



AEROTECH & DEFENSE

Advanced Motion Systems for Aerospace,
Defense & National Security

TABLE OF CONTENTS

Introduction 5

Manufacturing Systems 9

- Laser Processing 10
- Large-Format Media..... 12
- High-Precision Cartesian Robots..... 13
- Laser Processing & Additive Manufacturing 15
- Laser Scan Heads..... 16
- Additive Manufacturing 18

Electro-Optic Testing Systems 21

- Large-Component Test & Inspection 22
- Electro-Optic Manufacturing & Test..... 29
- Electro-Optic Pointing & Tracking 30
- Sensor Testing..... 31
- Electro-Optic Prototype Pointing 33
- Custom Test & Sensor Gimbals..... 34
- Directed Energy Pointing 37
- Weatherized Gimbals..... 38
- Mirror Gimbals..... 39-48

Testing & Simulation Systems..... 49

- Rotary Sensor Testing..... 50
- Custom Rotary Stages 52
- Hexapods 53-54
- Rotary & Linear Sensor Test..... 55
- Single-Axis Motion Simulators..... 56
- Inertial Testing Motion Simulators 57
- 3-Axis Motion Simulators..... 61
- Vacuums..... 64-67
- Advanced Controls for Ground Support Equipment (GSE)..... 69
- Ground Support Equipment (GSE)..... 70

continued on next page

Standard Products	71
Rotary Positioners.....	72
Rotary & Linear Sensor Test.....	74
Rotary Positioners.....	75
Linear Positioners.....	76
Goniometers.....	77
ANT Nanopositioners.....	78



Introduction

AEROTECH

55+ Years of Trusted Solutions

Since 1970, Aerotech has designed and manufactured precision positioning systems for government labs, research centers and aerospace and defense contractors engaged in aerospace and defense manufacturing, testing and field proof-of-concept demonstrations. Our high-accuracy aerospace and defense solutions have helped customers worldwide to manufacture and test jet engines, aircraft wings, surveillance and tracking electro-optics, directed energy systems, laser communications systems, countermeasures, inertial navigation systems, missile systems and satellites with their science payloads.

Aerotech is vertically integrated, manufacturing all positioners, electronic controls and software in our Pittsburgh, Pennsylvania facility. Having all engineering, machining, electronics manufacturing, assembly and testing under one roof allows Aerotech to provide systems that are engineered and tested to meet the highest performance possible. Our advanced metrology facility can measure and calibrate linear and rotary products to the exceptional performance levels needed in the aerospace and defense industries. Our experienced engineering staff can work with your engineers to customize our extensive product line to meet the most demanding requirements.



Multi-Axis Motion Solutions for Aerospace Manufacturing

Manufacturing large electro-optics, antennas and aerospace products to high accuracy is a reality with our high-accuracy, large-format systems. Sub-micron accuracy and nanometer-level motion are available for laser processing of aerospace materials. Our Cartesian gantries are ideal for dispensing 3D conductive ink onto radomes and other complex surfaces.

Aerospace & Defense Test Systems

Advanced Motion Simulators & Electro-Optic Motion Systems

Aerotech produces many single-axis rotary systems, multi-axis motion simulators and multi-axis gimbal systems for optical testing, gyro testing, inertial navigation testing and calibration, and target tracking. Aerotech controls can synchronize up to 32 axes to handle systems, laser processing machines and ground support equipment applications.



Our products are used in the laboratory, on the production floor and in the field. We specialize in products for cleanroom and high-vacuum operation.

Our talented and dedicated engineering staff has expertise in all core motion technology areas:

- Precision machine design
- Vibration & controls
- System modeling & characterization
- Magnetic circuit design
- Power electronics design
- Servo systems
- Software development

Our linear and rotary air- and mechanical-bearing stages can be assembled into multi-axis systems for payload positioning to sub-arc-second accuracy. Typical linear systems range in travel from 25 mm to 2 m. Load capabilities of linear and rotary systems are up to 1000 kg. Our facilities include temperature testing capabilities.

Aerotech is committed to continuing the development of new motion technology and products to better serve the defense, aerospace and national security markets.



Prove Your Equipment in the Field

Precision Pointing Systems, IP66-Rated Gimbals & Pedestals

Range tracking, electro-optic beam steering and surveillance applications regularly use Aerotech rotary systems. Many of our systems can be qualified for operation from -40°C to 70°C . Our direct-drive gimbals provide highly accurate pointing and tracking systems. Customers use our systems to field-qualify their sensors, lasers and antenna systems.

Reach the Stars

Vacuum-Compatible Motion Systems & Celestial & Satellite Tracking Mounts

Aerotech has provided thousands of axes for high-vacuum (up to 10^{-8} torr) and cleanroom (up to ISO Class 1) environments. Aerotech specializes in configuring our positioners with low outgassing materials to provide automation in space-rated environments.





Manufacturing Systems

LASER PROCESSING

Aerotech provides complete solutions, from individual motion components to fully motorized, multi-axis systems in laser-safe workstations.

These systems are essential for material testing, laser drilling, welding, cutting and additive manufacturing processes such as laser sintering and conductive ink writing.



Optional control console

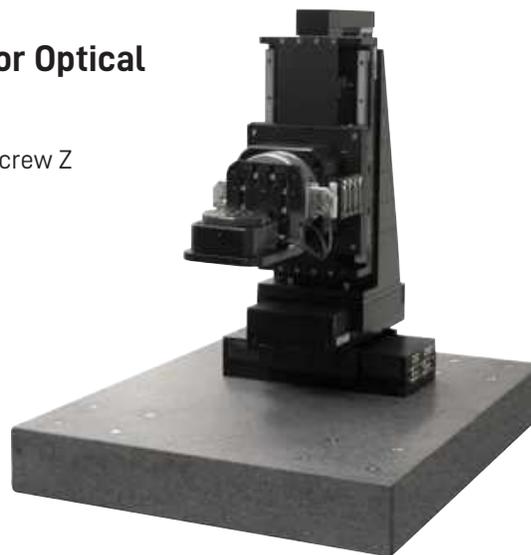


Laser Sintering Gantry

- Position synchronized laser firing
- CNC multi-axis control
- 2- to 32-axis contouring
- Multi-dimensional error correction
- Special sealed connectors to keep metal particles out
- Air purged
- Passive air vibration isolation
- 450 mm X
- 1300 mm Y
- 300 mm Z
- ASRT-245 cross-axis

5-Axis System for Laser Processing or Optical Sensor Positioning

- Direct linear encoders, direct-drive XYAB, ball-screw Z
- Submicron, sub-arc-sec incremental motion
- Continuous rotation of the AB rotary axes
- 5 kg payload capacity





Optional Control Console



Large-Travel Gantry

- PRO280LM XY
PRO165Z
- Laser processing, laser sintering, optical inspection
- 7 μm /axis accuracy
- 1.2 m XY, 300 mm Z travel
- Air-purge input ports to keep out metal dust

Large-Travel, High-Performance Gantry

- Optical metrology
- 3-axis ALS5000/ATS5000WB/ATS5000
- 1 m x 1 m XY, 300 mm Z travel
- High load: 80 kg
- <75 arc-sec total angular errors
- Passive air isolation
- Operator control console
- Accuracy: X = 140 μm , Y = 2 μm , Z = 2 μm



5-DOF System for Laser Processing or Additive Manufacturing

- XAB part motion
- YZ bridge dispense stages
- Controller position synchronizes output, triggers dispense pump
- $\pm 5 \mu\text{m}$ accuracy

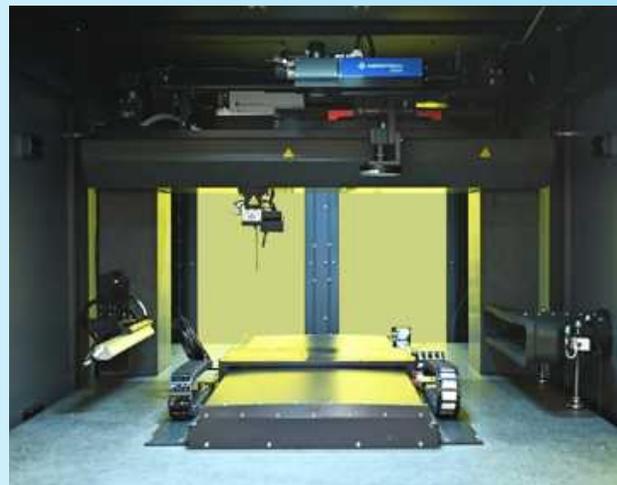
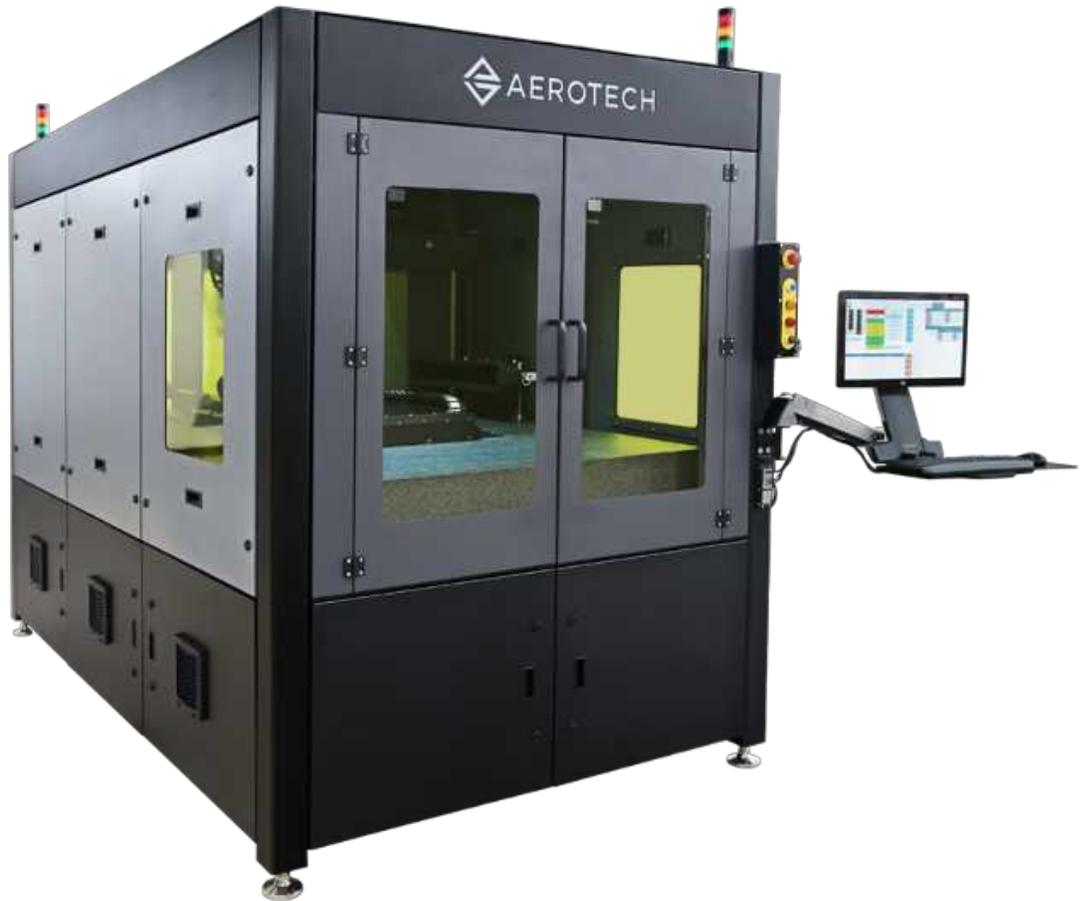


Standard dual redundant emergency stop controls

LARGE-FORMAT MEDIA, ASSEMBLY, LASER PROCESSING, ADDITIVE MANUFACTURING & RF/ELECTRO-OPTIC TESTING

- Our motion controllers offer user-friendly tool path planning & execution for laser applications with our galvanometer scanners
- The Position Synchronized Output (PSO) feature can trigger events such as laser firing, print dispensing or data capture
- Laser/print-head triggering based on trajectory path vector distance traveled

Aerotech expertise includes laser scan heads integrated with motion for turnkey laser processing machines, including ablation, welding, cutting and additive manufacturing systems solutions in laser-safe enclosures.



HIGH-PRECISION CARTESIAN ROBOTS FOR ASSEMBLY, TESTING, LASER PROCESSING, ADDITIVE MANUFACTURING



Flex Gantry

- Designed for ultra-precision & high-dynamic contouring
- The r- θ design allows control of the axes' linear & angular motion, offering additional motion flexibility & improving positioning & throughput
- Automation1 FLEX Distributed Amplifier Multi-Axis Servo Control System minimizes cable management & distributes amplifiers to reduce panel space, cable drag & particulate generation



Dual Gantry

Dual gantry mechanical- and air-bearing gantries, with inverted hexapod for multi-axis part placement.

The hexapod provides 6-axis virtual pivot point capability for tooling probes, printing nozzles, machine vision or electrical test probes to rotate and probe complex surface parts.



