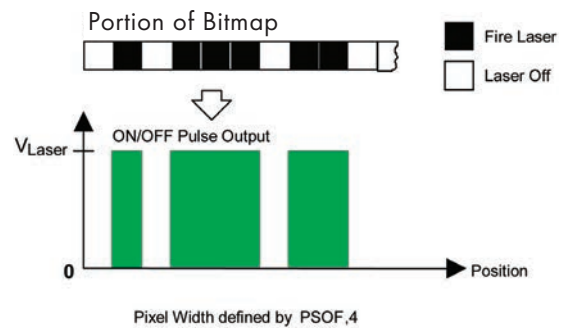
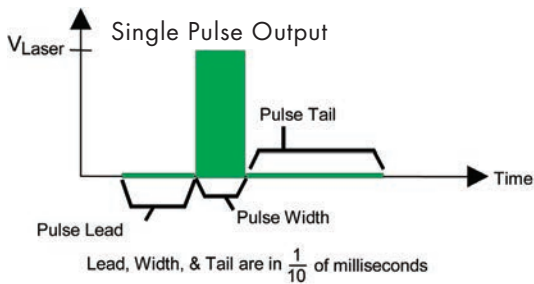
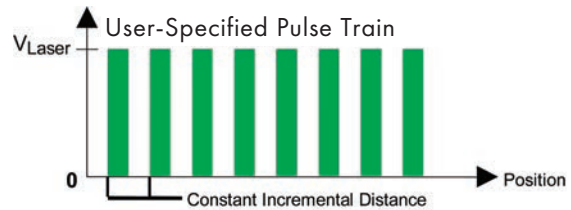
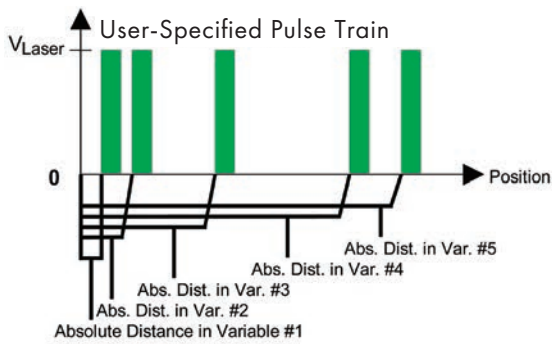
- Output pulses are restrained inside a user-defined window with the first pulse relative to the edge of the window
- Excellent for when the processing of a part requires the axes to move beyond the part for settling or direction reversal in applications such as flat-panel manufacturing or fuel injector drilling





## Fixed Distance Firing

- Single- or multiple-pulse output as a function of up to three axes' position feedback
- Minimizes heat-affected zone in welding, cutting, and drilling
- Outstanding for stent manufacturing, hermetic welding, and drilling holes in turbine blades



# AEROTECH AT A GLANCE



Corporate Headquarters • Pittsburgh, PA • USA



Aerotech United Kingdom

Aerotech Germany

Aerotech Japan

Aerotech China

Aerotech Taiwan

## High Volume Manufacturing

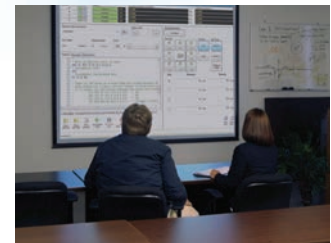


Over 100,000 axes installed worldwide

## Worldwide Service and Support



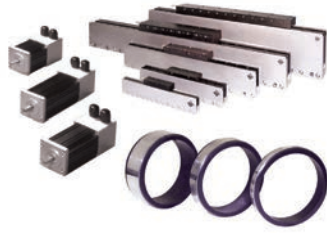
Worldwide startup service and on-site training



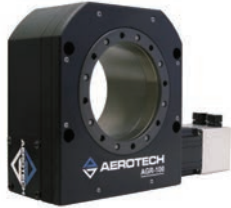
Fully equipped on-site training facilities

