

FIVE-AXIS PRECESSION SCANNER **AGV5D**



Aerotech's AGV5D opens new possibilities in multi-axis laser processing.

The AGV5D five-axis laser micromachining precession scanner is the fastest, most flexible and exacting solution for generating precise holes, contoured slots and other geometries with fully defined cross sections. It enables you to take control of your entire precision micromachining process, from the laser, to the scanning head, to the positioning of the workpiece.

Key Applications

- Medical device manufacturing
 - Interventional cardiovascular implants
 - Hypotubes
- Microelectronics processing
 - Probe cards
 - Microvias
- Automotive component manufacturing
 - Fuel injector nozzles
- Laser micromachining systems

Beam Manipulation in 5 Degrees of Freedom

Aerotech's AGV5D five-axis laser micromachining precession scanner manipulates a laser beam in five degrees of freedom (DOF):

- Spot placement within the field of view (2-DOF)
- Spot focus depth (1-DOF)
- Precession angle (2-DOF)

AGV5D produces extremely precise holes, slots and user-defined geometries, while maintaining exact control of the cross section.

One Controller for All Motion

Through coordination with other axes of motion using an Aerotech controller, AGV5D offers the unique capability to generate features larger than its field of view while maintaining the highest processing quality. Regardless of whether the motion platform is comprised of servo-motor or stepper-motor stages, piezoelectric nanopositioners, or hexapods, Aerotech is the only supplier that coordinates the precession scanner with the other motion axes, resulting in the greatest laser-processing precision possible.

— PRODUCT HIGHLIGHTS —

Ideal for use with a wide variety of commercial femtosecond lasers

Optics selections for compatibility with 1030 nm, 1064 nm, 515 nm, or 532 nm wavelengths

Water- and air-cooling features for maximum stability and consistent performance over time

Produces precise features with the greatest laser-processing precision available—even including features larger than the scanner's field of view

User-friendly features simplify integration into a machine, system, or subsystem

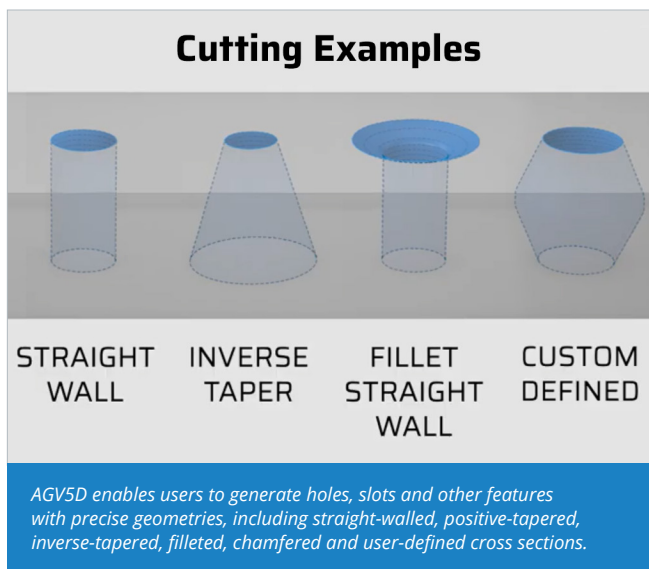
Assist gas pressure up to 200 psig for improved processing of high-aspect ratio features

A G-code-based programming interface gives you the ability to take control and forge your own trajectory. Alternatively, defined functions with parametric features and geometries are available for programming simplicity. User-accessible diagnostic tools accelerate process development and optimization.

Simple and Flexible Integration

AGV5D is the most flexible multi-axis laser micromachining solution available. Mounting interfaces on the front and rear faces of the housing, along with a multidirectional beam input, simplify delivery of the input beam. Additional kinematic mounting features on the underside of the housing allow for repeatable dismounting and remounting of the AGV5D, thus minimizing the need for realignment of the input beam. Optional beam alignment modules provide a simple mechanism by which users can set and adjust the input beam alignment and the polarization.

AGV5D also offers great flexibility to users in that it is easy to integrate with a diverse range of commercially available femtosecond lasers. This is made possible through adjustable software parameters, allowing users to compensate for laser properties such as beam divergence, diameter and quality, which often vary among laser sources. With some relatively quick and simple adjustments, users can set up the AGV5D with the laser that best suits their process requirements, and can easily swap out one laser for another.