LASER PROCESSING & ADDITIVE MANUFACTURING

Custom Heavy-Load, 4-Axis System for Laser Processing

- 20 μm tool-point XY accuracy
- 50+ kg load capacity
- XY with AB axis
- Travel 1200 mm X, 900 mm Y
- -25° to $+90^\circ$ pitch
- Continuous 360° yaw



High-Accuracy, 5-Axis System for Laser Processing or Electro-Optics Testing

- Lower stages provide linear X & dual yaw rotation axes
- Upper YZ linear air-bearing axes provide long travel, high stiffness
- Linear air-bearings provide exceptional straightness, flatness, roll, pitch, yaw errors
- Roll, pitch, yaw <10 arc-sec
- Includes base passive air isolation to eliminate floor vibrations from affecting the test results
- All axes are direct-drive, providing years of maintenance-free operation
- 400 mm x 150 mm bridge YZ travel, 100 mm X travel
- Two direct-drive rotaries, <1.5 arc-sec accuracy

LASER SCAN HEADS



Multi-Axis Air-Bearing System for Laser Writing or Drilling

- Split XY axes
- Accuracy 4 μm X, 4 μm Y, 0.7 μm Z
- Ideal for 5 μm or smaller laser spots
- Travel 1500 mm X, 1200 mm Y, 85 mm Z
- Air-bearing provides submicron flatness/straightness
- <5 μm straightness/flatness
- Single-digit arc-sec roll, pitch & yaw

IGM System with IFOV

- Position Synchronized Output (PSO) triggers laser based on mirror's position feedback for consistent spot overlap as scanner changes speed
- Infinite Field of View (IFOV) seamlessly combines servo & scanner motion to extend marking capability across servo stages' entire travel, eliminating stitching errors
- Delivers near-zero velocity & position tracking error, plus optimized thermal drift performance
- Applications include glass cutting, via drilling, surface texturing & micromachining





Universal IGM Machine Platform

- IGM platforms are available with the added convenience of electronics-integrated machine bases
- Housing electronics in the system base simplifies system wiring & setup for a clean, professional appearance
- An isolation subsystem decouples the granite motion platform from the machine base & protects your process from floor vibration

Multi-Axis Laser Motion System

- Flexible platform for a combination of machining processes
- Machine base includes control panels for drives, IO, safety circuitry & power
- Accurate, high-speed laser processing with Aerotech AGV laser scan head
- The second Z axis, which shares a split-bridge stage, carries an inspection tool
- Applications include precision machining development, metrology & inspection & laser microprocessing



ADDITIVE MANUFACTURING

Direct-write dispensing involves printing organic and inorganic components on various substrates including paper, plastics and textiles. Common configurations include gantries, split bridge assemblies and five- to six-axis DOF systems.

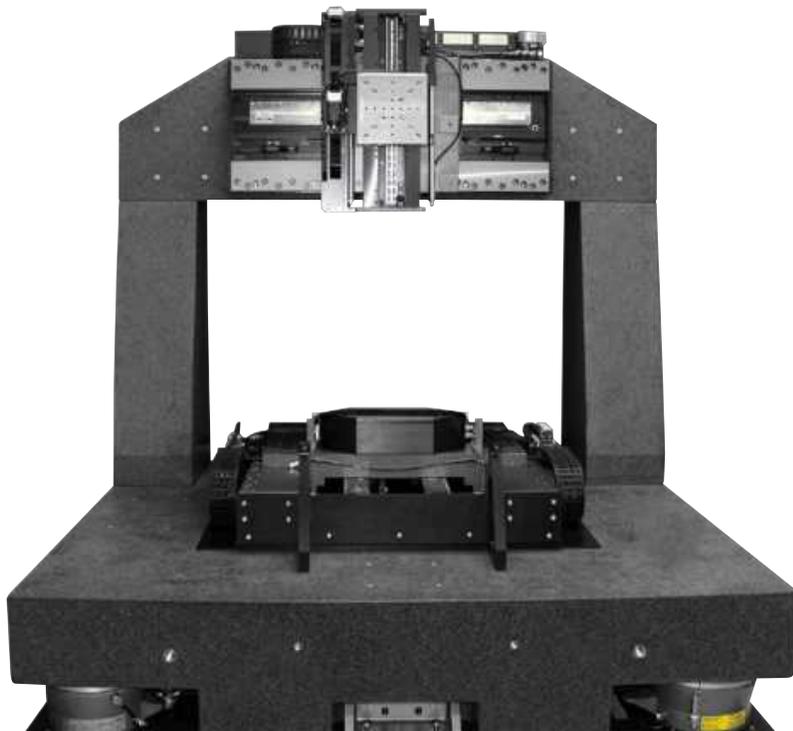
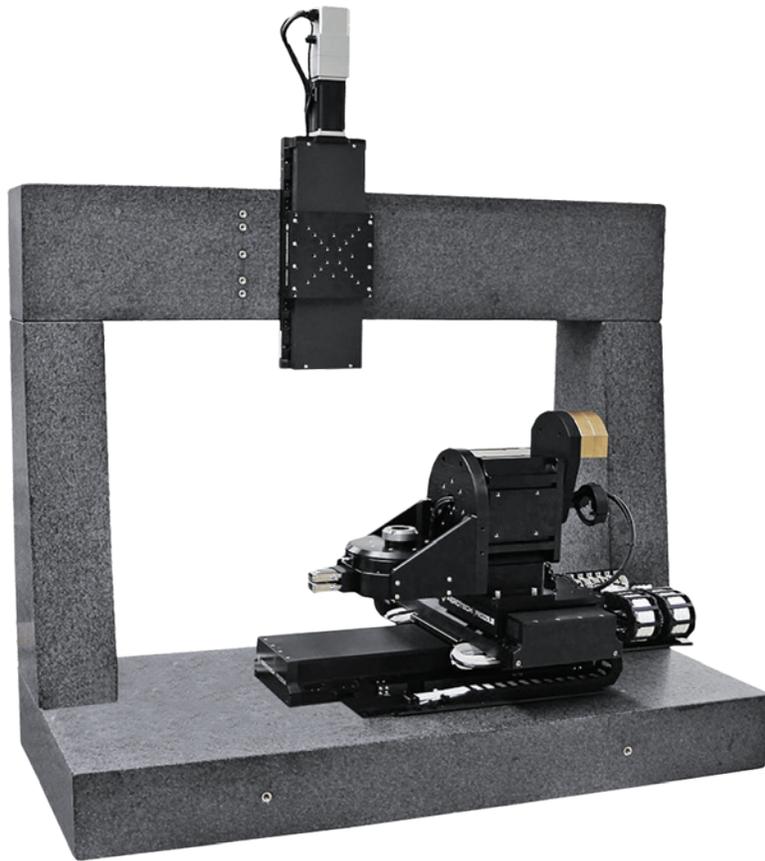


6-Axis DOF Dispensing System

- Split-axis, 6-DOF assembly allows dispensing on complex contours
- Motion synchronization of 32 axes, plus IO Control
- Precision rotational axis of intersection alignments minimizes three dimensional stack-up errors at the work point
- Multi-axis Position Synchronized Output (PSO) links the dispensing head directly to encoder feedback, ensuring consistent deposition regardless of contour complexity or velocity variations
- Direct-drive rotary axes exhibit high acceleration & zero backlash for ultra-smooth velocity regulation, delivering the highest possible throughput
- Ideal for printed electronics applications, including:
 - QLED displays
 - Electroluminescent lighting
 - Stretchable electronics
 - Wearable sensors
 - RFID tags
 - Photovoltaic panels
 - Conformal coatings

5-Axis System for Additive Manufacturing or Laser Machining

- XYAB part motion
- Z axis for dispense head or laser optic
- $\pm 5 \mu\text{m}$ accuracy
- Bridge, laser & optics mounting patterns



Large-Format Air-Bearing XYZ for Laser Processing or Additive Manufacturing

- $< 1.5 \mu\text{m}$ XYZ accuracy
- Additional 3-axis rotary option for 6-DOF processing
- Ideal for $5 \mu\text{m}$ or smaller features
- Travel 500 mm X, 500 mm Y, 280 mm Z
- Air bearings provide submicron flatness/straightness
- Single-digit roll/pitch/yaw errors
- Passive air isolation
- Oversized X air-bearing for high payload capacity
- $< 100 \text{ nm}$ incremental motion



8-Axis Air- & Mechanical-Bearing System

- Air-bearing/mechanical-bearing hybrid design to ensure the highest performance at the processing work-point
- Dual-carriage bridge tooling axes to reduce machine footprint while adding parallel processing capabilities
- Capable of 5+ axes of coordination using an advanced Aerotech motion controller
- Applications include high-accuracy machining & materials processing, flexible R&D platform for microassembly & multi-tool inspection



Electro-Optic Testing Systems

LARGE-COMPONENT TEST & INSPECTION

- Aerospace & defense test systems require precise motion for positioning & testing sensors (e.g., interferometers, autocollimators, vision systems, antennas).
- Aerotech positioning systems offer higher resolution than electro-optic sensors used in satellites, night vision, missile seekers, heads-up displays & surveillance systems.
- Engineered for maximum accuracy, reliability & long life—requiring minimal maintenance.
- Systems designed for both air & vacuum environments.

5-Axis, XYZ, Tip/Tilt System

- Integrated cable management
- Direct drive, high accuracy
- Pneumatic vertical counterbalance

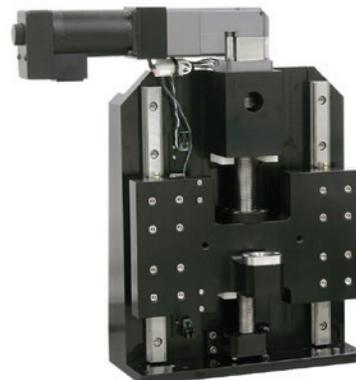


Large-Capacity Heavy Duty System

- 227 kg payload capacity, cantilevered 400 mm off Z
- 200 nm stepping capability
- 300 mm XYZ travel
- 4 nm resolution direct encoders
- Cleanroom or Vac 10⁻⁶ torr compatible

VTS300 High-Load Vertical Stage

- 455 kg load capacity
- No back-driving
- Adjustable electrical limits



High-Load, Ball Screw, XY Linear Stages

- Payloads up to 682 kg
- Optional linear encoders for high accuracy & repeatability
- Cleanroom or Vac 10⁻⁶ torr compatible
- 600 mm x 300 mm travel
- ±2 μm accuracy with linear encoder

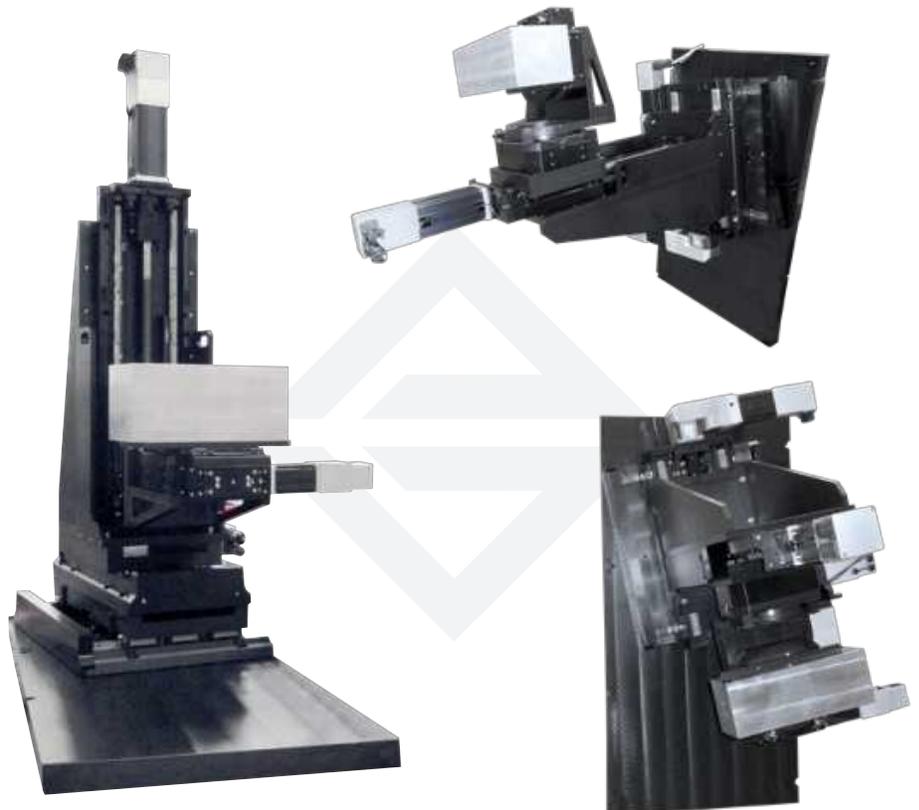


High-Load X/Theta

- 350 mm travel
- Continuous 360° rotation
- 682 kg load capacity
- ±10 μrad rotary accuracy
- Cleanroom or Vac 10⁻⁶ torr compatible
- Only 200 mm tall

5-Axis XYZ AZ/EL System Operates at 0°, 90°, 180°, 270° Mounting Configurations

- Can be mounted in almost any orientation relative to gravity
- Cleanroom or Vac 10⁻⁶ torr options
- XYZ min. incremental motion <0.2 μm
- 1 μm linear axis repeatability
- Pitch/yaw min. incremental motion <2 arc-sec
- Pitch/yaw 5 arc-sec unidirectional repeatability



High-Accuracy XZ AZ/EL

- XZ 2 μm accuracy, 0.3 μm repeatability
- ± 220 mm XZ travel
- 4.85 μrad accuracy, 1.5 μrad repeatability
- $\pm 12^\circ$ AZ/EL travel
- 20 kg load capacity



High-Accuracy AZ/ROLL Gimbal with Adjustable Linear Axis

- Precise AZ & ROLL positioning combined with an adjustable PRO225 6.35 mm/rev lead-screw axis allows easy centering of payload over AZ axis regardless of the payload length
- ALAR200-SP AZ, ALAR80-SP, PRO225-500 manual lead-screw stages
- ROLL: 80 mm aperture with front & back rotating tabletops & mounting holes
- AZ/ROLL calibrated accuracy of ± 10 μrad , 0.5 μrad min. incremental step size
- 25 kg load capacity, larger load configurations available
- Max speed: AZ 36 $^\circ$ /s, ROLL 360 $^\circ$ /s with linear amplifiers
- Includes breadboard mounting plate
- Roll 360 $^\circ$ continuous or 340 $^\circ$ limited travel
- Yaw 210 $^\circ$ limited travel
- Linear X500 mm manual travel
- 1.52 m swing radius

Aerotech produces specialized linear positioners for high loads, long travels and high-capacity payloads. Each of these positioners has specialized features designed to meet customer requirements and provide years of reliable operation. These mechanical- and air-bearing stages are used for aerospace testing operations, laser processing and other unique test applications.

