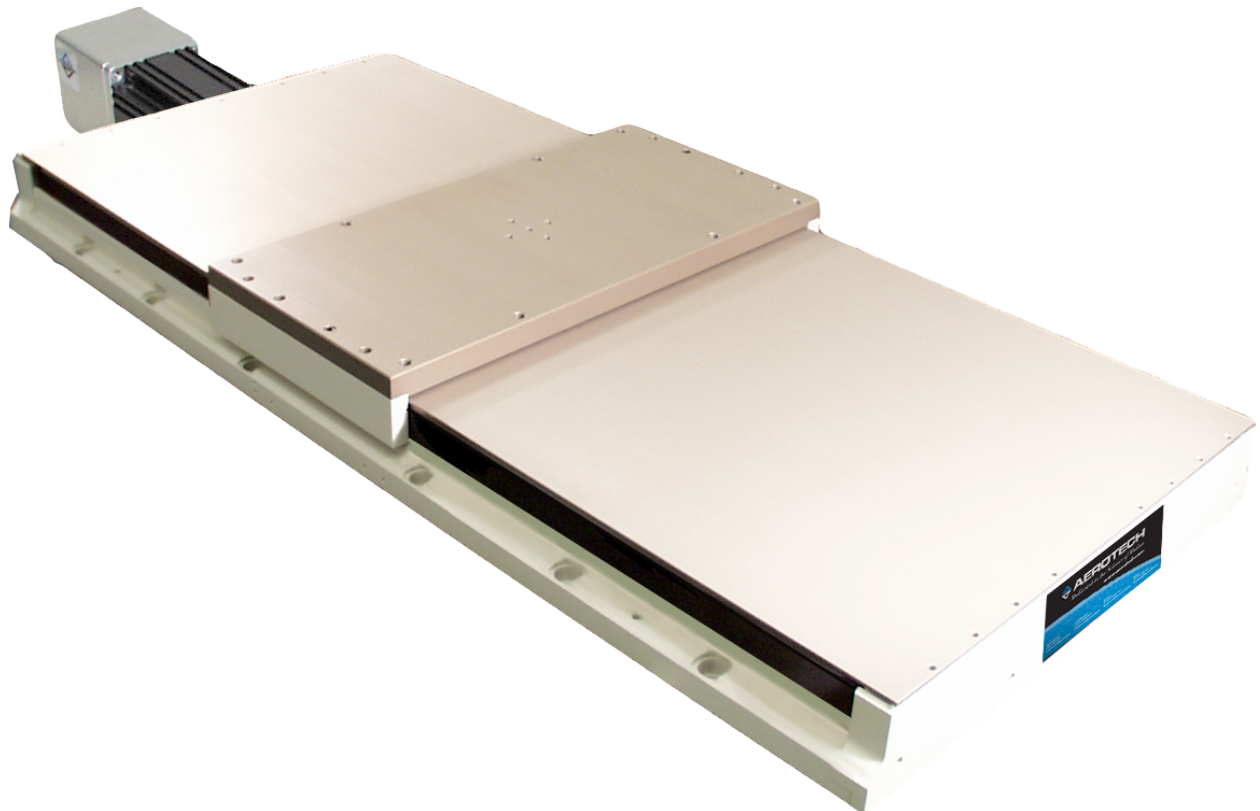




# ATS5000WB Hardware Manual

Revision: 1.00.00



## Global Technical Support

Go to [www.aerotech.com/global-technical-support](http://www.aerotech.com/global-technical-support) for information and support about your Aerotech products. The website provides downloadable resources (such as up-to-date software, product manuals, and Help files), training schedules, and PC-to-PC remote technical support. You can also complete Product Return (RMA) forms and get information about repairs and spare or replacement parts. For immediate help, contact a service office or your sales representative. Have your customer order number available before you call or include it in your email.