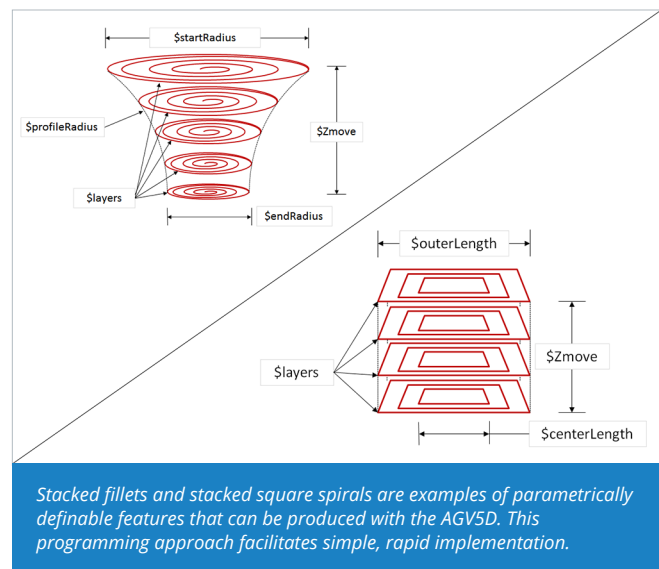
Optimized for Industrial Use

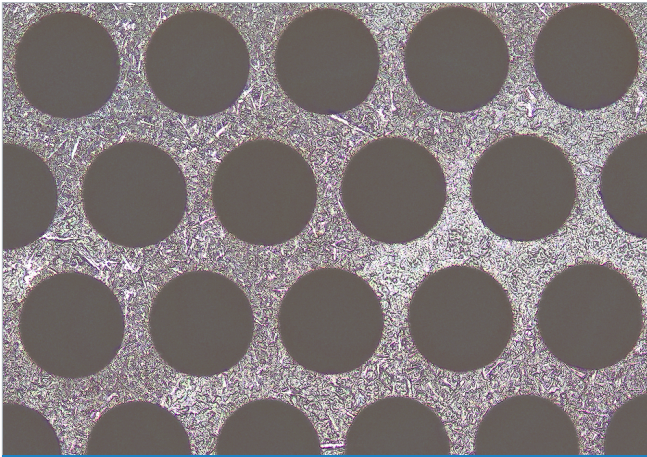
Like all Aerotech products, AGV5D is designed for long-term durability in production environments. Water- and air-cooling mechanisms regulate temperature gradients within the AGV5D, thereby mitigating thermal drift errors. The housing is sealed and includes an air purge to help keep the optical components free from contamination, greatly reducing the risk of damage.

Your One-Stop Precision Motion Control Partner

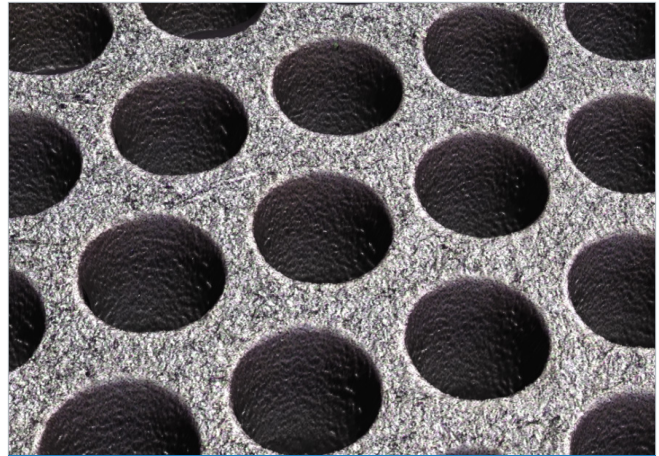
Since 1970, customers around the world have relied on Aerotech's trusted support through every step of the process: from system layout and design, to out-of-the-box setup and support, to putting your process in motion and keeping it moving.

Aerotech is the only supplier offering solutions for every motion challenge. From precision mechanics and mechatronic devices, to state-of-the-art galvo scanners and light-manipulation technologies, to highly capable, user-friendly controller software and hardware, you achieve greater precision and quality with Aerotech because all components integrate seamlessly and are coordinated through one controller.