High-Force, High-Load Direct-Drive Actuator with Mechanical Bearings

- Includes air cooling ports for continuous operation
- Max speed 3 m/s, max acceleration 5g with 5 kg payload
- Load capacity 150 kg, moving mass 70 kg
- Force 8000 N peak, 1400 N continuous
- 2 m travel, 1.8 m travel at max acceleration & speed
- Accuracy $\pm 2 \mu\text{m}$ calibrated, $\pm 50 \mu\text{m}$ uncalibrated

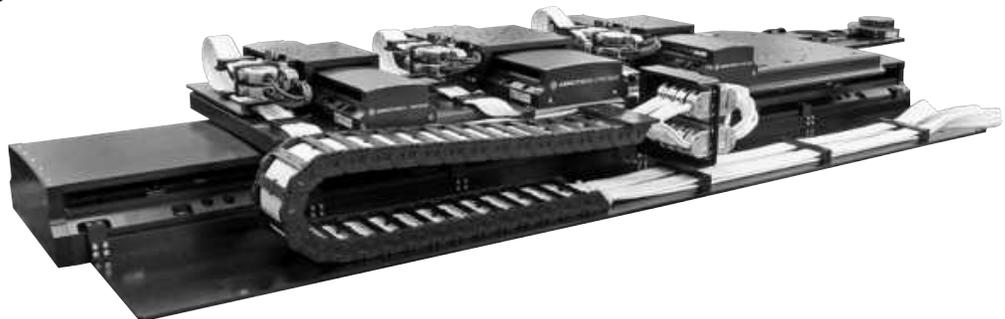


High-Force, High-Speed Linear Motion Simulator with Mechanical Bearings

- 5 g, 5 m/s in center 1 m of travel with 5 kg load
- 2 m travel, 1.7 m travel at max acceleration & speed
- $\pm 1\%$ velocity stability at 5 m/s
- 150 kg max load
- Accuracy $\pm 5 \mu\text{m}$ calibrated, $\pm 50 \mu\text{m}$ uncalibrated
- Replaceable e-chain cables

PRO-LM YYYY 4-Axis Linear Motor Stage

- 1 m X travel
- Mechanical bearings
- Up to 40 kg load capacity per axis
- Accuracy $\pm 5 \mu\text{m}$ calibrated



High-Load 1.5 m Travel, Direct-Drive, Mechanical-Bearing Stage

- Modified PRO560LM
- Travels up to 1.5 m
- 350 kg horizontal load capacity
- Solid carriage, thicker base provide higher stiffness
- 0.1 μm min. incremental motion
- $\pm 1.5 \mu\text{m}$ calibrated accuracy



2 m Travel, Direct-Drive, PR0225LM

- Shown with optional YZ, two motorized axes & granite bridge
- 2 m/s, 3 g max speeds with 1 kg load
- 100 kg load capacity
- Accuracy $\pm 5 \mu\text{m}$ calibrated, $\pm 50 \mu\text{m}$ uncalibrated



1.5 m Travel, Direct-Drive, Air-Bearing Stage

- 1.5 m/s, 1.5 g with 5 kg payload
- $\pm 5 \mu\text{m}$ flatness, straightness
- ± 5 arc-sec roll, pitch, yaw
- $\pm 1 \mu\text{m}$ accuracy calibrated, $\pm 0.6 \mu\text{m}$ repeatability
- 35 kg load capacity



Dual-Carriage, Direct-Drive Air-Bearing System in Bridge Configuration for Optics Inspection

- Granite stage, stainless-steel carriages
- 1 m travel for each carriage
- 0.25 g, 250 mm/s with 5 kg load
- $\pm 2.5 \mu\text{m}$ straightness, $\pm 5 \mu\text{m}$ flatness
- ± 2.5 arc-sec roll, pitch, yaw
- $\pm 1 \mu\text{m}$ accuracy calibrated, $\pm 0.6 \mu\text{m}$ repeatability



Rack-mount controllers simplify equipment installation



Standard dual redundant emergency stop controls



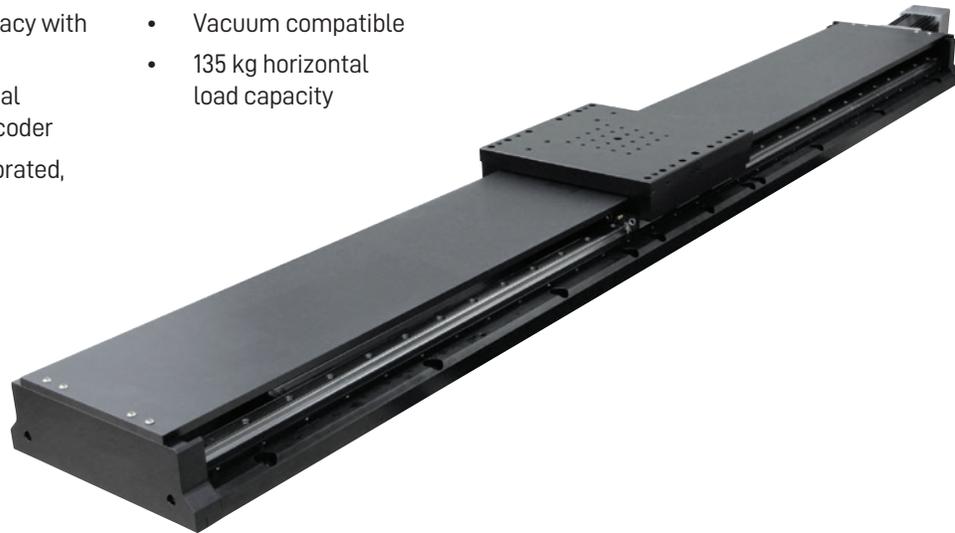
1.5 M Travel, Direct-Drive Air-Bearing System

- Granite stage, stainless-steel carriage
- 1.5 m/s, 1.5 g with 5 kg payload
- $\pm 5 \mu\text{m}$ flatness, straightness
- ± 5 arc-sec roll, pitch, yaw
- Accuracy $\pm 1 \mu\text{m}$ calibrated, $\pm 0.6 \mu\text{m}$ repeatability
- 35 kg load capacity
- $< 40 \text{ nm}$ in-position stability
- 1.2 m travel stage shown



2 M Travel PR0280 Stage

- 2 μm calibrated accuracy with linear encoder
- 0.1 μm min. incremental motion with linear encoder
- Accuracy $\pm 10 \mu\text{m}$ calibrated, $\pm 40 \mu\text{m}$ uncalibrated
- 5 mm ball screw
- Vacuum compatible
- 135 kg horizontal load capacity



High-Load, Ball Screw, Mechanical-Bearing Stages

- 600 mm, 1000 mm, 1500 mm travel sizes
- 685 mm square carriage
- 1000 kg load capacity
- Can be vacuum 10^{-6} torr rated
- Bellows covers to protect from particles, laser slag
- Accuracy $\pm 8 \mu\text{m}$ calibrated, $\pm 50 \mu\text{m}$ uncalibrated
- Air purge for positive air pressure



ELECTRO-OPTIC MANUFACTURING & TEST

These high-accuracy motion systems are designed for superior multi-axis angular testing and calibration of electro-optic sensors, missile seeker gimbals, sensors and inertial navigation guidance units. They are also used as target-tracking gimbal mounts. With our advanced controls and software, customers can rapidly integrate and test their products. Beam-director configurations are possible with 100 mm to 325 mm clear apertures for high-energy beam pointing and testing.

Features & Benefits

- High accuracy
- Repeatability
- Direct drive
- Smooth motion
- High speed
- Non-cogging



High-Accuracy, 2-Axis, Direct-Drive Gimbal Mount

- Continuous 360° rotation of both axes
- $\pm 7.5 \mu\text{rad}$ or better accuracy
- $\pm 2.5 \mu\text{rad}$ repeatability
- 0.05 μrad min. step
- Direct drive, brushless, slotless servomotors
- Cog-free design for outstanding velocity stability
- Accommodates loads up to 1000 mm diameter
- Vacuum-compatible versions

Ultimate Bearing Precision, 2-Axis, Air-Bearing Motion Simulator/Positioner

- Direct drive, brushless, slotless motors
- $\pm 10 \mu\text{rad}$ accuracy
- Cleanroom compatible
- $< 3 \mu\text{rad}$ tilt error per axis
- 5 μrad repeatability
- 300 mm aperture
- 120 nm axial error motion per axis
- 170 nm radial error motion per axis



ELECTRO-OPTIC POINTING & TRACKING

We provide high-accuracy standard gimbals for many applications, including image and laser scanning. Customers often have unique payload size, shape and weight requirements that need special design considerations. Our direct-drive and gear-drive rotary products are readily configured into two-axis gimbals as shown in the pages that follow. Many features are available such as travel limits, slip rings for continuous travel, power-off brakes and adjustable counterbalances. Systems shown include load capacities up to 500 kg. If you do not see an appropriate solution for your application, please contact the factory with your requirements so that we can configure a system for your needs.



Direct-Drive, 2-Axis Azimuth/Elevation Positioner

- ALAR150-SP gimbal
- MS connectors
- Pilot mounting ID on pitch axis
- Rear pitch tabletop for counterbalance
- Universal breadboard mounting plate
- $\pm 7.5 \mu\text{rad}$ accuracy
- 45 kg load capacity
- $\pm 2.5 \mu\text{rad}$ repeatability
- $0.05 \mu\text{rad}$ min. step
- Circular connectors

Large-Aperture, 2-Axis Azimuth/Roll Positioner

- Direct drive
- $\pm 7.5 \mu\text{rad}$ accuracy
- $\pm 2.5 \mu\text{rad}$ repeatability
- $0.05 \mu\text{rad}$ min. step
- 100-325 mm apertures available
- Azimuth slip-ring; limited or unlimited travel available
- 150 mm apertures shown



SENSOR TESTING

High-Load-Capacity Sensor Testing Positioner

- $\pm 7.5 \mu\text{rad}$ accuracy per axis
- Air or vacuum versions available
- Up to 182 kg load capacity
- Limited travel AZ; continuous or limited travel EL
- $0.005 \mu\text{rad}$ resolution allows super-fine stepping & excellent repeatability



Our gimbals are used to test and verify missile guidance systems.




We supply full systems or rack-mount drives to operate our positioners.

Electro-Optic Sensor Calibration Gimbal

- 2-axis direct drive
- AZ ± 95 deg travel, roll 360 continuous
- Tooling ball fixture aligned to axes of rotation for removable gimbal alignment datum
- $\pm 7.5 \mu\text{rad}$ accuracy
- $\pm 2.5 \mu\text{rad}$ repeatability
- $0.05 \mu\text{rad}$ min. step



High-Accuracy, Direct-Drive, 2-Axis Positioner

- AZ $\pm 170^\circ$ travel
- EL $\pm 170^\circ$ travel
- $\pm 7.5 \mu\text{rad}$ accuracy
- $\pm 2.5 \mu\text{rad}$ repeatability
- $0.05 \mu\text{rad}$ min. step



Missile accuracy depends on seeker and navigation systems. Our gimbals are used to measure and calibrate these systems.



AMG300 Custom Sensor Gimbal

- Continuous 360° rotation of azimuth & elevation including built-in slip ring
- High-accuracy angular position & rate capability
- High axis stiffness for precise pointing
- Direct-drive, brushless servo motors result in zero backlash



ELECTRO-OPTIC PROTOTYPE POINTING

Prototype development systems are used to prove our customers' products in real-world environments. Our systems provide precise pointing of customer payloads with easy-to-use controls and software. This allows customers to focus on field qualification of their devices and relieves them from engineering the pointing system. Our experience includes engineering electrical hook-ups, slip rings, mechanical mounting interfaces, distributed control, power requirements, safety electronics and post-processing of motion events.