## Technically Superior Components

Highest performance brushless linear and rotary motors



AGR rotary stage



PRO Series Linear Stage



Ndrive®



A3200



Npaq®

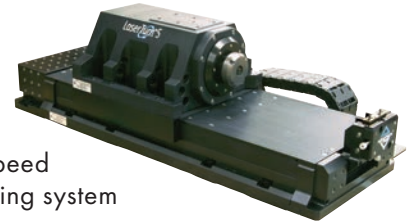
Award-winning Automation 3200 1-32 axis motion, vision, PLC, robotics, and I/O platform

## High Performance Sub-Assemblies

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

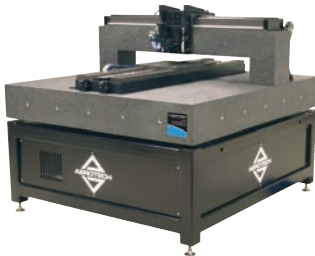


LaserTurn® 5 high-speed cylindrical laser cutting system



Highest throughput linear motor Cartesian gantry systems

## Best-in-Class Subsystems



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



Custom-engineered vacuum- and cleanroom-compatible systems

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

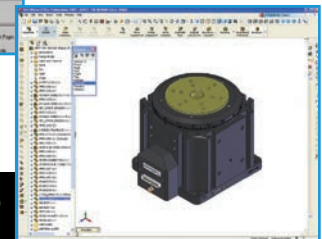


## Comprehensive Technical Support Services

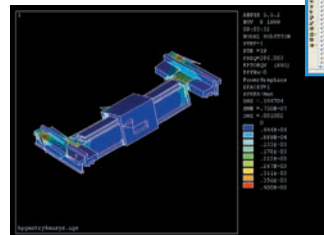
Custom software application support



3D models to facilitate faster and more accurate system layout

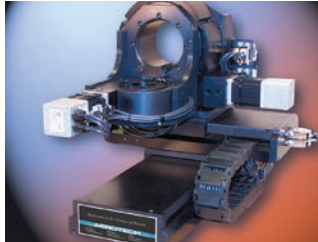


Advanced analytical techniques for optimization of system geometry

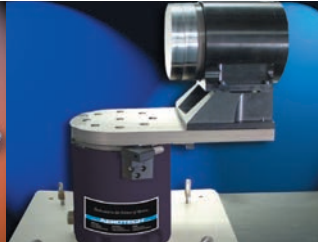


# ENGINEERED SYSTEMS

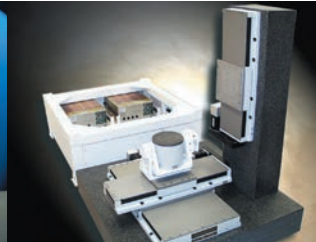
Aerotech engineers and manufactures specialty high-performance subsystems. Our highly-trained staff of experienced software and hardware engineers enables our customers to get to production readiness faster. Aerotech provides real-time collaborative support — either at your facility, at our facility,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