United States (World Headquarters)	
Phone: +1-412-967-6440 Fax: +1-412-967-6870 Email: <a href="mailto:service@aerotech.com">service@aerotech.com</a>	101 Zeta Drive Pittsburgh, PA 15238-2897 <a href="http://www.aerotech.com">www.aerotech.com</a>
United Kingdom	Japan
Phone: +44 (0)1256 855055 Fax: +44 (0)1256 855649 Email: <a href="mailto:service@aerotech.co.uk">service@aerotech.co.uk</a>	Phone: +81 (0)50 5830 6814 Fax: +81 (0)43 306 3773 Email: <a href="mailto:service@aerotechkk.com.jp">service@aerotechkk.com.jp</a>
Germany	China
Phone: +49 (0)911 967 9370 Fax: +49 (0)911 967 93720 Email: <a href="mailto:service@aerotechgmbh.de">service@aerotechgmbh.de</a>	Phone: +86 (21) 3319 7715 Email: <a href="mailto:saleschina@aerotech.com">saleschina@aerotech.com</a>
France	Taiwan
Phone: +33 1 64 93 58 67 Email: <a href="mailto:sales@aerotech.co.uk">sales@aerotech.co.uk</a>	Phone: +886 (0)2 8751 6690 Email: <a href="mailto:service@aerotech.tw">service@aerotech.tw</a>

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## Aerotech Worldwide

United States ■ France ■ Germany ■ United Kingdom  
China ■ Japan ■ Taiwan



**Table of Contents**

- Table of Contents ..... iii
- List of Figures ..... iv
- List of Tables ..... v
- Safety Procedures and Warnings ..... vi
- EC Declaration of Incorporation ..... vii
  
- Chapter 1: Overview ..... 1**
  - 1.1. Environmental Specifications ..... 3
  - 1.2. Accuracy and Temperature Effects ..... 3
  - 1.3. Basic Specifications ..... 4
  - 1.4. Vacuum Operation ..... 5
  
- Chapter 2: Mechanical Specifications and Installation ..... 7**
  - 2.1. Unpacking and Handling the Stage ..... 7
  - 2.2. Dimensions ..... 8
  - 2.3. Securing the Stage to the Mounting Surface ..... 9
  - 2.4. Attaching the Payload or Fixturing to the Stage ..... 10
  
- Chapter 3: Electrical Specifications and Installation ..... 13**
  - 3.1. Motor and Feedback Connectors ..... 14
  - 3.2. Motor and Feedback Wiring ..... 18
  - 3.3. Motor and Feedback Specifications ..... 20
  - 3.4. Limits, Marker, and Machine Direction ..... 24
  - 3.5. Motor and Feedback Phasing ..... 25
  
- Chapter 4: Maintenance ..... 27**
  - 4.1. Service and Inspection Schedule ..... 27
  - 4.2. Cleaning and Lubrication ..... 28
  - 4.3. Troubleshooting ..... 30
  
- Appendix A: Warranty and Field Service ..... 31**
- Appendix B: Revision History ..... 33**
- Index ..... 35**

**List of Figures**

Figure 2-1: Lifting Features ..... 7  
Figure 2-2: ATS5000WB Dimensions ..... 8  
Figure 2-3: Load Orientations ..... 11  
Figure 2-4: Cantilevered Load Capabilities ..... 12  
Figure 3-1: Motor and Feedback Wiring [BM/BMS Motor] ..... 19  
Figure 3-2: Machine Direction ..... 24  
Figure 3-3: Hall Phasing ..... 25  
Figure 3-4: Analog Encoder Phasing Reference Diagram ..... 26  
Figure 3-5: Encoder Phasing Reference Diagram (Standard) ..... 26

## List of Tables

Table 1-1: Model Numbering System .....	1
Table 1-2: Environmental Specifications .....	3
Table 1-3: ATS5000WB Series Specifications .....	4
Table 2-1: Stage to Mounting Surface Hardware .....	9
Table 3-1: Motor Wiring Connector .....	15
Table 3-2: Feedback Wiring Connector (BM/BMS Motor Configuration) .....	15
Table 3-3: 15-Pin Linear Encoder Connector (AS) .....	16
Table 3-4: 15-Pin Linear Encoder Connector (LT) .....	16
Table 3-5: 9-Pin Limit Connector (-NC-9DU or -NO-9DU Option) .....	17
Table 3-6: Limits with Flying Leads (-NC-FLY or -NO-FLY Option) .....	17
Table 3-7: Feedback Specifications .....	20
Table 3-8: Motor Specifications [BMS280] .....	21
Table 3-9: Motor Specifications [BM250] .....	22
Table 3-10: Encoder Specifications .....	23

## Safety Procedures and Warnings

Read this manual in its entirety before installing, operating, or servicing this product. If you do not understand the information contained herein, contact an Aerotech representative before proceeding. Strictly adhere to the statements given in this section and other handling, use, and operational information given throughout the manual to avoid injury to you and damage to the equipment.