2-Axis, Direct-Drive Positioner

- Continuous 360° rotation of azimuth & elevation including built-in slip ring
- High-accuracy angular position & rate capability
- Direct-drive brushless servomotors result in zero backlash
- Cog-free design for outstanding velocity stability
- Box cell provides multiple mounting locations for user flexibility
- Low maintenance & high reliability provide the lowest cost of ownership



IR or Day Camera Pointing

Medium Performance

- Direct drive gives rapid motion in a small package
- $\pm 24 \mu\text{rad}$ accuracy
- $\pm 2.5 \mu\text{rad}$ repeatability
- Can be vertically or horizontally mounted
- Rectangular mirror cell
- Limited travel in AZ & EL
- Also useful as antenna steering gimbal



Video Tracker Testing

High Performance

- T configuration EL over AZ, direct drive
- Mounting for sensor or laser on both sides of the EL axis
- Limited or unlimited travel
- 36 kg load capability
- $\pm 10 \mu\text{rad}$ accuracy
- $\pm 2.4 \mu\text{rad}$ repeatability
- 0.01 μrad stepping



EO Pointing

Medium Performance

- T configuration EL over AZ, direct drive
- Mounting on both sides of the EL axis
- Limited or unlimited travel
- 10 kg total load capability
- $\pm 14 \mu\text{rad}$ accuracy
- $\pm 8 \mu\text{rad}$ repeatability
- 0.5 μrad min. step



CUSTOM TEST & SENSOR GIMBALS

Combining standard rotary and linear products provides many multi-axis possibilities for complex angular and linear solutions for testing and tracking systems.



5-Axis, Direct-Drive Gimbal with Integrated Rotary & Linear Axes

- Pitch/yaw 0.5 μ rad or smaller steps
- Pitch - ADRS
- Yaw - ALAR-SP
- XYZ - ANT, 1 nm stepping capability
- Pneumatic Z counterbalance



Stainless Steel Telescope Gimbal

- +/-10 μ rad accuracy
- 0.01 μ rad stepping
- 500kg load capacity
- 1 m telescope cell
- Shock absorber travel limits
- Optional coude path optical mounts with up to a 325mm aperture



Large-Payload, Box Cell Gimbals

- +/-10 μ rad accuracy
- 0.01 μ rad stepping
- 50-500kg load capacity
- Single or dual EL drive motors
- Shock absorber travel limits
- Larger sizes available
- ALAR-SP & -XP rotary stages

With our extensive line of positioners, we can readily configure a system for unique payloads.



High-Performance, 3-Axis, Large-Aperture, Direct-Drive Guidance Test System

- 100 to 325 mm ROLL aperture
- Used for testing or calibration
- Continuous or limited travel versions
- Slip rings for customer signals & power
- High resolution
- $\pm 10 \mu\text{rad}$ accuracy
- $0.03 \mu\text{rad}$ resolution
- Precision angular contact bearings result in low axis-error motions
- No backlash or gear wear

High-Load, 3-Axis Gimbal and Linear Stage for Precision Pointing

- 350 kg capacity direct drive gimbal
- Gimbal $<15 \mu\text{rad}$ accuracy, $5 \mu\text{rad}$ repeatability
- Center height 1.05 m
- Yaw ± 100 , Pitch ± 10 , Roll ± 145 degrees
- Roll front and rear payload mounting for dual sided operation
- Optional gimbal brakes
- 1000 kg capacity linear ball-screw stage with brake
- Up to 1500 mm travel available
- Linear $<10 \mu\text{m}$ accuracy, $3 \mu\text{m}$ repeatability
- Work point XYZ in-position stability $<200 \text{ nm}$



3-Axis Gimbal for Microradian Positioning of Electro-Optic Sensors, Optics & Inertial Devices

- 1 m aperture
- Low backlash gear drives
- +/-90 degrees pitch travel, continuous travel in yaw/roll
- Accuracy: pitch <math><150 \mu\text{rad}</math>, roll <math><75 \mu\text{rad}</math>, yaw <math><15 \mu\text{rad}</math>
- Max load on gimbal without XYZTT 91kg
- Optional manual XYZTT sample manipulator for payload centering

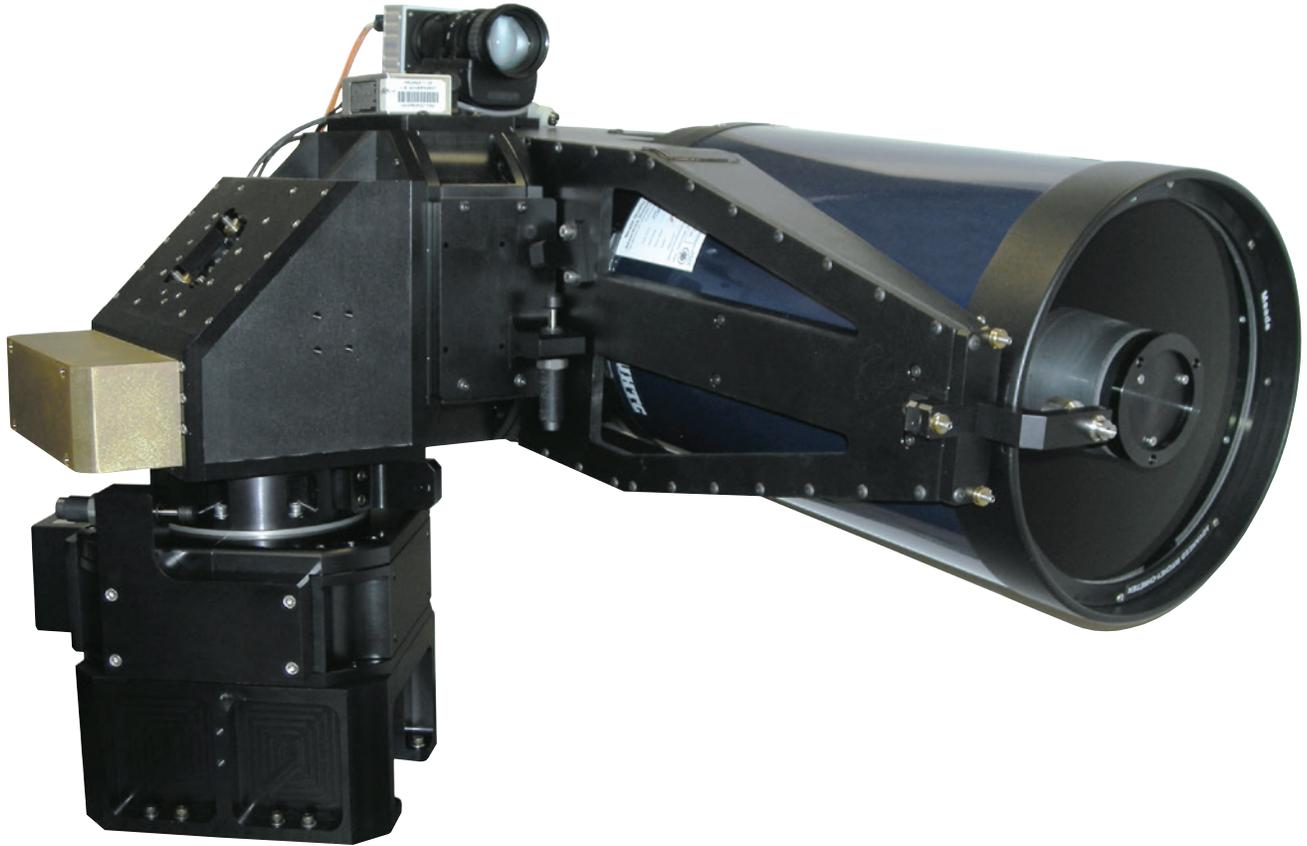


2.3 m | **2 m** | **1.2 m** | **1 m**
tall | wide | deep | aperture



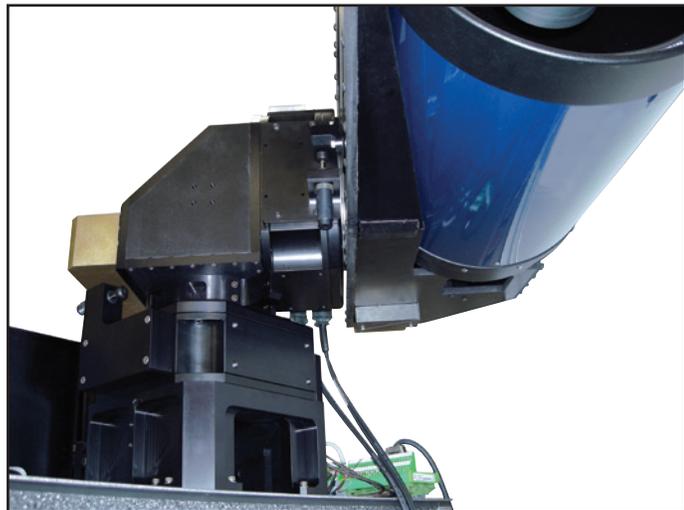
DIRECTED ENERGY POINTING

Aerotech's large-aperture rotary stages provide high-resolution motion and can be configured into two-axis gimbals with a coudé path to direct laser energy through the stages and out through a telescope. This system shows a custom beam director built with our ALAR rotary stages.

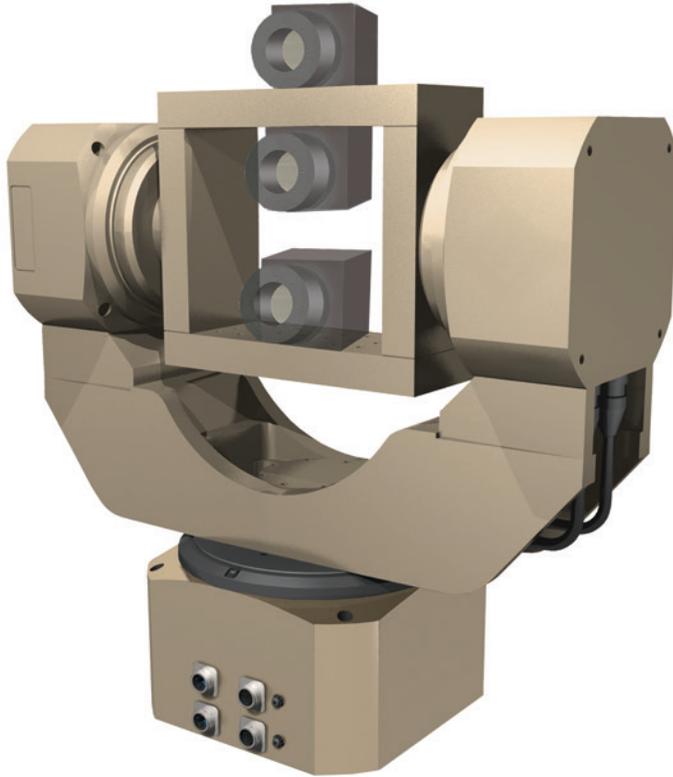


2-Axis Beam Director

- 100 mm to 325 mm optical apertures available
- Used for star tracking or laser beam pointing
- Active or passive applications



WEATHERIZED GIMBALS

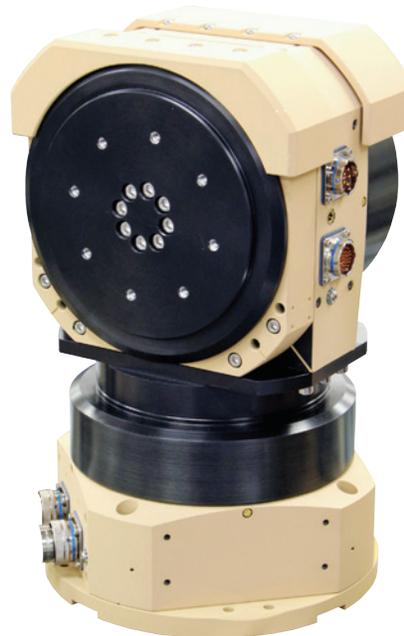


Direct-Drive Outdoor Sensor-Pointing Mount, IP66-Sealed

- Environmentally hardened for field testing
- Provides easy mounting points
- Continuous or limited travel
- Slip-ring options
- Payloads up to 45 kg
- Sealed connectors

Direct-Drive Outdoor Camera or Antenna Mount, IP66-Sealed Pan & Tilt

- Payloads up to 23 kg
- Slip-ring options
- Low maintenance
- Sealed connectors
- Continuous or limited travel



MIRROR GIMBALS - AMG

Key Applications

AMG direct-drive gimbals are extremely precise & robust, making them ideal for high-performance pointing, tracking & motion simulation applications, such as:

- Missile seeker testing & calibration
- Electro-optical sensor testing
- Airborne target tracking
- Motion simulation
- Optical testing of space-based sensors in vacuum
- Pointing of optics, lasers, antennas & more



Design Features

- Provides continuous 360° rotation in both azimuth & elevation
- Ultra-precise positioning & smooth tracking thanks to high-resolution encoder feedback
- Ironless direct-drive motors provide outstanding velocity stability & long-term reliability
- Customizable design to suit your application, including special payload cells, yokes, travel range, environmental conditions & more



AMG400 400 mm Mirror Gimbal on PRO280 1 m Linear Ball-Screw Stage

- Allows customer to reposition the gimbal over 1 m for different optical tests
- $\pm 10 \mu\text{rad}$ AZ/EL
- $\pm 3 \mu\text{m}$ linear calibrated accuracy
- Smaller or larger configurations available
- 360° continuous pitch & yaw gimbal travel



AMG500 with Special Front Surface Reflecting Mirror Cell & Counterweights

- Mirror surface is at the center of the AZ/EL rotations
- Mirror cell is offset behind AZ-EL rotation point
- Mirror cell includes counterweights on upper & lower mirror cell to balance the offset mirror load

Mirror face is on the AZ/EL axes for true beam turning. Additional counter weights at top and bottom of the cell provide gravity balance to both axes.