Advanced Laser Machining



Discrete Part Milling Machine



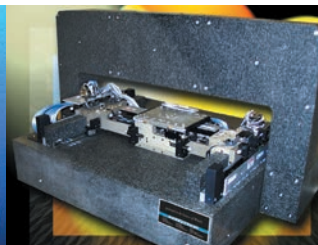
Rapid Prototyping



Advanced Pick-Place-Inspect Station



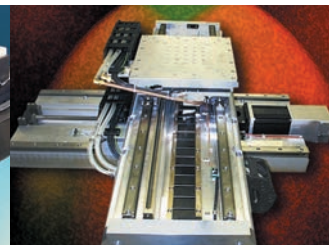
Ion Beam Profiling in Vacuum



Precision Optical Production



High-Precision Air Bearings



Liquid-Cooled, Vacuum-Prepped System



High-Volume Production Inspection Station



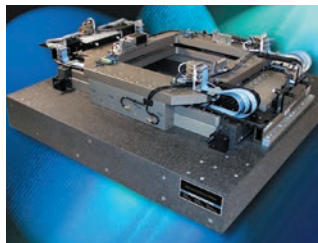
4-Axis Coordinate Measuring Machine



Electronic Inspection



High-Speed Optical Indexer



Patterned Media Inspection



Printhead Inspection Station



High-Accuracy Laser Machining



Optical Lens Fabricating

# AWARDS AND RECOGNITION



2013 Prism Award Finalist –  
Nmark CLS, Nmark AGV



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

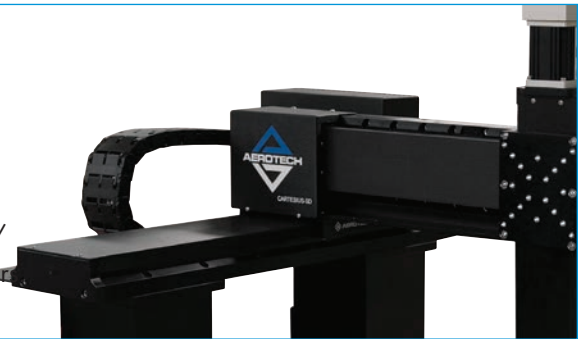


## Photovoltaic, Fuel Cell and Alternative Energy

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.

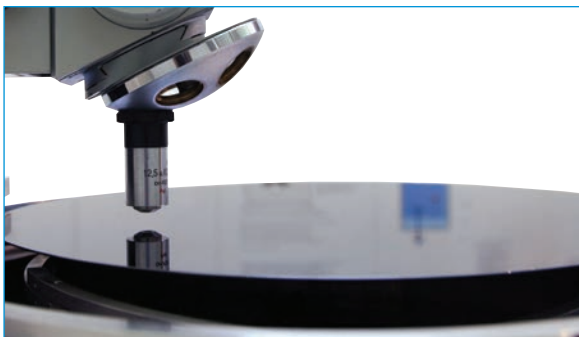
## General Automation

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.



## 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.



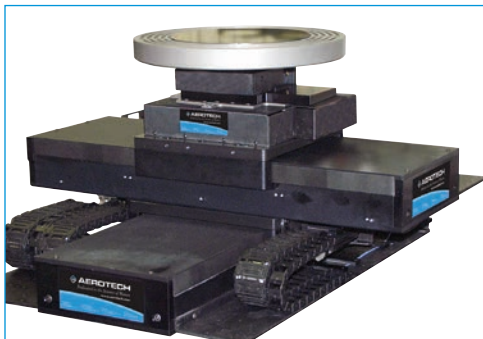
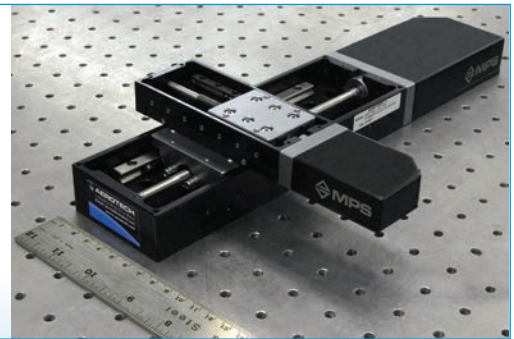


## Defense and Aerospace

Aerotech has manufactured hundreds 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 nano-machining 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.

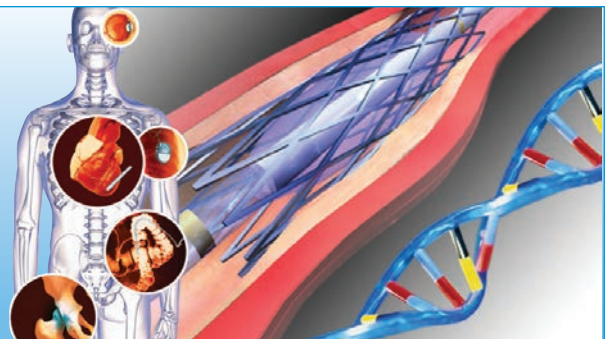


## Electronics Manufacturing and Assembly

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.