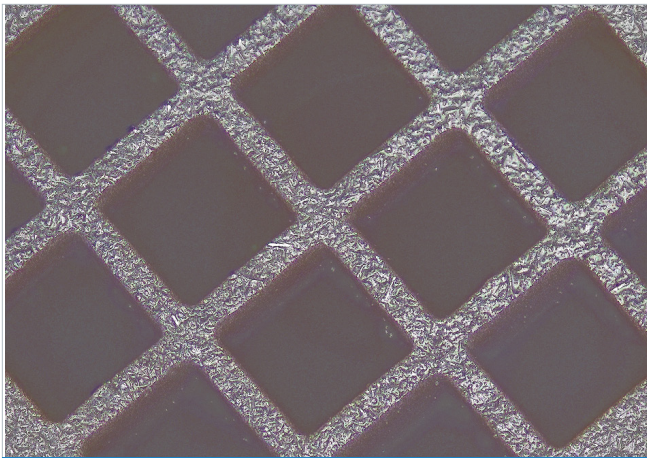




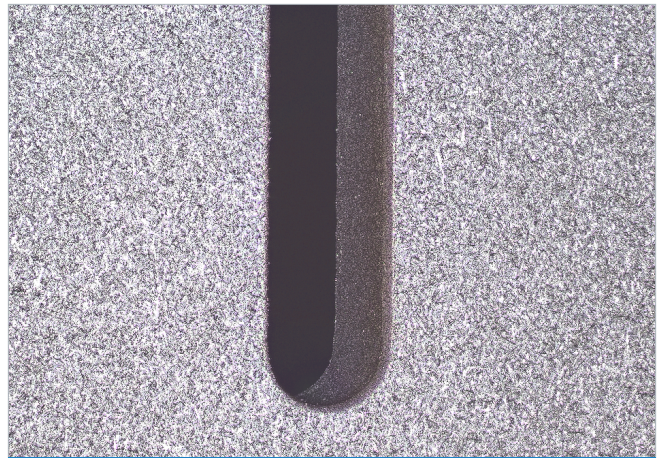
Circular, straight-walled holes, 100 μm diameter in 320 μm thick silicon nitride



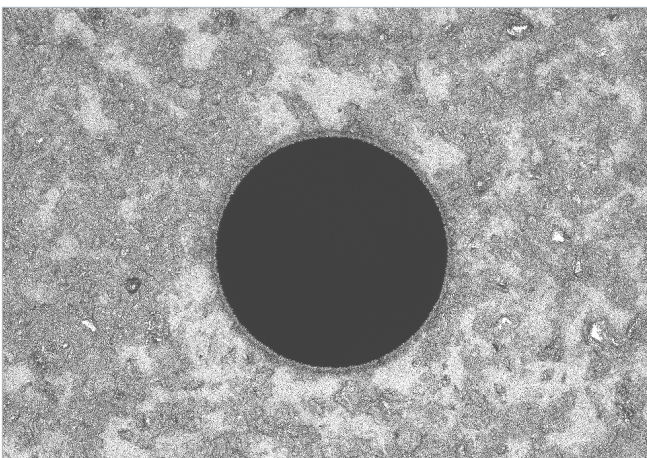
Circular, straight-walled holes, 100 μm diameter in 320 μm thick silicon nitride



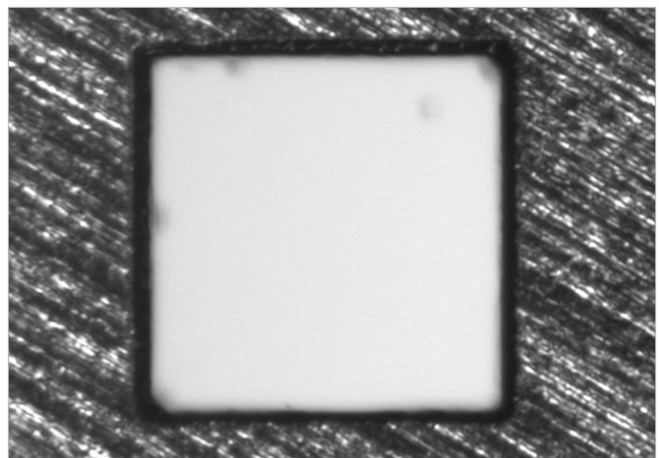
Square, straight-walled holes, 100 μm sq. in 320 μm thick silicon nitride