AMG500 with Special Front Surface Reflecting Mirror Cell & Counterweights

- Mirror surface is at the center of the AZ/EL rotations.
- Mirror cell is offset behind the AZ-EL Rotation Point
- Adjustable counterweights are mounted outside the EL axis to be out of the optical path



2-Axis, Direct-Drive Mirror Mounts

- Smooth motion for accurate target tracking
- Vac 10⁻⁶ torr version available
- Limited AZ/EL travel
- $\pm 5 \mu\text{rad}$ accuracy
- $\pm 2.9 \mu\text{rad}$ repeatability
- 660 mm ID mirror cell shown
- Custom yoke needed for hard stops & limited AZ travel

MIRROR GIMBALS - AMG-LP

AMG-LP Low-Profile Direct-Drive Gimbals

Aerotech's AMG-LP (Low Profile) gimbal mounts provide ultra-precise angular position, rate and acceleration for development and production testing of a wide range of systems. The AMG-LP series is ideal for directing optics, lasers, antennas and sensors at high speed to precise pointing angles.



AMG200 AZ Custom High-Capacity Bearing with AMG200LP EL

- Custom 8-front surface reflecting mirror
- Mirror surface is at the center of the AZ/EL rotations
- Inside axis counter balances for high-dynamics motion
- Custom smaller yoke, narrower EL swing radius
- Special limited travel hardstops & limit switches
- Can be mounted in any orientation
- Balanced in AZ/EL direction

AMG200LP Custom, Direct-Drive, High- Acceleration Gimbal

- Raised EL axis allows steep beam angles vertically
- Mirror cell easily removable to add other payloads
- Sub-arc-sec jitter
- AZ slip-ring allows continuous rotation
- 8" ID mirror cell, 14" height to mirror center
- Optional high-load AZ for vertical surface mounting



Beam Scanning, High-Speed Gimbal

- $\pm 7.5 \mu\text{rad}$ accuracy plus high acceleration capability
- Direct-drive motors can operate in any orientation relative to gravity
- Mirror front surface is centered on AZ/EL axes to eliminate off-axis reflection error
- AZ slip-ring allows 360° continuous rotation in both axes
- 4" (100 mm) mirror cells shown, 6" (150 mm) & 8" (200 mm) available
- Increased AZ bearing capacity for higher moment load capacity & mounting in any orientation vs gravity



AMG200LP High-Speed Scanning Gimbal for High-Duty-Cycle Oscillation

- $\pm 95^\circ$ electrical limits, $\pm 100^\circ$ hard stops
- No slip-ring allows higher current/torque to EL motor for greater scanning & oscillation speed than possible with standard slip-ring
- Long life with no slip-ring brushes to wear out



High-Load, Low-Profile Gimbal for EO Sensor Pointing

- Two ADRS-200 direct-drive stages, $\pm 7.5 \mu\text{rad}$ calibrated accuracy
- Limited AZ & EL travel to avoid sensor cable wrap-up ($\pm 25^\circ$ AZ, $\pm 15^\circ$ EL)
- Payload size up to 18 kg, 10.25 mm wide
- Center of rotation 280 mm above mounting
- Gimbal dims 464 mm wide x 381 mm high x 280 mm deep including cables

MIRROR GIMBALS - AMG2 DIRECT-DRIVE



Built with our high-performing, powerful ALAR & APR rotary stages, the AMG2 delivers many advantages including:

- Lower height
- Smaller EL-axis cross section to allow for larger angle reflections
- Higher motion accuracy
- Better tilt
- Larger payload capacity
- Smaller minimum incremental stepping
- Smaller in-position stability

Direct-Drive AZ/EL Mirror Gimbal

- 0.5-0.05 μ rad min. incremental motion
- ± 9 accuracy, ± 2.5 μ rad repeatability
- 150-800 mm mirror sizes
- EL 360° travel
- Counterbalanced front surface reflecting mirror cells optional
- AZ 360° with slip ring or limited AZ
- Factory configured up to $\pm 170^\circ$ travel
- Air or vacuum 10⁻⁶ torr rated



MIRROR GIMBALS - AMG-GR MEDIUM PERFORMANCE GEAR-DRIVE



AMG-GR 2-Axis, Gear-Drive, Optical Mount

- Servo or micro-stepper motors
- Rectangular & circular cell models
- 100,150, 200, 300 mm STD mirror cells
- Larger mirror cells special order
- $\pm 25 \mu\text{rad}$ - $\pm 145 \mu\text{rad}$ accuracy
- $\pm 15 \mu\text{rad}$ - $\pm 110 \mu\text{rad}$ repeatability
- AZ $\pm 90^\circ$ or 360° continuous w/ slip ring
- EL $\pm 45^\circ$, $\pm 157^\circ$ or 360° continuous
- No mirror cell option for sensor mounting
- Custom sensor mount cells available



MIRROR GIMBALS - AOM-HG HYBRID

Customizable Features

- AZ hardstops, limits
- Mirror cell can be rotated manually to any angle & locked. Motorized travel is +/-6 deg about that position.
- AZ slip ring
- FSR mirror cell & counterweights
- Vac prep
- Anodize finish standard
- Optional paint, nickel plating or unfinished



Direct-Drive AZ / Mechanical-Drive EL Mirror Gimbal with Direct Encoders

- 0.25 μ rad AZ, 1 μ rad EL min. incremental motion
- ± 9 μ rad AZ, ± 15 μ rad EL accuracy
- ± 2.5 μ rad repeatability
- 400, 500, 600 & 760 mm STD mirror sizes
- EL travel ± 6 degrees, hold position with power off
- AZ travel up to +/-170 degrees, or continuous with slip ring
- Air or vacuum 10⁻⁶ torr rated
- Other sizes special order

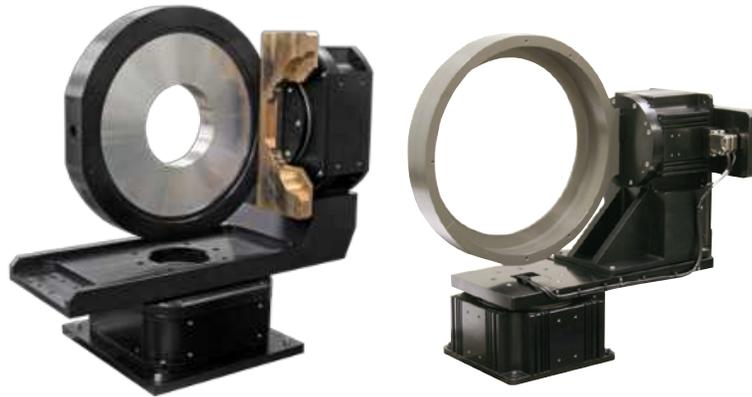


AOM-HG-600mm shown with mirror mass simulator.

MIRROR GIMBALS - CUSTOM

One-Sided Gimbals

- 4"-16" mirror cells
- ALAR/APR accuracy



Vacuum Versions

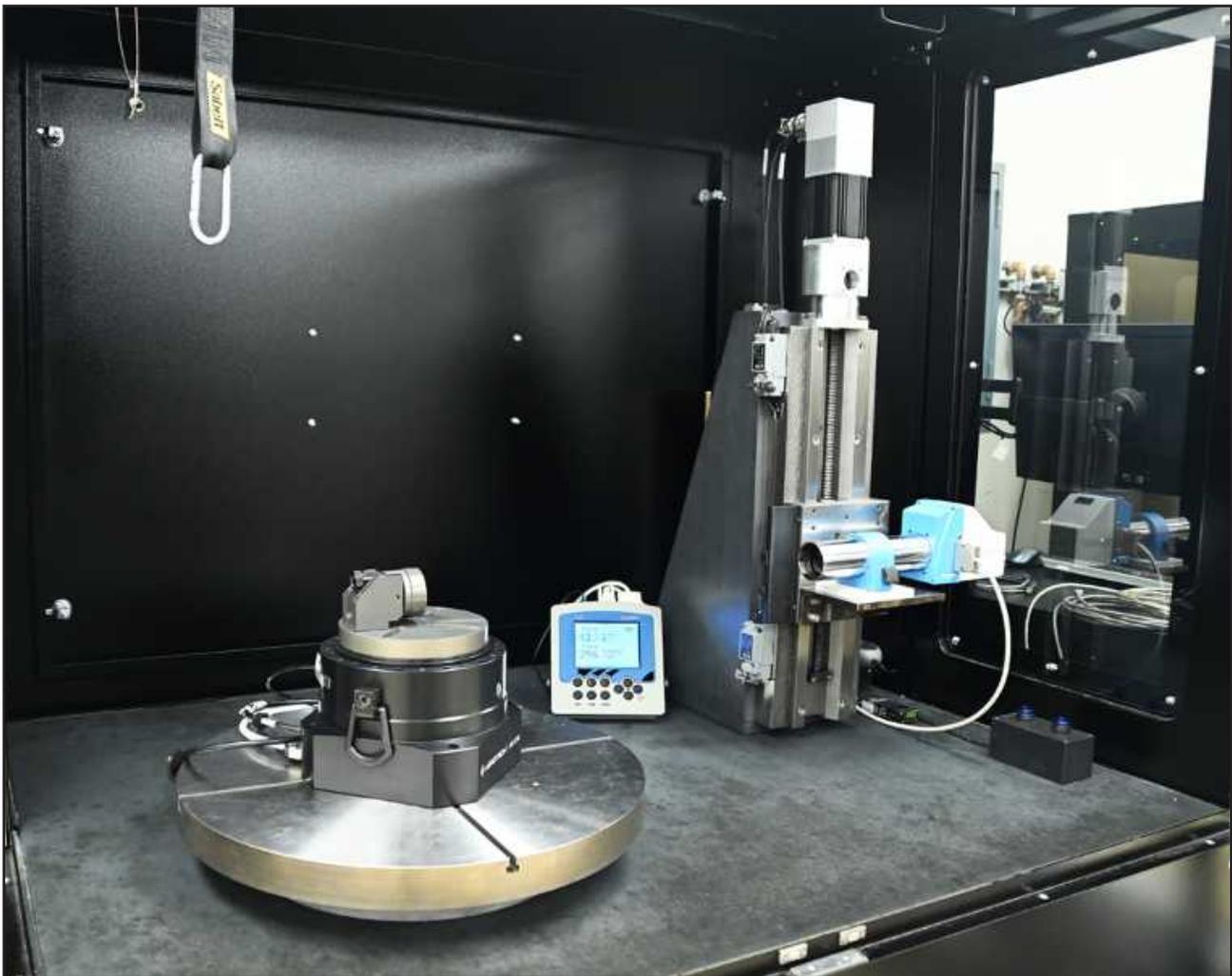


Oversized Mirror Gimbals

- ALAR/APR accuracy
- Limited or continuous travel
- Air or 10⁻⁶ torr vacuum
- High load capacity
- AZ/EL apertures optional
- FSR mirror cell & counterweights

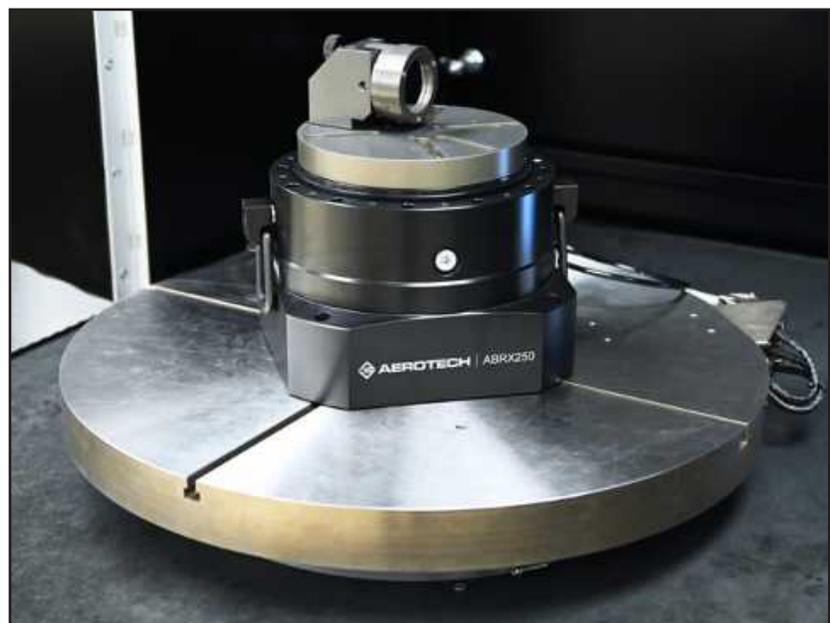
Testing & Simulation Systems

ROTARY SENSOR TESTING



Specifications

- Master-axis accuracy: $<0.6 \mu\text{rad}$ (<0.12 arc-second)
- Min. incremental step: $0.035 \mu\text{rad}$ (0.007 arc-sec)
- Angular measurement uncertainty: $<0.73 \mu\text{rad}$, $k=2$ (<0.15 arc-sec expanded uncertainty, $k=2$)
- 200 kg load capacity





Stainless-Steel APR260 for Best Tilt & Thermal Stability

- High-accuracy direct drive
- Mechanical bearing
- $\pm 2.5 \mu\text{rad}$ tilt
- $\pm 3.6 \mu\text{rad}$ accuracy
- 250 kg load
- Optional oversized steel tabletop & mounting post



High-Load ALAR325-SP Rotary Calibrator

- $\pm 2.5 \mu\text{rad}$ accuracy
- $\pm 1.3 \mu\text{rad}$ repeatability
- $\pm 5 \mu\text{rad}$ tilt
- 900kg load capacity
- Vacuum versions available
- 1 m tabletop
- 90° manual lock positions

CUSTOM ROTARY STAGES

Custom Features

- Special electrical slip rings
- Gas rotary joints
- Fiber-optic data rotary joints
- Special circular connectors
- Custom tabletops & mounting plates
- Stainless steel
- Custom high torque motors
- Custom seals
- Custom housings



HEXAPODS



HexGen® HEX150-125HL Miniature Hexapod 6-DOF Positioning System

- 12 kg load capacity
- 15 nm, 0.2 μ rad min. incremental motion



HexGen® HEX300- 230HL Hexapod 6-DOF Positioning System

- 45 kg load capacity
- 20 nm, 0.2 μ rad min. incremental motion



HexGen® HEX450 Hexapod 6-DOF Positioning System

- 350 kg load capacity
- 50 nm, 1 μ rad min. incremental motion



HexGen® HEX500-350HL Hexapod 6-DOF Positioning System

- 200 kg load capacity
- 20 nm, 0.2 μ rad min. incremental motion



Custom Hexapods

- Vacuum 10⁻⁶ - 10⁻⁸ torr
- Custom travel options
- Custom mounting
- Larger apertures
- Integrated rotary stage options

CUSTOM HEXAPOD TEST SYSTEMS



High-Load ALAR325-SP Roll on HEX500-350 Hexapod

- 20 nm linear, 0.05 μ rad angular min. steps
- 3 μ m linear accuracy
- 10 μ rad angular accuracy

High-Accuracy XY

- HEX500-350 hexapod
- 200 KG load capacity
- 10 μ rad angular accuracy
- 5 μ m linear accuracy



Large EO payloads can be precisely pointed in air or vacuum applications.