The following statements apply wherever the Warning or Danger symbol appears within this manual. Failure to observe these precautions could result in serious injury to those individuals performing the procedures and/or damage to the equipment.



**DANGER:** This product contains potentially lethal voltages. To reduce the possibility of electrical shock, bodily injury, or death the following precautions must be followed.

1. Access to the ATS5000WB and component parts must be restricted while connected to a power source.
2. Do not connect or disconnect any electrical components or connecting cables while connected to a power source.
3. Disconnect electrical power before servicing equipment.
4. Make sure the ATS5000WB and all components are properly grounded in accordance with local electrical safety requirements.
5. Operator safeguarding requirements must be addressed during final integration of the product.



**WARNING:** To minimize the possibility of electrical shock, bodily injury or death the following precautions must be followed.

1. Cables can pose a tripping hazard. Securely mount and position all system cables to avoid potential hazards.
2. Do not expose the ATS5000WB to environments or conditions outside of the listed specifications. Exceeding environmental or operating specifications can cause damage to the equipment.
3. The ATS5000WB must be mounted securely. Improper mounting can result in injury and damage to the equipment.
4. Use care when moving the ATS5000WB. Lifting or transporting the ATS5000WB improperly can result in injury or damage to the ATS5000WB.
5. The ATS5000WB is intended for light industrial manufacturing or laboratory use. Use of the ATS5000WB for unintended applications can result in injury and damage to the equipment.
6. If the ATS5000WB is used in a manner not specified by the manufacturer, the protection provided by the ATS5000WB can be impaired and result in damage, shock, injury, or death.
7. Operators must be trained before operating this equipment.
8. All service and maintenance must be performed by qualified personnel.

## EC Declaration of Incorporation

**Manufacturer:** Aerotech, Inc.  
101 Zeta Drive  
Pittsburgh, PA 15238-2897  
USA

**herewith declares that the product:**  
ATS5000WB

**is intended to be incorporated into machinery to constitute machinery covered by the Directive 2006/42/EC as amended;**

**and that the following harmonized European standards have been applied:**

ISO 12100  
Safety of machinery - General principles for design  
- Risk assessment and risk reduction  
EN 60204-1  
Safety of machinery - Electrical equipment of machines

**and further more declares that**

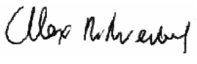
***it is not allowed to put the equipment into service until the machinery into which it is to be incorporated or of which it is to be a component has been found and declared to be in conformity with the provisions of the Directive 2006/42/EC and with national implementing legislation, i.e. as a whole, including the equipment referred to in this Declaration.***

**This is to certify that the aforementioned product is in accordance with the applicable requirements of the following Directive(s):**

2011/65/EU

RoHS 2 Directive

**Authorized Representative:** Simon Smith, European Director  
**Address:** Aerotech Ltd  
The Old Brick Kiln  
Ramsdell, Tadley  
Hampshire RG26 5PR  
UK

**Name**  / Alex Weibel  
**Position** Engineer Verifying Compliance  
**Location** Pittsburgh, PA

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## Chapter 1: Overview

**NOTE:** Aerotech continually improves its product offerings; listed options may be superseded at any time. All drawings and illustrations are for reference only and were complete and accurate as of this manual's release. Refer to [www.aerotech.com](http://www.aerotech.com) for the most up-to-date information.

**Table 1-1: Model Numbering System**

<b>APR Series Direct Drive Rotary Stage</b>	
ATS50030WB	300 mm (12 in) travel stage with ground ball screw and limits
ATS50045WB	450 mm (18 in) travel stage with ground ball screw and limits
ATS50060WB	600 mm (24 in) travel stage with ground ball screw and limits
ATS50075WB	750 mm (30 in) travel stage with ground ball screw and limits
ATS50090WB	900 mm (36 in) travel stage with ground ball screw and limits
ATS50100WB	1000 mm (40 in) travel stage with ground ball screw and limits
<b>Stage Construction (Optional)</b>	
/VAC3	Vacuum preparation of stage to 10 <sup>-3</sup> torr
/VAC6	Vacuum preparation of stage to 10 <sup>-6</sup> torr
/STEEL	All steel construction
<b>Drive Screw (Required)</b>	
-02P	0.2 inch per rev drive-screw lead
-40P	4 mm per rev drive-screw lead
<b>Tabletop (Required)</b>	
-M	Metric dimension mounting pattern and holes
-U	English dimension mounting pattern and holes
<b>Motor (Required)</b>	
-NM	No motor or encoder
-BMS	Brushless, slotless servomotor with connectors and 1000-line encoder; requires cable (BMS280-AH-MS-E1000H)
-BM	Brushless servomotor with connectors and 1000-line encoder; requires cable (BM250-MS-E1000H)
<b>Limits (Required)</b>	
-NC	Normally-closed end of travel limit switches (standard)
-NO	Normally-open end of travel limit switches
-9DU	With 9-pin limit connector
-FLY	With flying leads