## Medical Device Manufacturing and Life Sciences

Aerotech manufactures high-performance motion systems and components for medical and life sciences applications including stent cutting, medical laser welding systems for cardiac pacemakers and catheters, IOL and contact lens manufacturing, DNA sequencing, blood sequencing, haptic mills and drills, x-ray machines, magnetic resonance scanners and CAT scanners. We can customize a medical laser welding system for any need.



# BRINGING VALUE AND CONVENIENCE TO OUR CUSTOMERS

Aerotech offers its customers a number of important advantages as a single-source provider:

## Vertical Integration

Our expertise in motors, amps, controls and stages enables us to provide a complete optimized solution.

## Interconnectability

Aerotech systems are designed to work together. This allows you to spend time and resources on your process, not on system integration.

## System Checkout

Prior to shipment, all systems are fully assembled and checked out. All system parameters are factory-set based on your specifications.

## Documentation

All systems are fully documented. System interconnect-drawings, specification sheets and stage certification plots are included with every system.

## Support & Service

Because all system elements are designed and manufactured by Aerotech, we provide the highest level of technical knowledge available. Unlike companies that only manufacture part of the system, Aerotech manufactures all of the system components, minimizing service time.

## Single-Source Solution

Aerotech designs and manufactures precision stages, motors, drives and controllers giving you all of the components needed for a complete system.

## Application Experience

Since 1970, Aerotech has completed thousands of motion control projects, spanning an extensive range of applications.

## R&D

Our engineering teams are dedicated to product development and continuous improvement.

## Technology Leader

Aerotech engineers are continuously updating existing products and introducing new products. We are truly "Dedicated to the Science of Motion."

## Quality

Aerotech is an ISO 9001 certified supplier with a rigorous quality program.

## Worldwide Presence

Aerotech is committed to supporting customers worldwide. We operate full sales and service facilities in the United Kingdom, Germany, Japan, Taiwan and China. We also maintain a growing number of direct field sales and application engineering offices throughout North America, and work with representatives across the globe.



Corporate Headquarters • Pittsburgh, PA • USA



Aerotech  
United Kingdom



Aerotech  
Germany



Aerotech  
Japan

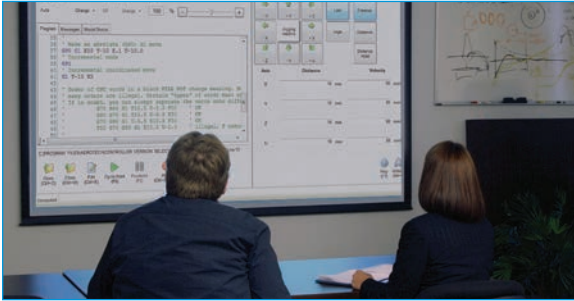


Aerotech  
China

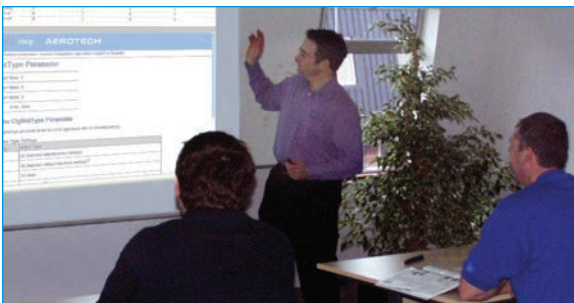


Aerotech Taiwan

# WORLDWIDE TRAINING AND SUPPORT



Aerotech Inc (U.S.A.)