ROTARY & LINEAR SENSOR TEST

Aerotech motion simulators are designed for high-accuracy testing and calibration of aerospace and defense systems. The Aerotech family of motion simulators can generate accurate and repeatable acceleration, velocity or position motion trajectory for angular or linear device testing. Single- and multi-axis solutions are available.

Our motion simulators are used to test inertial sensor components such as MEMS, fiber-optic gyroscopes & accelerometers. Our multi-axis systems are used to test inertial measurement units (IMU), Inertial Navigation Systems (INS) & Attitude Heading Reference Systems (AHRS) used in missiles, aircraft, spacecraft, stabilized electro-optic payloads, ships & ground vehicles.

- High-accuracy, direct-drive motion simulators
- No cogging
- High torque
- Mechanical or air bearings
- Real-time data collection
- Position, rate & oscillation modes
- Easy user profile importing
- Windows®-based programming
- Slip rings or twist cables feed UUT signals/power
- Solutions range from economical single-axis systems to high-performance 3-axis systems
- Fiber-optic rotary union options
- Gas rotary union options



SINGLE-AXIS MOTION SIMULATORS FOR INERTIAL SENSOR TESTING & CALIBRATION

Single-axis motion simulators are used to induce precise angular or linear acceleration, velocity or positions to sensors such as gyroscopes, accelerometers and other inertial sensing equipment. Our single-axis motion simulators are used in laboratories for sensor research or in manufacturing for test of production inertial sensor systems. Electrical slip rings are included in the rotary tables to connect the sensors to control and power while allowing continuous rotation with no cable wrap-up. Aerotech employs high-accuracy feedback devices in our motion simulators to provide low- or high-speed trajectory accuracy. Aerotech's single-axis rotary tables have multiple size units to handle a wide range of payload inertias and form factors. Optional features include floor stands with manual tilt for vertical or horizontal axis testing.

Precision Direct-Drive Rotary Position & Rate Tables

- High-capacity angular contact bearings or air bearings
- Highly accurate closed-loop control
- Brushless, slotless motor for smooth motion with no cogging
- Large selection of integrated, low-noise slip rings for customer signals & power
- Multiple motor types for high-speed or high-torque configurations
- Excellent error motion performance
- Dual liquid or gas ports
- Low-maintenance design
- Position resolution to 0.000006° ($0.1 \mu\text{rad}$) (0.02 arc-sec)



Aerotech products are capable of testing today's top inertial navigation systems.

INERTIAL TESTING MOTION SIMULATORS

ARMS260

- 227 kg payload capacity
- Unloaded acceleration $>20,000^{\circ}/s^2$
- Min. rate $0.001^{\circ}/s$



High-Accuracy, Single-Axis Rate Table with Tilt Table

- Allows rate-table performance at multiple inclination angles
- Mounted to a gear-drive rotary for tilt motion
- User adjustable pitch mounting location of the yaw stage to balance the system
- 146 Nm peak torque
- 24-90 slip rings standard
- Manual tilt table for vertical or horizontal operation
- 230-600 mm tabletop options (600 mm shown)



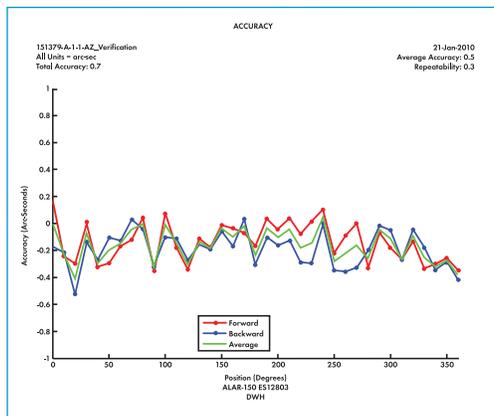
2-Axis Rate Table with Integrated Electronics

Two-axis rate tables are used for point-to-point or continuous motion to excite two-axis sensor systems. Simultaneous acceleration, velocity or position motion can be produced and repeated for production and qualification testing of inertial measurement and navigation systems. Multiple systems can be tested at once to increase testing throughput.

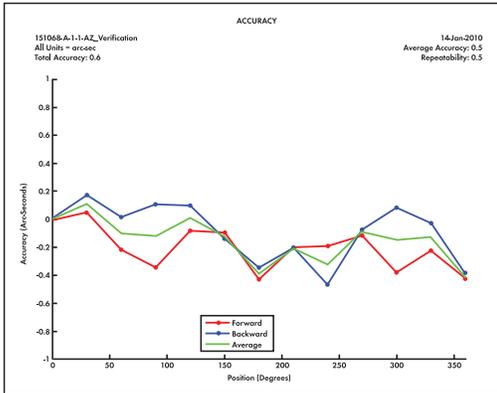
- Continuous rotation of both axes
- Smooth motion from non-cogging brushless, slotless motors
- Power & signal slip rings
- Two rotating gas/liquid ports
- Machine base includes motion controller, linear digital amps & ESTOP safety controls
- Free-standing, post-mounted two-axis systems or integrated control weldment base configurations are available to optimize floor space



Gyro & inertial navigation testing



Accuracy plot showing better than ± 1 arc-sec accuracy ($\pm 4.85 \mu\text{rad}$)



Accuracy plot showing better than ± 1 arc-sec accuracy ($\pm 4.85 \mu\text{rad}$)



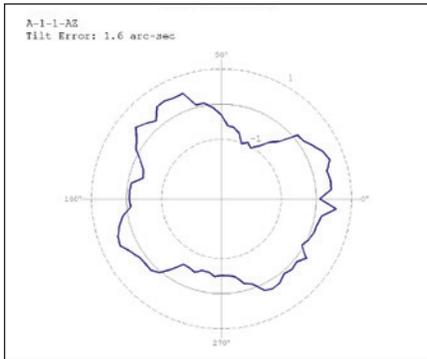
2-Axis Direct-Drive Motion Simulator

- 91 kg load capacity
- Optional slip rings
- $\pm 5\text{--}\pm 10 \mu\text{rad}$ positioning accuracy
- $0.001 \mu\text{rad}$ resolution for high-velocity stability & low jitter
- 100 mm–325 mm aperture option
- Limited or continuous travel

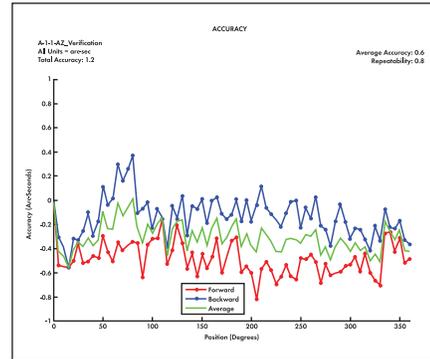


3-axis motion simulators provide simultaneous roll, pitch and yaw motion for real-world angular velocity profiles.

- Smaller than traditional three-axis simulators to accommodate miniature MEMS gyros in a much smaller footprint
- Modular design based on the ARMS rate tables
- Continuous or limited travel options
- Pedestal options



- Each motion simulator is tested for accuracy & tilt errors.
- Typical tilt is below 10 μ rad. Typical accuracy is ± 5 – ± 10 μ rad.



- High-torque 3-axis system for testing INU & autopilot packages
- Continuous or limited travel options
- Base weldment options for free-standing configuration

3-AXIS MOTION SIMULATORS

3-Axis Angular Oscillation Gimbal

- Travel: yaw ± 100 deg, pitch $\pm 90/-10$ deg, roll ± 170 deg
- Accuracy: ± 5 μ rad positioning accuracy
- Repeatability: ± 2.5 μ rad
- 325 mm aperture



3-Axis Motion Simulator

- Continuous or limited travel
- Electrical slip rings
- Fiber-optic rotary unions for 2 GHz Ethernet bi-directional data
- Accuracy < 10 μ rad

Limited-travel motion simulators benefit from a more simple system configuration and economical price point. By eliminating slip rings and restricting the axes' travel range, the payload's native cables can be used during motion testing. This reduces the cost of making special test cables, reduces labor and number of connectors, and eliminates slip rings, making the system less expensive. Operational longevity is extended as there are no slip rings to wear out.

ADRT150-185/ADRT260-180 Direct-Drive Stages

- Travel $\pm 165^\circ$ pitch, $\pm 165^\circ$ yaw
- Inner 30 N-m peak torque, outer 146 N-m peak torque
- Can easily add a third axis for limited outer



ADRT100-85/ADRT150-135 Direct-Drive Stages

- Continuous inner rotation, limited outer
- Tabletop size with breadboard mounting base
- 3-5 kg load capacity depending on inertia & move profile
- Can be configured with larger rotary stages for more load capacity

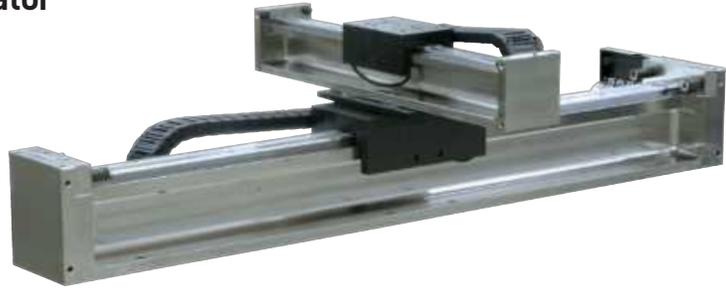
ARMS200 with Removable Hard Stops

- Limited-travel rate table that can be reconfigured from limited travel to continuous travel
- Can test payload with native cables over limited travel or easily changed over to use the internal slip rings
- Removable hard stop & switchable electrical limits protect INU cables from damage
- 355 mm tabletop, D connectors or circular connectors



High-Acceleration Linear Actuator

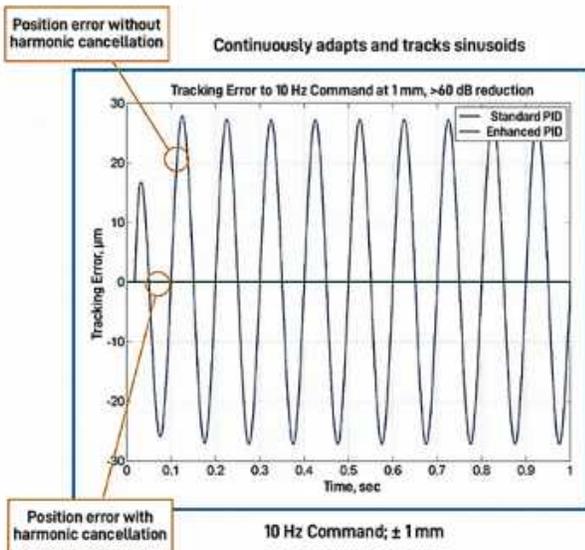
- 1 m travel
- 3 m/s, 4 g with 1 kg load
- Mechanical bearings
- 60 kg load capacity
- Accuracy 5 μm calibrated, $\pm 50 \mu\text{m}$ uncalibrated
- Vacuum 10⁻⁶ torr



ACT Linear Actuators for Acceleration & Velocity Testing

- High-performance, cost-effective actuator
- Travel range from 100 mm to 1.5 m
- Acceleration capability up to 3 g
- Velocity capability up to 5 m/s
- Maximum continuous force output up to 105.5 N
- Maintenance free, direct drive, zero-cogging motor & noncontact optical linear encoder

Harmonic Cancellation Software Greatly Reduces Sinusoidal Position Disturbances



Advanced Control: Harmonic Cancellation

Challenge

Many times a sinusoidal excitation is needed in the testing or calibration procedure of an inertia device. The very nature of this test introduces errors in the motion at the excitation frequency and other higher order harmonics. Left uncorrected, these errors can skew test results, lead to poor calibration or trigger unnecessary failures in quality assurance.