<b>Linear Encoders</b>	
-LT30AS	Linear encoder for ATS50030WB; amplified sine output 1 Vpp (20 $\mu$ m signal period); requires signal multiplier
-LT45AS	Linear encoder for ATS50045WB; amplified sine output 1 Vpp (20 $\mu$ m signal period); requires signal multiplier
-LT60AS	Linear encoder for ATS50060WB; amplified sine output 1 Vpp (20 $\mu$ m signal period); requires signal multiplier
-LT75AS	Linear encoder for ATS50075WB; amplified sine output 1 Vpp (20 $\mu$ m signal period); requires signal multiplier
-LT90AS	Linear encoder for ATS50090WB; amplified sine output 1 Vpp (20 $\mu$ m signal period); requires signal multiplier
-LT100AS	Linear encoder for ATS50100WB; amplified sine output 1 Vpp (20 $\mu$ m signal period); requires signal multiplier
-LT30X5	Linear encoder for ATS50030WB; 1.0 micron line driver output
-LT45X5	Linear encoder for ATS50045WB; 1.0 micron line driver output
-LT60X5	Linear encoder for ATS50060WB; 1.0 micron line driver output
-LT75X5	Linear encoder for ATS50075WB; 1.0 micron line driver output
-LT90X5	Linear encoder for ATS50090WB; 1.0 micron line driver output
-LT100X5	Linear encoder for ATS50100WB; 1.0 micron line driver output
<b>Options</b>	
-BRK34	24 VDC spring-set motor brake for NEMA 34 motor
-P5	Air-purge pressure fittings
-FB	Foldback motor kit
-FB-BRK	Foldback motor kit for use with NEMA 34 brake (brake between stage and fold-back)
<b>Accessories (to be ordered as a separate line item)</b>	
ALIGNMENT-NPA	Non-precision XY assembly
ALIGNMENT-NPAZ	Non-precision XZ or YZ assembly
ALIGNMENT-PA10	XY assembly; 10 arc sec orthogonal
ALIGNMENT-PA10Z	XZ or YZ assembly with L-bracket; 10 arc second orthogonal
ALIGNMENT-PA5	XY assembly; 5 arc sec orthogonal
ALIGNMENT-PA5Z	XZ or YZ assembly with L-bracket; 5 arc second orthogonal
HALAR	High-accuracy system linear error correction for accuracy and repeatability
HALSF	High-accuracy system improved straightness and flatness

## 1.1. Environmental Specifications



**WARNING:** Do not expose the ATS5000WB to environments or conditions outside of the listed specifications. Exceeding environmental or operating specifications can cause damage to the equipment.

**Table 1-2: Environmental Specifications**

<b>Ambient Temperature</b>	Operating: 10° to 35° C (50° to 95° F) The optimal operating temperature is 20° C ±2° C (68° F ±4° F). If at any time the operating temperature deviates from 20° C degradation in performance could occur.
	Storage: 0° to 40° C (32° to 104° F) in original shipping packaging
<b>Humidity</b>	Operating: 20% to 60% RH
	Storage: 10% to 70% RH, non-condensing in original packaging. The stage should be packaged with desiccant if it is to be stored for an extended time.
<b>Altitude</b>	Operating: 0 m to 2,000 m (0 ft to 6,562 ft) above sea level Contact Aerotech if your specific application involves use above 2,000 m or below sea level.
<b>Vibration</b>	Use the system in a low vibration environment. Excessive floor or acoustical vibration can affect system performance. Contact Aerotech for information regarding your specific application.
<b>Protection Rating</b>	ATS5000WB stages have limited protection against dust, but not water. This equates to an ingress protection rating of IP50.
<b>Use</b>	Indoor use only

## 1.2. Accuracy and Temperature Effects

Aerotech products are designed for and built in a 20°C (68°F) environment. Extreme temperature changes could cause a decrease in performance or permanent damage to the ATS5000WB. At a minimum, the environmental temperature must be controlled to within 0.25°C per 24 hours to ensure the ATS5000WB specifications are repeatable over an extended period of time. The severity of temperature effects on all specifications depends on many different environmental conditions, including how the ATS5000WB is mounted. Contact the factory for more details.