Straight-walled slot, 250 μm diameter in 1 mm thick nickel-titanium alloy



Circular, straight-walled hole, 250 μm diameter in 1 mm thick silicon nitride



Square, straight-walled hole, 250 μm sq. in 1 mm thick stainless steel

AGV5D Specifications

Specifications	AGV5D
Optical Specifications	
Laser Wavelength ¹	1030 nm, 1064 nm 515 nm, 532 nm
Maximum Laser Pulse Energy ²	400 µJ (λ = 1030 nm, 1064 nm) 350 µJ (λ = 515 nm, 532 nm)
Minimum Laser Pulse Length	250 fs ³
Average Power	≤ 100 W
Objective Focal Length	55 mm
Minimum Focused Spot Diameter ⁴	15 µm (λ = 1030 nm, 1064 nm) 7 µm (λ = 515 nm, 532 nm)
Input Beam Diameter (1/e ²)	2.3 mm recommended 2.8 mm maximum ⁵
Polarization	Circular or Linear ⁶
Mechanical Specifications	
Axes	5 total: Spot positioning (X,Y); Focusing (Z); Precession (A,B)
Field of View ⁷	Ø 2 mm
Z Focus Range	2 mm (motorized) 4 mm (manual adjustment)
Working Distance from Nozzle	Up to 4 mm ⁸
Maximum Precession Angle ⁷	± 9° (18° full-cone angle)
Positioning Resolution	40 nm (X,Y) 30 nm (Z) 0.004 mrad (A,B)
Positioning Repeatability	0.1 µm (X,Y) 0.1 µm (Z) 0.15 mrad (A,B)
Hole Diameter Accuracy	< 0.2 µm
Precession Frequency ⁹	up to 800 Hz
Maximum Focusing Speed	130 mm/s
Purge Gas ¹⁰	Nitrogen, up to 5 psig
Process Assist Gas	User selectable, up to 200 psig
Cooling	Water-cooled motors and air-cooled optics ¹¹
Mass	31 kg
Electrical Specifications	
Drive System	Direct-Drive Brushless Motors
Feedback	Noncontact Optical Encoders
Maximum Bus Voltage	± 40 VDC
Limit Switches	Optical Limit Switches and Software Limits
Home Switch	At Center

1 Consult factory for other wavelengths.

2 Valid for input beam diameters of 2 mm (1/e²) and larger. Contact factory if input beam diameter is less than 2 mm.

3 To avoid damage to the optics, the minimum laser pulse length should not be less than 250 fs. For optimal focused spot quality, a minimum pulse length of 400 fs is recommended.

4 Diameter is represented as 1/e² and assumes an input beam quality of M²=1.2. Values shown assume a 2.3 mm (1/e²) input beam diameter.

5 Entrance beam diameters exceeding the maximum value can result in a reduction in the field of view and/or maximum precession angle.

6 Requires the -AM2 alignment module option, or alternatively, external customer-supplied polarizing optics.

7 Maximum travels are listed for the specified input beam diameter and are mutually exclusive. Consult factory for detailed working volume sizing.