Solution

Using Harmonic Cancellation, which is part of our Dynamic Controls Toolbox, users easily cancel out any disturbances caused by the excitation frequency or an unbalanced load. This feature adapts to magnitude and frequency of error source. An easy-to-use setup wizard is provided through the Digital Scope and the Motion Simulator. Using Harmonic Cancellation results in the most accurate testing and calibration available.

VACUUM SYSTEMS

Aerotech specializes in understanding customer vacuum system needs and customizing our product line to provide additional application-specific capabilities.

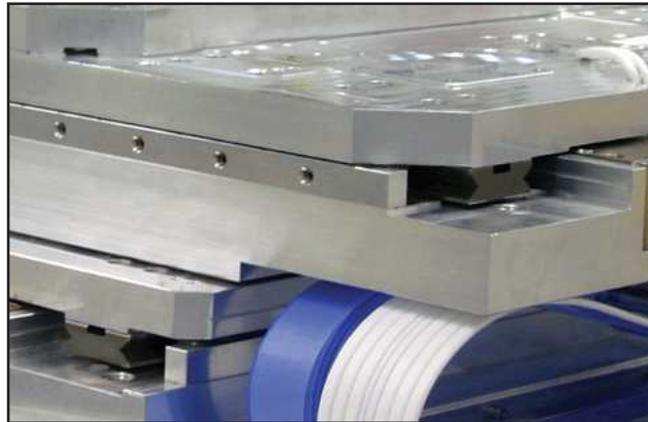
Our vacuum-compatible motion platforms minimize pump downtime, chamber contamination and thermal issues. We offer complete systems including cables, connectors and bulkhead feed-through connectors.

A wide range of Aerotech motion products are available in vacuum-prepared versions. We also manufacture custom systems to meet specific needs, such as reducing magnetic fields or operating in space-rated environments.

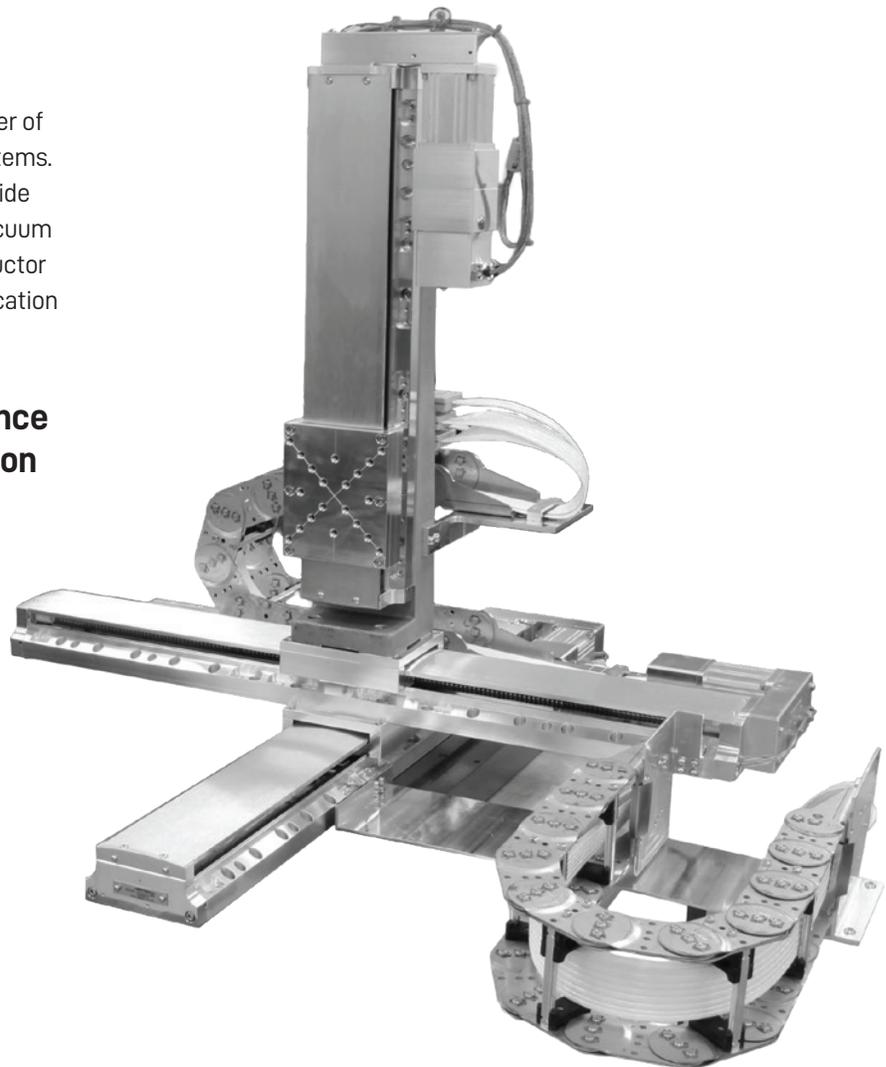
Aerotech's experience, product scope and engineering capabilities make us the partner of choice for vacuum-compatible motion systems. Our precision motion control products provide the critical performance for demanding vacuum applications in markets such as semiconductor manufacturing and inspection, optics fabrication and defense/aerospace.

Aerotech has specific experience with vacuum-compatible motion platforms for 10⁻³ to 10⁻⁸ torr environments:

- Material selection
- Surface preparation
- Hardware venting & elimination of trapped volumes
- Lubricant selection
- Cable selection
- Thermal management
- Magneticfield control
- Cleaning
- Bake-out
- Handling & packaging



XY linear motor-driven motion system showing several key design elements that allow stage operation in high vacuum.





Vertical Stage with Free-Standing Base

- 114 kg load capacity
- Linear encoder
- High-precision ball screw
- Can be easily configured as an XYZ system



Heavy Load XYZ

- 100 kg load capacity
- $\pm 0.1 \mu\text{m}$ minimal incremental motion
- Direct linear encoders
- $\pm 5 \mu\text{m}$ XYZ work-point accuracy



5-Axis, Large-Travel System

- Direct-drive provides ultimate scanning system for calibrating satellite instruments
- High accuracy
- High resolution
- Excellent straightness & flatness



XYZ Ball-Screw Positioner

- 36 kg load capacity
- Linear encoders
- High accuracy
- Excellent repeatability

XYZ AZ/EL Vacuum System

- 60 kg load capacity
- 0.1 μm linear & 0.5 arc-sec angular min. incremental motion
- Direct linear & rotary encoders
- $\pm 5 \mu\text{m}$ XYZ work-point accuracy



XYZ AZ/EL Vacuum System

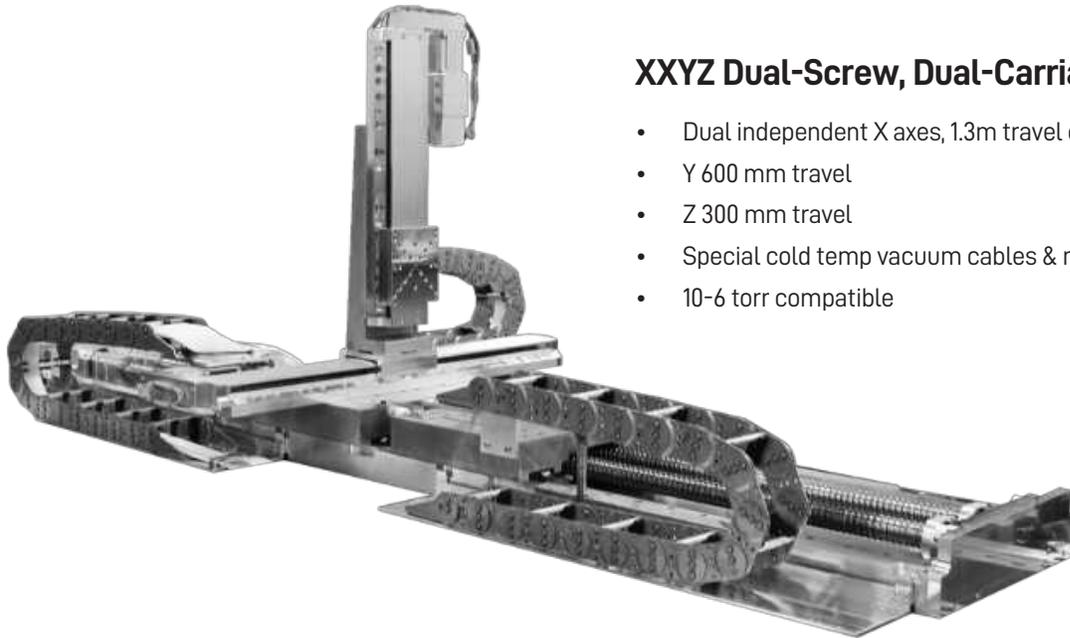
- 60 kg load capacity
- 0.1 μm linear & 0.5 arc-sec angular min. incremental motion
- Direct linear & rotary encoders
- $\pm 5 \mu\text{m}$ XYZ work-point accuracy

6-Axis, High-Accuracy System

- 10-6 torr vacuum compatible
- Direct-drive roll, pitch, yaw: min. incremental motion 0.05 arc-sec
- Direct encoder XYZ ball-screw stages: min. incremental motion 0.1 μm , $\pm 5 \mu\text{m}$ XYZ work-point accuracy

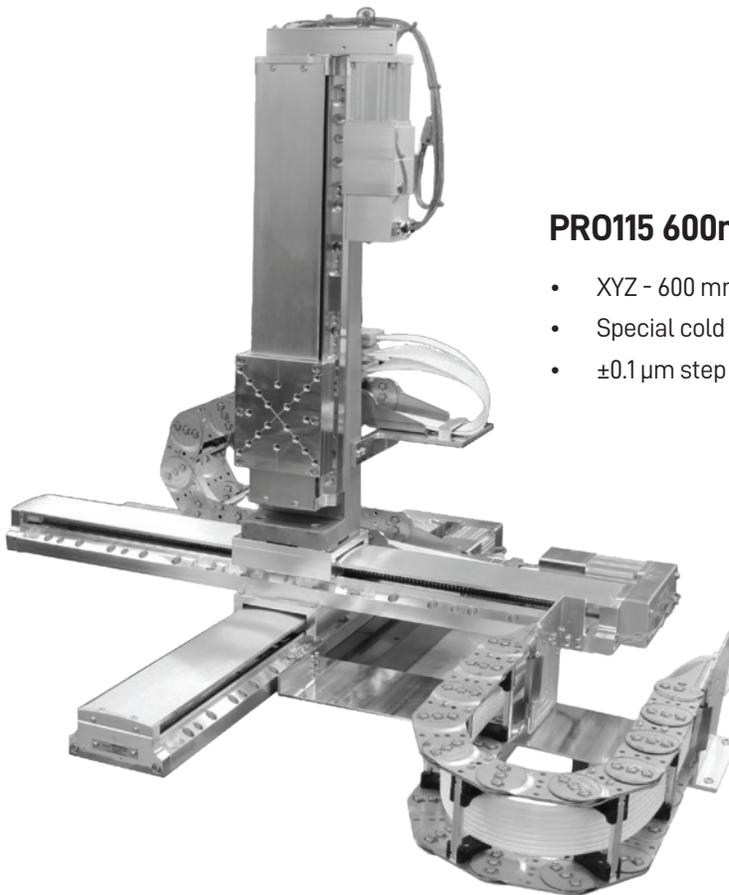


CUSTOM VACUUM-RATED SYSTEMS



XXYZ Dual-Screw, Dual-Carriage X-Axis

- Dual independent X axes, 1.3m travel each
- Y 600 mm travel
- Z 300 mm travel
- Special cold temp vacuum cables & metal CMS
- 10⁻⁶ torr compatible

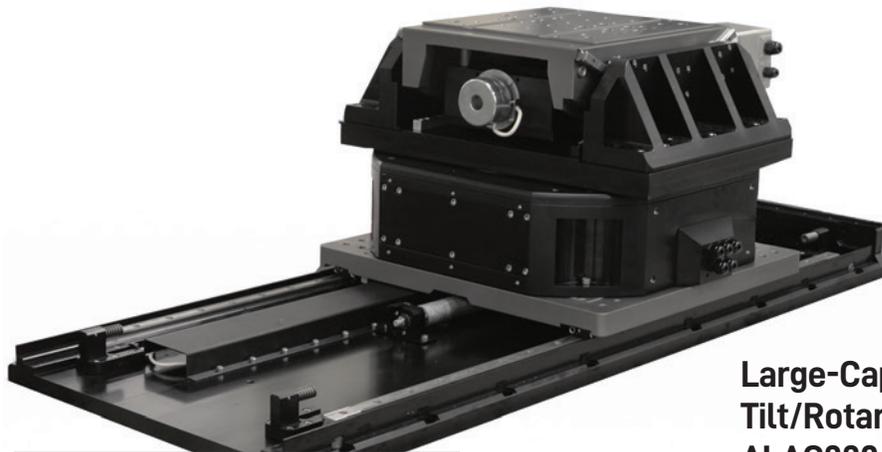
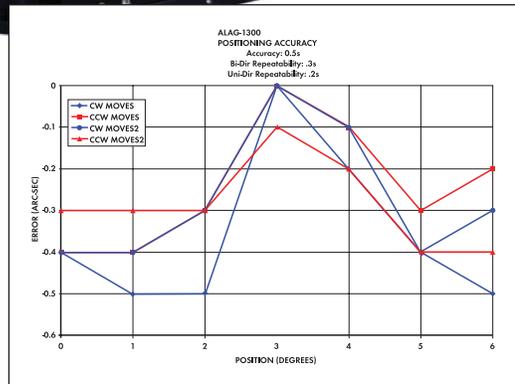