If the stage is not equipped with an optional linear encoder, the accuracy of the screw is a key element in the overall positioning accuracy. A scale error can be expected if temperature of the screw differs from 20° C (68° F). The greater the temperature difference, the greater the error. The temperature of the screw depends on the speed and duty cycle of the stage. The faster the movement and higher the duty cycle, the more the stage accuracy will be affected by heat. The thermal expansion coefficient of the screw is 11.7 ppm/°C.

Likewise, if the stage is equipped with an optional linear encoder, travel of the stage will expand at a rate of the encoder scale (7.5 ppm/°C).

### 1.3. Basic Specifications

**NOTE:** Aerotech continually improves its product offerings; listed options may be superseded at any time. All drawings and illustrations are for reference only and were complete and accurate as of this manual's release. Refer to [www.aerotech.com](http://www.aerotech.com) for the most up-to-date information.

**Table 1-3: ATS5000WB Series Specifications**

		ATS50	030WB	045WB	060WB	075WB	090WB	100WB	
Travel		300 mm	450 mm	600 mm	750 mm	900 mm	1000 mm		
Drive System		Superprecision Ground Ball Screw/Brushless Servomotor (BM250-MS-E1000H)							
Bus Voltage		Up to 320 VDC							
Continuous Current	Apk	Up to 10.5 A							
	Arms	Up to 7.4 A							
Feedback		Noncontact Rotary Encoder (1000 line)							
Resolution	4 mm/rev Lead	1.0 $\mu\text{m}$ @ 4000 steps/rev Motor Resolution							
	0.2 in/rev Lead	1.25 $\mu\text{m}$ @ 4000 steps/rev Motor Resolution							
	LT Linear Encoder	0.005 $\mu\text{m}$ - 1.0 $\mu\text{m}$							
Maximum Travel Speed <sup>(1)</sup>	4 mm/rev Lead	250 mm/s	250 mm/s	250 mm/s	200 mm/s	200 mm/s	200 mm/s		
	0.2 in/rev Lead	300 mm/s	300 mm/s	300 mm/s	250 mm/s	200 mm/s	200 mm/s		
Maximum Load <sup>(2)</sup>	Horizontal	135.0 kg							
	Vertical	45.0 kg							
	Side	45.0 kg							
Accuracy	Ball Screw	HALAR <sup>(3)</sup>	$\pm 1 \mu\text{m}$	$\pm 1.5 \mu\text{m}$	$\pm 2.0 \mu\text{m}$	$\pm 2.0 \mu\text{m}$	$\pm 3.0 \mu\text{m}$	$\pm 3.0 \mu\text{m}$	
		Standard	+0.0, -12.0 $\mu\text{m}$	+0.0, -18.0 $\mu\text{m}$	+0.0, -24.0 $\mu\text{m}$	+0.0, -30.0 $\mu\text{m}$	+0.0, -32.0 $\mu\text{m}$	+0.0, -36.0 $\mu\text{m}$	
	LT	HALAR <sup>(3)</sup>	$\pm 1.0 \mu\text{m}$						
		Standard	$\pm 12.0 \mu\text{m}$	$\pm 18.0 \mu\text{m}$	$\pm 24.0 \mu\text{m}$	$\pm 30.0 \mu\text{m}$	$\pm 36.0 \mu\text{m}$	$\pm 40.0 \mu\text{m}$	
Bidirectional Repeatability	Ball Screw	HALAR <sup>(3)</sup>	$\pm 0.5 \mu\text{m}$						
		Standard	$\pm 1.0 \mu\text{m}$						
	LT	$\pm 0.5 \mu\text{m}$							
Straightness and Flatness	HALSF	$\pm 2 \mu\text{m}$	$\pm 2.5 \mu\text{m}$	$\pm 3.0 \mu\text{m}$	$\pm 3.5 \mu\text{m}$	$\pm 4.5 \mu\text{m}$	$\pm 5.0 \mu\text{m}$		
	Standard	$\pm 3.0 \mu\text{m}$	$\pm 4.0 \mu\text{m}$	$\pm 6.0 \mu\text{m}$	$\pm 7.0 \mu\text{m}$	$\pm 8.0 \mu\text{m}$	$\pm 9.0 \mu\text{m}$		
Pitch and Yaw		6 arc sec	10 arc sec	14 arc sec	17 arc sec	20 arc sec	25 arc sec		
Nominal Stage Weight	Less Motor	75 kg	84 kg	92 kg	102 kg	111 kg	117 kg		
	With Motor	78 kg	87 kg	96 kg	105 kg	115 kg	120 kg		
Construction		Aluminum Body/Stage; Hard Coated Table (62 Rockwell Hardness); Textured Epoxy (Polane-T) Pebble Grey Paint							
1. Excessive duty cycle may impact stage accuracy. 2. Payload specifications are for single-axis system and based on ball screw and bearing life of 2500 km (100 million inches) of travel. 3. Available with Aerotech controllers 4. Specifications are for single-axis systems measured 25 mm above the tabletop. Performance of multi-axis system is payload and workpoint dependent. Consult factory for multi-axis or non-standard applications.									