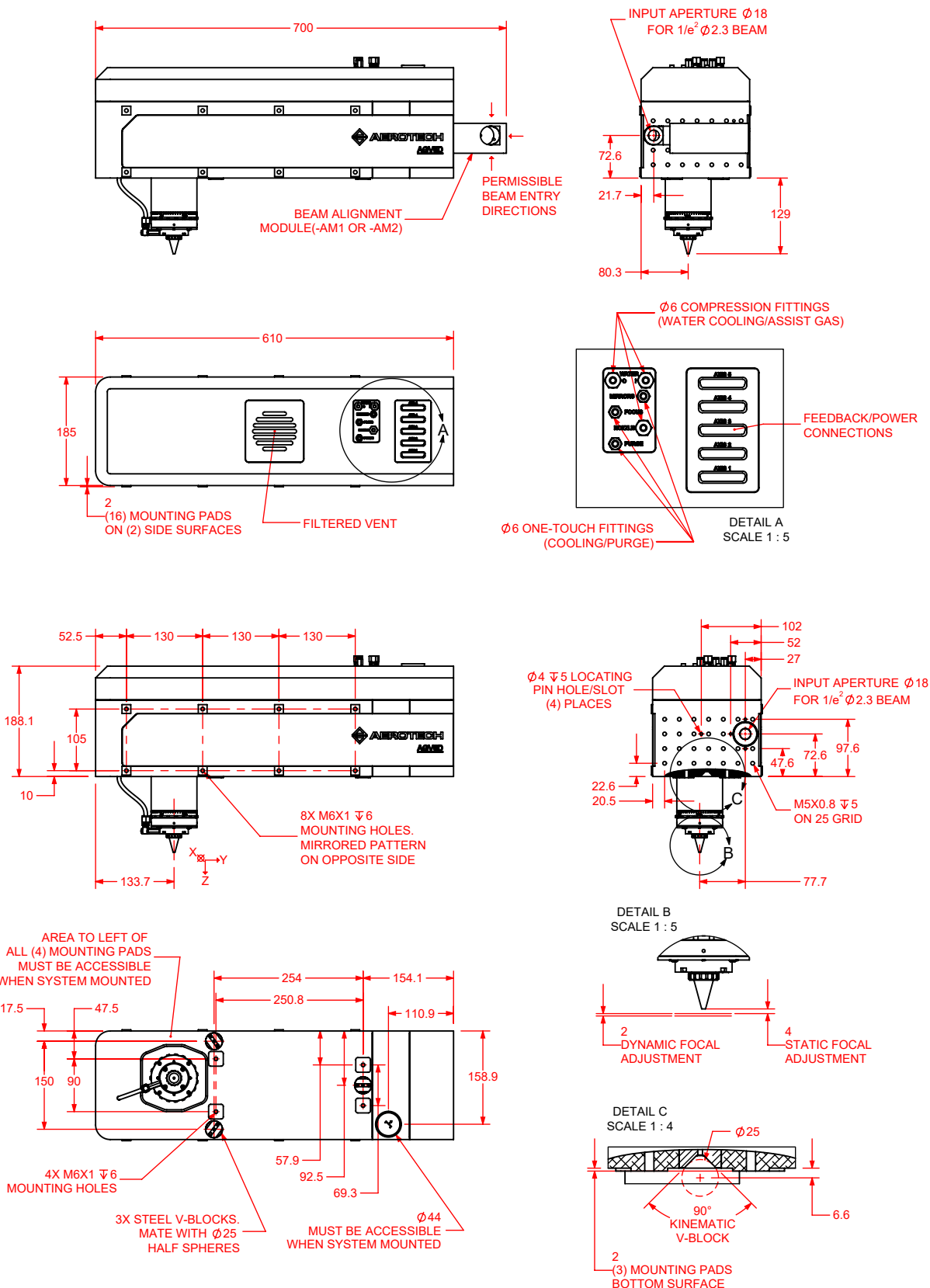
8 Working distances greater than 3.25 mm from the nozzle will restrict the maximum precession angle.

9 Precession frequency is dependent on angle of incidence and feature diameter.

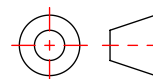
10 If nitrogen is used, it must be 99.99% pure and filtered to 0.25 µm. If compressed air is used, it must be filtered to 0.25 µm, dry to 0° F dew point and oil free.

11 Water- and air-cooling inputs are standard on all AGV5D models. The use of these cooling features is recommended, but is not strictly required in all use cases.

AGV5D Dimensions



DIMENSIONS: MILLIMETERS



AGV5D Ordering Information

Wavelength (Required)

-W004	1064 nm
-W005	1030 nm
-W006	532 nm
-W007	515 nm

Contact factory for additional wavelengths.

Beam Entry (Required)

-BE1	Right-side laser beam entry
-BE2	Left-side laser beam entry

Alignment Module (Optional)

-AM1	Beam alignment module with adjustable turning mirror mechanism for input beam alignment
-AM2	Beam alignment module with adjustable turning mirror mechanism for input beam alignment, and half-wave and quarter-wave plates for polarization adjustment.

Integration (Required)

Aerotech offers both standard and custom integration services to help you get your system fully operational as quickly as possible. The following standard integration options are available for this system. Please consult Aerotech if you are unsure about the level of integration you require, or if you desire custom integration support with your system.

-TAS	Integration - Test as system Testing, integration and documentation of a group of components as a complete system that will be used together (ex: drive, controller and stage). This includes parameter file generation, system tuning and documentation of the system configuration.
-TAC	Integration - Test as components Testing and integration of individual items as discrete components. This is typically used for spare parts, replacement parts or items that will not be used or shipped together (ex: stage only). These components may or may not be part of a larger system.