Motion Control for Precision Manufacturing
Aerotech Overview

Single-source supplier for motion components, drive electronics, controls, and complete motion subsystems for precision manufacturing.

Micromachining Applications

Motor Components for Machine Builds and Upgrades

- Linear and rotary motors offered in a full range of sizes and torques
- Brush, brushless, and slotless motors
- High coil-density for maximum torque in a small package
- Vacuum compatible motors

Rotary Applications

- Precision rotary axes for moving workpieces and tools
- Combine with linear stages to reach 4, 5, or 6 degrees of freedom
- Axis of intersection alignment and multi-axis orthogonality alignment reduce offset-induced errors at the work point
- Integral rotary union for vacuum or air-activated tooling

Lathe-Style Part Holding and Tube Cutting Applications

- Integrated pneumatic chucks and collets for ideal runout properties
- Low profile and high-performance designs meet various application requirements
- Combine with linear stages and coordinated motion for dynamic tube-cutting applications

AXR two-axis rotary assembly

CCS and ACS integrated pneumatic chuck and captive collet direct-drive rotary stages
Manufacturing Solutions for Drilling

- Complex hole geometries are achievable with multi-axis motion systems
- High-resolution direct-drive axes allow micron-level dynamic tolerances for drilling deep aspect-ratio holes with complex contours
- Engineered counterbalances enable arc-sec precision positioning of the part in 3D space
- Motion coordinate transformations allow the user to specify the programming coordinates while the axis commands run based on the positions or velocities of other axes

Nanomanufacturing Applications

Direct-Drive Servo Stages

- Excellent accuracy and in-position stability achievable with direct-drive linear and rotary motors
- Linear, rotary, lift, and goniometer configurations provide solutions for all degrees of freedom necessary for complex part geometries
- Mechanical- and air-bearing options for a variety of part tolerance and surface finish requirements

Piezo Nanopositioners

- Sub-nanometer positioning resolution and nanometer-level accuracies (linearity)
- High stiffness and large resonant frequencies for higher throughput and faster closed-loop response
- Ideal for diamond turning, high-dynamic tool movements, and precision alignment routines
- Offered in various configurations including X, XY, and Z with a powerful networkable controller
Component Assembly and Alignment

Precision Positioning

- Hold nanometer-level in-position stability over long periods of time
- High mechanical-resolution stages capable of producing nanometer and sub-arc-sec step sizes
- Anti-creep crossed-roller bearings and direct-drive servo motors enable smooth velocity regulation and negligible hysteresis or backlash

Cartesian Gantry Systems

- High-performance gantries available in both H- and T-style configurations
- Aerotech gantries allow for 5g accelerations and 3 m/s velocities that are ideal for increasing throughput without sacrificing precision
- Customized cable management provisions for customer process components
- Ideal for electronics manufacturing, high-speed pick-and-place, assembly, part processing, component inspection, and alignment applications

ANT130 XYZ direct-drive counterbalanced stage system
ANT95 linear stage showing a 1 nm step plot tested using advanced metrology methods
Cartesius-HD T-style gantry
AGS15000 H-style gantry
Precision Grinding Applications

Cam Grinding

- Easily defined cam tables provide slave positions as a function of master position with as many or as few points as the part profile requires.
- High coil-density allows rotary and linear motors to provide the highest output in the smallest space.

Optic Grinding

- Direct-drive motors allow for high dynamics and minimum velocity errors for a high-quality surface finish.
- Stainless steel and sealed rotary stages ideal for optical grinding and polishing in a variety of environments.

Environmentally Sealed Applications

- Components for environments that are harmful to precision mechanics.
- Ideal for micromachining and diamond turning applications that produce debris.
- Sealing options for both air-bearing and mechanical-bearing stages.
Welding Applications

- Gantry design optimized for minimal tracking error and high-positional accuracy along weld paths
- Position Synchronized Output (PSO) allows for a welding head to be fired based on the calibrated feedback of the stage for ultimate geometric control

Electrical-Discharge Machining (EDM) Applications

- Negative MFO (Manual Feedrate Override) allows an EDM generator to command the axis to reverse direction depending on burn characteristics
- Multiple gains for the negative MFO allow the axis to retract and advance at different rates
- Intra-block retrace eliminates the need to break motion programs into multiple small modules for retrace capabilities
- IP66-sealed direct-drive rotary stages optimized for wet environments while providing high accuracy at high speeds for high-quality parts and throughput