## 1.4. Vacuum Operation

Aerotech can specially prepare the ATS5000WB for operation in vacuum environments. Aerotech offers two vacuum preparation options; one for low vacuum (for use in atmospheric pressures to  $10^{-3}$  torr) and one for high vacuum (preparation for environments from  $10^{-3}$  to  $10^{-6}$  torr). As part of this preparation, attention to detail during modification, cleaning, and assembly results in products with optimal performance in vacuum applications.

To ensure that the ATS5000WB will continue to perform well in the vacuum environment, follow the guidelines listed below (in addition to standard handling, installation, and lubrication guidelines outlined in this manual).

1. Do not remove the ATS5000WB from the sealed bag until it is ready for use.
2. Always handle the ATS5000WB in a clean environment and use powder-free polyethylene gloves to prevent any contaminants from adhering to the surface of the ATS5000WB.
3. During installation, use cleaned, vented, stainless steel fasteners when securing the ATS5000WB.
4. Reduced air pressure eliminates significant convective heat transfer. This, coupled with the viscous vacuum-compatible lubricants, could result in excessive motor operating temperatures. Because of this, consider all continuous torque ratings to be 40 to 60% lower than the value specified for operation in normal atmospheric environment. Reduce motor usage accordingly.
5. For vacuum applications, the recommended lubricant is a small quantity of **Braycote® 602EF** grease or a compatible substitute of equal quality.
6. Baking vacuum components between 100 and 125 °C for 24 to 48 hours significantly reduces outgassing at initial pump-down to vacuum pressure and evaporates water vapor that impregnates porous surfaces on the aluminum surfaces and Teflon cables. Aerotech recommends that customers bake out vacuum systems when first installing them in the vacuum chamber.

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## Chapter 2: Mechanical Specifications and Installation



**WARNING:** ATS5000WB installation must be in accordance to instructions provided by this manual and any accompanying documentation. Failure to follow these instructions could result in injury or damage to the equipment.

### 2.1. Unpacking and Handling the Stage



**DANGER/HEAVY:** Do not attempt to manually lift or move the stage. The stage base is equipped with 3/8-16 tapped mounting holes to accept customer-supplied lifting hardware.

- Refer to [Section 1.3](#) for stage mass specifications.
- Refer to [Figure 1-1](#) for the lifting features.
- Do not use the drive screw, motor, or any of the cables as lifting points.



**WARNING:** It is the customer's responsibility to safely and carefully lift the stage.

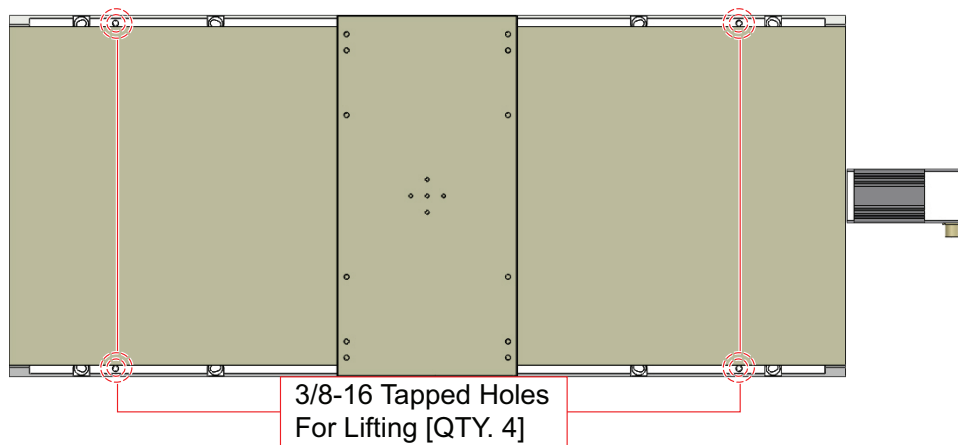
- Make sure that all moving parts are secure before moving the ATS5000WB. Unsecured moving parts may shift and cause bodily injury.
- Improper handling could adversely affect the ATS5000WB's performance. Use care when moving the ATS5000WB.