PR0115 600mm XYZ

- XYZ - 600 mm travel on each axis
- Special cold temp vacuum cables & metal CMS
- $\pm 0.1 \mu\text{m}$ step capability

Large-Capacity Tilt/Rotary Positioner ALAG1200/ALAR325-SP

- 682 kg load capacity
- Rotation point is 1200 mm above tilt stage
- $\pm 2 \mu\text{rad}$ repeatability
- $\pm 5 \mu\text{rad}$ accuracy
- Vac 10⁻⁶ torr
- AZ direct drive
- 0.025 μrad machine resolution
- Goniometer includes direct tabletop feedback
- $\pm 3^\circ$ travel



Large-Capacity Tilt/Rotary/Linear Positioner ALAG330/ALAR325-SP/ High Load Linear Vac 6 682 kg

- 600 mm linear shown; up to 1.2 m available
- AZ direct drive: $\pm 2.5 \mu\text{rad}$ repeatability & $\pm 5 \mu\text{rad}$ accuracy
- Pitch goniometer 330 mm rotation point
- Goniometer includes direct encoder feedback
- $\pm 5^\circ$ travel

ADVANCED CONTROLS FOR GROUND SUPPORT EQUIPMENT (GSE)

Hardware Features

- Rack-mount controllers, panel-mount or desktop configurations
- Emergency stop safety relays to remove power & stop motion
- Optional discrete drives allow modular controller integration into existing customer equipment
- 115 VAC, 200 VAC, 208 VAC or 230 VAC single-phase input

Motion Controller

- PC-based or stand-alone motion controllers
- User easily switches between manual & program control
- Digital controller closes PID loops at 8 kHz - 20 kHz
- Servo-loop transmission & autotuning are standard features
- Programmable digital filters to eliminate system resonances & improve bandwidth
- PC motion controller can be expanded to operate up to 32 axes so additional motion requirements can be handled in one program & one integrated hardware solution
- Stand-alone motion controllers can run up to 10 axes

Digital Drives

- Aerotech advanced controls provide 65536x analog encoder multiplication
- Digital amplifiers simplify electrical connections & minimize unwanted electrical noise in critical signals
- Easily retrofit to run motion simulators with brush/brushless motors & optical analog or digital encoders
- Linear or PWM amplifiers
- Real-time digital I/O, 16-bit analog inputs, 18-bit analog outputs
- High-speed position latching for 50 ns angle capture
- 1D, 2D, 3D Position Synchronized Output provides high-speed, vector-based event triggering based on actual simulator position
- Ethernet, USB, Ethernet/IP, EtherCat, ModBus TCP/IP



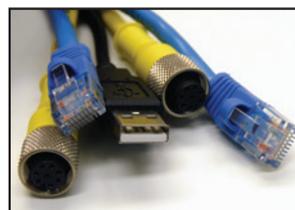
GROUND SUPPORT EQUIPMENT (GSE)

Controls

- Save time & money with reconfigurable ground support equipment
- Windows®-based motion controllers provide simple, user-friendly software in LabVIEW®, .NET, C, C#, AeroScript, Python
- Position Synchronized Output trigger for laser, eddy current or ultrasonic sensor control
- Easily configured for brushless, brush & stepper motors
- Reads incremental & absolute encoder signals
- Capture all motion performance during testing for quality control
- Safe Torque Off (STO)
- Loop transmission frequency response testing built-in

Interfaces

- Ethernet/IP™
- Modbus®/TCP
- DeviceNET
- Ethernet sockets TCP/IP
- USB



Linear/Rotary Servo & Torque Motors

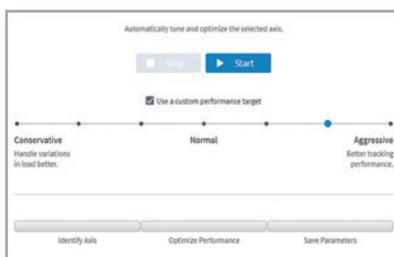
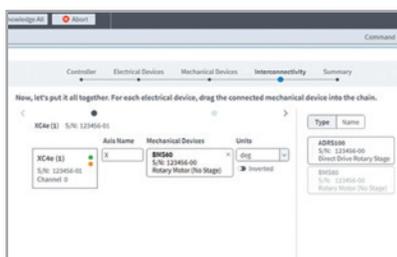


Accessories

- AC transformers
- DC brake power supply
- ESTOP
- Rack-mount PCs



Integrated Development Environment, Setup Wizard, MachineApps GUI Builder, EasyTune® & Loop Transmission Optimizer



Standard Products

ROTARY POSITIONERS

Aerotech's large-aperture rotary stages (ALAR) are direct-drive stages that provide exceptional performance for high-load capacity and ultra-precise rotary positioning.

- ALAR advantages
- Large apertures
- Direct-drive motors
- Cog-free motor provides smooth motion
- Extremely high resolution & accuracy
- Maintains accuracy, repeatability over time
- Low tilt errors
- High-bearing load, stiffness
- Configurable for 10-6 torr vacuum environments
- Zero backlash
- No gear wear or vibration
- High speeds
- Low maintenance

ALAR-LP & ALAR-SP Large-Aperture, Direct-Drive Rotary Stages

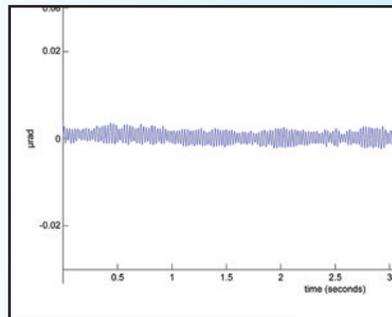
- 100, 150, 200, 250 & 325 mm apertures
- Axial load capacity of 120 - 600 kg
- +/-2.4 μ rad repeatability
- +/-9.7 μ rad accuracy
- 0.1-0.04 μ rad min. step
- Higher accuracy special order
- 45-300 rpm continuous rotation speed
- Incremental or absolute encoder
- Custom brakes, hard stops, circular connectors, weather seals available



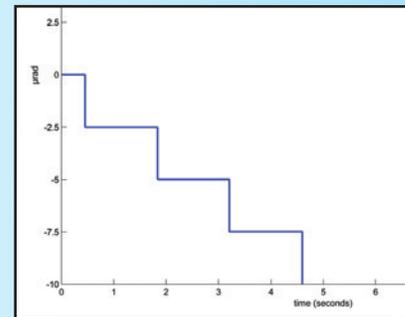
Our ALAR-LP is designed to be mounted with the vertical axis coincident with gravity. The LP is lower profile than the SP for applications that have less space available.



Our ALAR-SP is designed to be mounted in any configuration – vertical or horizontal.



In-position stability of $\pm 0.05 \mu$ rad



High resolution gives small step capability



ALAR-XP High-Torque Stages

- 250, 325 mm apertures
- 548 Nm-1110 Nm peak torque
- 64-143 Nm continuous torque

APR Mechanical-Bearing Direct-Drive Rotary Stages

- Accuracies up to +/-0.75 arc-sec
- Axial load capacity up to 250 kg
- Incremental or absolute encoders
- Large bearings provide high-payload & moment-load capacity
- 375-800 rpm continuous rotation speed
- Nine models are available, each with 15, 50, 75 or 100 mm clear aperture



AGR Mechanical-Bearing Gear-Drive Rotary Stages

- Enhanced speed & load capacity
- Large aperture addresses a wide range of applications
- Continuous 360° rotary positioning
- Direct encoder options available



ROTARY & LINEAR SENSOR TEST

ASRT Direct-Drive, Sealed Rotary Stages

- IP66 environmental protection
- Optical or magnetic position feedback
- -20°C to +70°C operation
- Optional absolute encoder for -40°C to +70°C operation
- Open aperture or solid tabletop
- Up to 182 kg capacity
- Optional slip-ring



ABRS Ultra-Precise, Low Profile, Direct-Drive Rotary Air-Bearing Stages

- Excellent radial, axial & tilt error motions
- Direct-coupled, high-accuracy rotary encoder
- Low profile, planar design
- 9 to 100 kg payload capacity
- Magnetic preload



ABRX Ultra-Precise, High-Accuracy, Direct-Drive Rotary Air-Bearing Stages

- High-torque output, direct-drive slotless, brushless servomotor
- Zero-cogging motor for outstanding velocity stability
- Excellent radial, axial & tilt error motions
- Direct-coupled, high-accuracy rotary encoder
- Large-diameter clear aperture
- No mechanical contact
- Fully constrained air bearing can be run upside down or on its side
- 20 to 68 kg payload capacity

ROTARY POSITIONERS

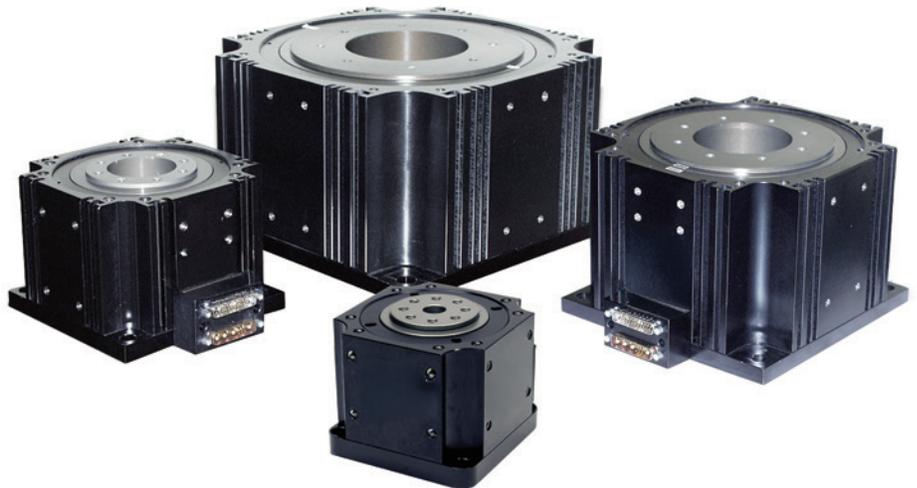
ADRT & ADRS Stainless-Steel Direct-Drive Rotary Stages

- High-torque, brushless, slotless servomotor produces no cogging torque, allowing for high speed & low stage-error motions
- Sealed stages survive harsh environments
- Custom mounting & tabletop options provide flexibility & easy integration
- Construction options include passivated stainless-steel for corrosion resistance & thermal stability



ADRT High-Torque Output, Direct-Drive Rotary Stages

- Cog-free brushless servomotor design for outstanding velocity stability
- Large-diameter clear aperture
- High load capacity & high speed
- ± 10 to ± 50 μ rad accuracy



ADRS Low-Profile, Direct-Drive Rotary Stages

- High-torque output, direct-drive brushless servomotor
- Cog-free, slotless motor design for superior velocity stability
- Direct-coupled, high-accuracy rotary encoder
- Ultra-low-profile minimizes working height

LINEAR POSITIONERS

Aerotech manufactures air-bearing linear and rotary stages for testing optical encoders, resolvers and potentiometers used in aerospace and defense aircraft, ships and ground vehicles.

ABL1500 Air-Bearing, Direct-Drive Linear Stage

- Designed for high-performance scanning & inspection
- 450 mm wafer compatible
- Active air preload on all air-bearing surfaces
- Linear encoder feedback provides subnanometer resolution
- High stiffness for heavy loads & excellent geometric performance
- Travel up to 500 mm



Aerotech manufactures many different linear mechanical-bearing stages. Please see aerotech.com to view the large range of linear stages.



GONIOMETERS

Large-Capacity Goniometer

- 682 kg load capacity
- Rotation point is 330 mm or 1200 mm above tilt stage
- $\pm 2 \mu\text{rad}$ repeatability
- $\pm 5 \mu\text{rad}$ accuracy
- Vac 10-6 torr
- AZ direct drive
- 0.025 μrad machine resolution
- Goniometer includes direct tabletop feedback
- $\pm 3^\circ$ to $\pm 5^\circ$ travel



Direct-Drive Goniometer

- Vacuum or air
- Noncontact direct drive
- High speed & high resolution
- No maintenance
- 20 degrees of travel
- $\pm 30 \mu\text{rad}$ accuracy
- 1.5 to 5 kg load capacity
- Stackable for pitch/roll

Gear-Drive Goniometer

- $\pm 60 \mu\text{rad}$ accuracy
- $\pm 45^\circ$ rotary positioning with unobstructed 360° view of customer load
- Precision worm-gear drive for outstanding accuracy & repeatability
- Direct encoder options available
- Horizontal or vertical mounting orientation
- 20 to 50 kg load
- AZ stage 0.25 μrad min. incremental motion

ANT NANOPositionERS

Linear

- 1 nm resolution
- <1 nm in-position stability
- 75 nm repeatability
- 250 nm accuracy
- Up to 160 mm travel





Through the collaborative expertise of **Aerotech**, **Kiski Precision** and **Peak Metrology**, we deliver unparalleled manufacturing and engineering solutions tailored to meet the rigorous demands of advanced industries worldwide.

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