Electron-Beam Manufacturing

- High-vacuum motion systems capable of $10^{-8}$ Torr built to minimize outgassing while maintaining performance
- Custom cable management solutions for vacuum compatibility
- Liquid-cooled linear motors for high dynamics and improved thermal management
- Custom stage configurations to fit into existing chambers
Printing and Holography Applications

Industrial Printing

- High-speed printing axis with low-speed step axis provide a cost-effective solution for ink-jet printing processes
- Excellent velocity stability and small minimum step sizes accommodate the most demanding printheads
- Compact stage designs minimize machine footprint

Holographic Master Manufacturing

- Linear air-bearing options designed to optimize dynamic straightness, ensuring scan-line parallelism
- Scalable designs for masters of many sizes
- Industry-leading control system with real-time position-based laser firing output ensures laser pulses are fired at precise intervals, maximizing hologram quality
- Hold tolerances over long periods for consistent processing of large holograms

Drum Writing

- High-accuracy linear air-bearing for excellent straightness and angular performance with tight line spacing with no overlap
- Large capacity mechanical or air-bearing rotary stages carry heavy loads while maintaining high positional accuracy and velocity stability
- Sliding tailstock accommodates multiple drum lengths
- Precision alignments minimize tool offset errors
Part Inspection Applications

Traditional Measurement Configurations

- Mechanics with excellent straightness and flatness specifications ideal for raster scan and Cartesian testing processes
- Crossed-roller and air-bearing stages for high dynamic accuracies
- Linear motor options for high-dynamics and throughput to decrease measurement time
- Screw-driven versions for a cost-effective solution

Surface Profiling

- Surface measurement platforms designed for various profiling applications
- Ideal for rotationally symmetric objects
- 60% smaller than traditional Cartesian systems while maintaining a 40% increase in scanning speed over traditional methods
Aerotech’s Software and Controls

CADFusion CAD to G-Code Software

- Easily imports vector-based drawing files and produces Aerotech compatible motion programs
- Manually or automatically re-shapes tool paths for optimal processing routes
- Supports advanced Aerotech programming features such as Position Synchronized Output (PSO)
- Extensive drawing tools for part creation and transformation

CAM Profiling and Machine Moves

- Electronically command one axis position as a function of another axis with a CAM table and trigger I/O during the move
- Tool-path cutter compensation, arbitrary path generation, acceleration limiting, and coordinated motion are all standard control capabilities that make machine control effortless

CNC Operator Interface

- Traditional CNC look and feel for operating a machine running G-code
- Customizable buttons that can execute simple or complex actions written in G-code and AeroBasic™
- Interface displays the actively running program and allows the user to issue immediate commands

Machine Retrofits

- Nservo and Nstep control third-party servo amplifiers with advanced A3200 Automation Controller allowing for powerful control upgrades while retaining the existing motors and drives
- Aerotech also offers a full line of amplifiers and motors for applications requiring complete controller/motor replacement
Drive Electronics and Controls

Advanced System Controls
- A multitude of drive options increases flexibility
- Easily configured for brushless, brush, and stepper motors
- Capture all motion performance during testing for quality control

Machine Tool Specific Features
- 5-6 axis contouring capabilities
- Position Synchronized Output (PSO) trigger for laser sensor or camera control
- Calculators for quick and easy setup

Software
- 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

Automation 3200 Machine Controller
- Up to 32 tasks
- PC-based
- RS-274 G-code, .NET, LabVIEW®, AeroBasic™
- Advanced features for demanding applications
- PLC IEC 61131-3, PLCopen compliant

Controller Features

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

Coordinated Motion
Linear and circular motions are supported in all languages

Spindle Control
Commands for speed, direction, activation, behavior, and status
Interfaces

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

Accessories

- Linear amplifiers
- ESTOP
- Rack-mount configuration
- Rack-mount PCs

Integrated Development Environment (IDE) Reduces Development Time

Programming Interface

- Integrated I/O panel
- Debugging features (breakpoint, step-in, etc.)

Autotune

- One click EasyTune™ to set gains and place filters
- Optimization and performance read-outs

Digital Scope

- 1D and 2D plot capability
- Plot move profiles, I/O, and commands for easy troubleshooting

Parameter Editor

- Easy-to-use calculators for system setup
- Integrated HELP files