**NOTE:** If any damage has occurred during shipping, report it immediately.

Carefully remove the ATS5000WB from its protective shipping container. Gently set the ATS5000WB on a smooth, flat, and clean surface.

Before operating the ATS5000WB, it is important to let it stabilize at room temperature for at least 12 hours. Allowing it to stabilize to room temperature will ensure that all of the alignments, preloads, and tolerances are the same as they were when tested at Aerotech. Use compressed nitrogen or clean, dry, oil-less air to remove any dust or debris that has collected during shipping.

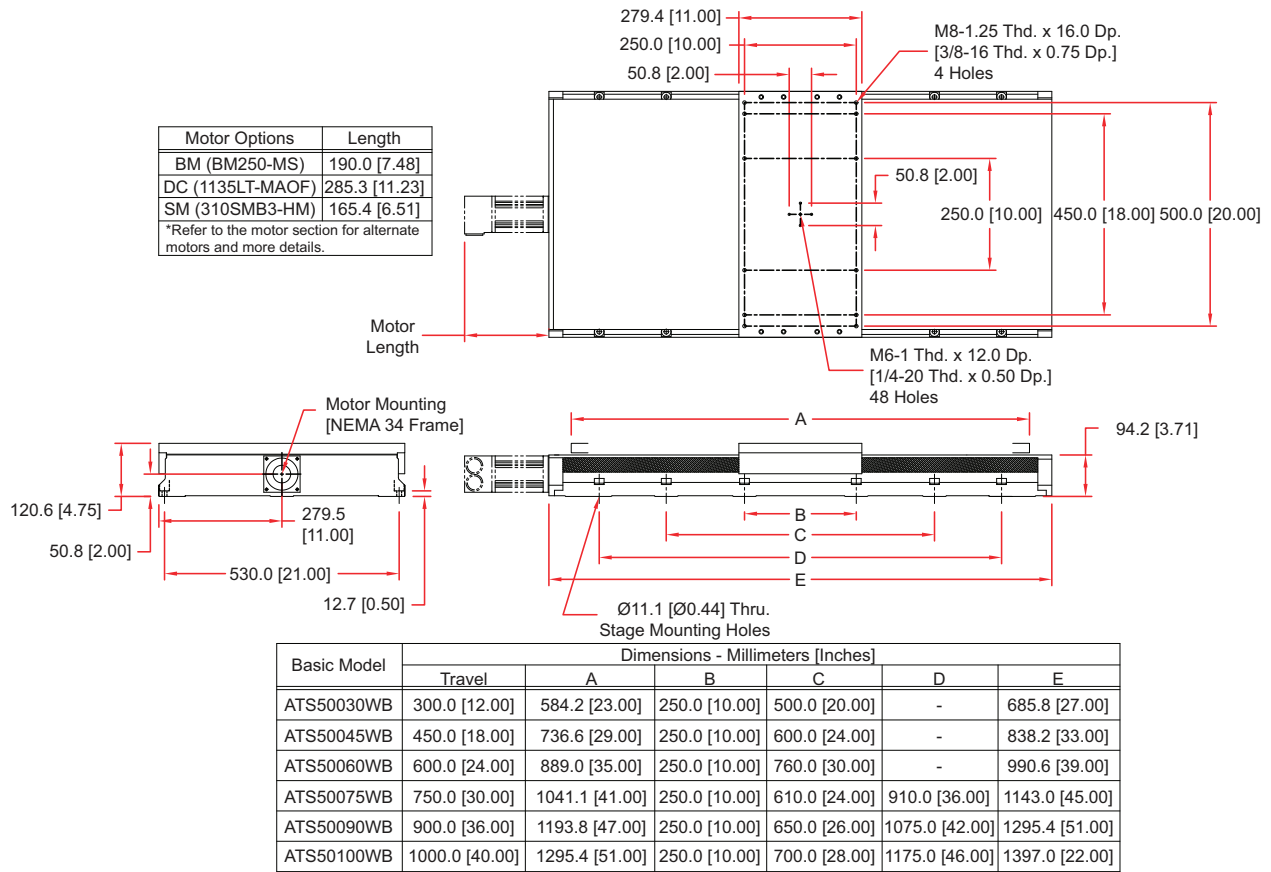
Each ATS5000WB has a label listing the system part number and serial number. These numbers contain information necessary for maintaining or updating system hardware and software. Locate this label and record the information for later reference.