Aerotech Ltd (United Kingdom)



Aerotech GmbH (Germany)



Aerotech KK (Japan)

Aerotech offers comprehensive worldwide training and customer service either at customer facilities or at one of our Aerotech training centers.

## Our Training Program Features:

- *Standard and customized courses*
- *Hands-on training with Aerotech positioning systems*
- *Interactive training with experienced instructors*
- *Comfortable, spacious facilities*

## Installation and Start up (Commissioning)

Startup and commissioning services minimize startup times, reduce cost and accelerate time-to-production. By combining our product knowledge with your process and application expertise, new systems and applications can be completed faster at a reduced overall cost.

## Engineering Support

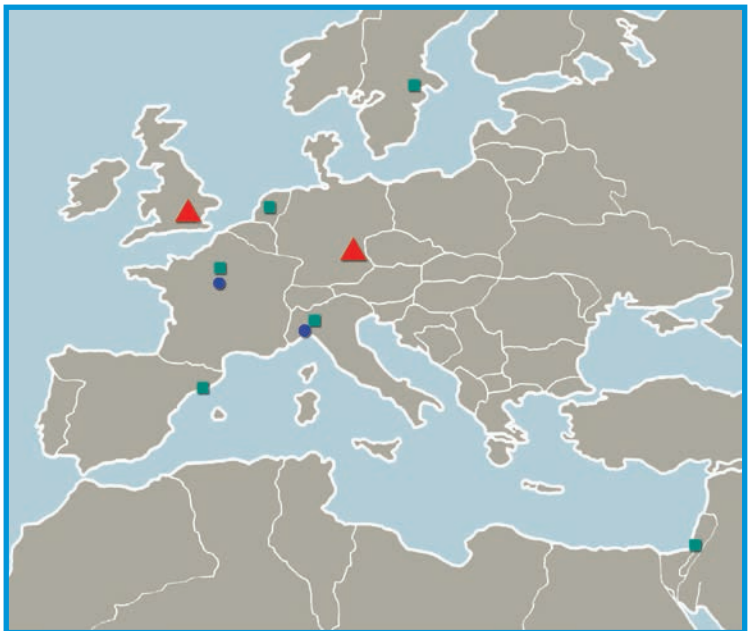
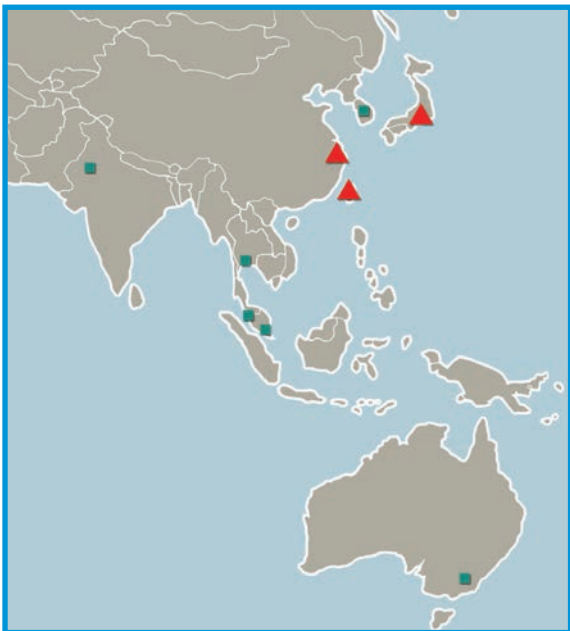
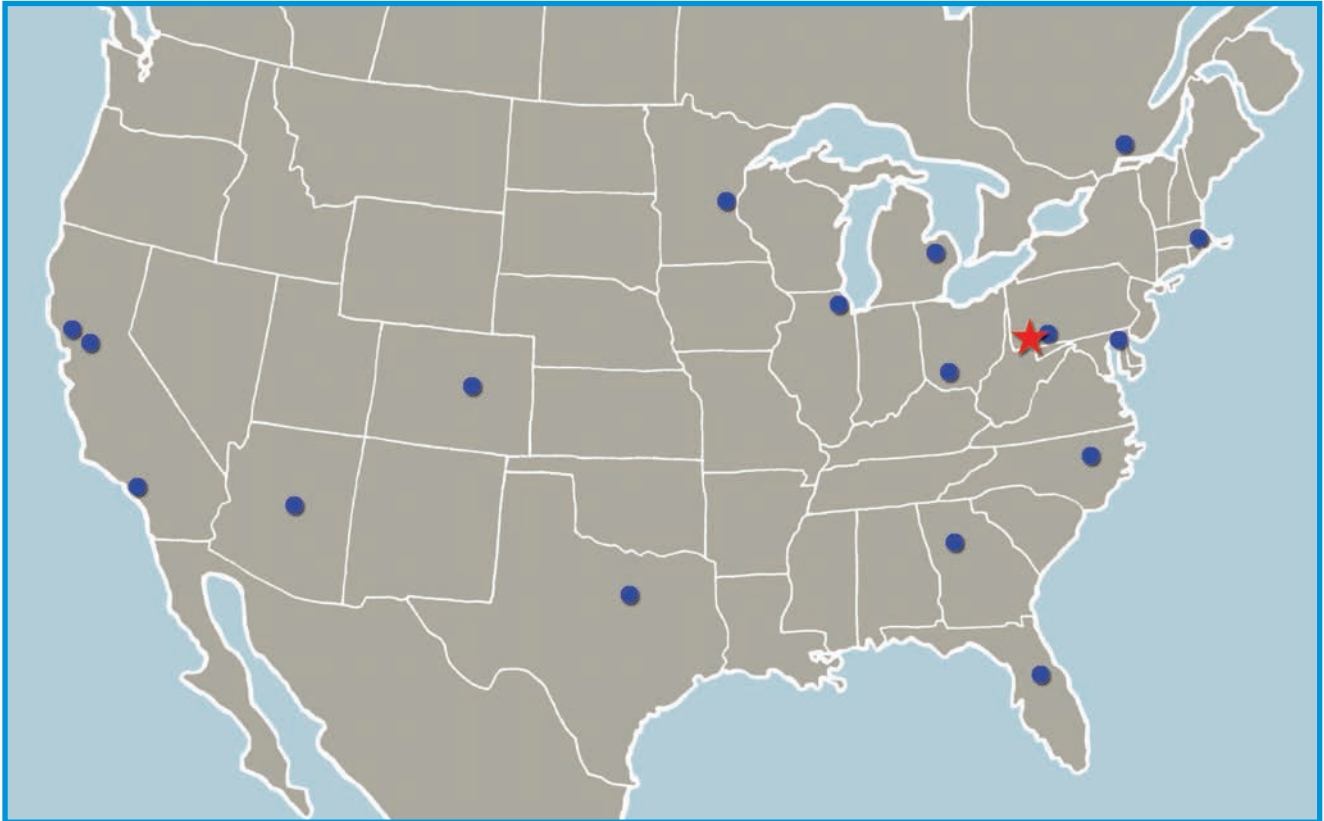
Aerotech provides complete engineering support for our products, including on-site support and maintenance, and remote support via phone, fax, website and/or WebEx® software. As a manufacturer staffed by engineers, we understand the unacceptability of downtime.

## Training

Comprehensive training classes are designed to help our customers realize the full potential of our products. By demonstrating all of a product's features and how to use them, customers have been able to reduce startup time and quickly optimize their applications. Our classes have been developed, and continually upgraded, using feedback from our customers.

Since 1970, Aerotech has designed motion control and positioning systems and components with an unsurpassed track record of reliability. When you make the choice to purchase from Aerotech, we urge you to learn how to get the most from your new products. We provides both on-site (your facility) and/or in-house (our facility) training for our customers' convenience.

## AEROTECH'S WORLDWIDE SALES AND SERVICE LOCATIONS



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