**Figure 2-1: Lifting Features**

## 2.2. Dimensions

**NOTE:** Aerotech continually improves its product offerings; listed options may be superseded at any time. All drawings and illustrations are for reference only and were complete and accurate as of this manual's release. Refer to [www.aerotech.com](http://www.aerotech.com) for the most up-to-date information.



**Figure 2-2: ATS5000WB Dimensions**



### 2.3. Securing the Stage to the Mounting Surface



**WARNING :** Make sure that all moving parts are secure before moving the ATS5000WB. Unsecured moving parts may shift and cause bodily injury.



**WARNING :** The ATS5000WB must be mounted securely. Improper mounting can result in injury and damage to the equipment.

The mounting surface must be flat and have adequate stiffness in order to achieve the maximum performance from the ATS5000WB stage. When it is mounted to a non-flat surface, the stage can be distorted as the mounting screws are tightened. This distortion will decrease overall accuracy. Adjustments to the mounting surface must be done before the stage is secured.

Inspect the mounting surface for dirt or unwanted residue and clean if necessary. Use precision flatstones on the mounting surface to remove any burrs or high spots. Clean the mounting surface with a lint free cloth and acetone or isopropyl alcohol and allow the cleaning solvent to completely dry. Gently place the stage on the mounting surface.

**NOTE :** To maintain accuracy, the mounting surface must be flat to within 7.5  $\mu\text{m}$ .

**NOTE :** The ATS5000WB is precision machined and verified for flatness prior to product assembly at the factory. If machining is required to achieve the desired flatness, it should be performed on the mounting surface rather than the ATS5000WB. Shimming should be avoided if possible. If shimming is required, it should be minimized to improve the rigidity of the system.

ATS5000WB series stages have a fixed mounting pattern to secure the stage to a mounting surface. Manually move the stage table so that the access holes on the stage table are aligned with any two of the mounting holes on the under side of the stage (refer to 2.3). Install the appropriately sized mounting screws through the access holes and secure the stage to the mounting surface. Repeat this process for each set of mounting holes.

**NOTE :** The stage table may offer a considerable amount of resistance when it is moved manually. This is especially true if the stage is fitted with a motor assembly.



**WARNING :** Do not attempt to manually move the ATS5000WB if it is connected to a power source.

Tightening torque values are dependent on the properties of the surface on which the stage is being mounted. Values provided in Table 2-1 are typical values and may not be accurate for your mounting surface. Refer to Section . for specific model mounting locations and dimensions.

**Table 2-1: Stage to Mounting Surface Hardware**

Mounting Hardware	Typical Screw Torque
3/8-16 or M10 SHCS	26 N·m

## 2.4. Attaching the Payload or Fixturing to the Stage

Inspect the mounting surface for dirt or unwanted residue and clean if necessary. Clean the mounting surface with a lint free cloth and acetone or isopropyl alcohol and allow the cleaning solvent to completely dry.

To prevent damage to the payload or stage, test the operation of the stage before the payload is attached. Aerotech recommends that customers use a representative payload during start-up to prevent accidental damage to the stage and the payload. Proceed with the electrical installation and test the motion control system in accordance with the system documentation. Document all results for future reference. For information on electrical installation refer to [Chapter 3](#) and the documentation delivered with the stage.

The payload must be flat, rigid, and comparable to the stage in quality to maintain optimum performance.

**NOTE:** For valid system performance, the mounting interface should be flat within 12  $\mu\text{m}$ .

Applied loads should be symmetrically distributed whenever possible (i.e., the payload should be centered on the stage table and the entire stage should be centered on the support structure).

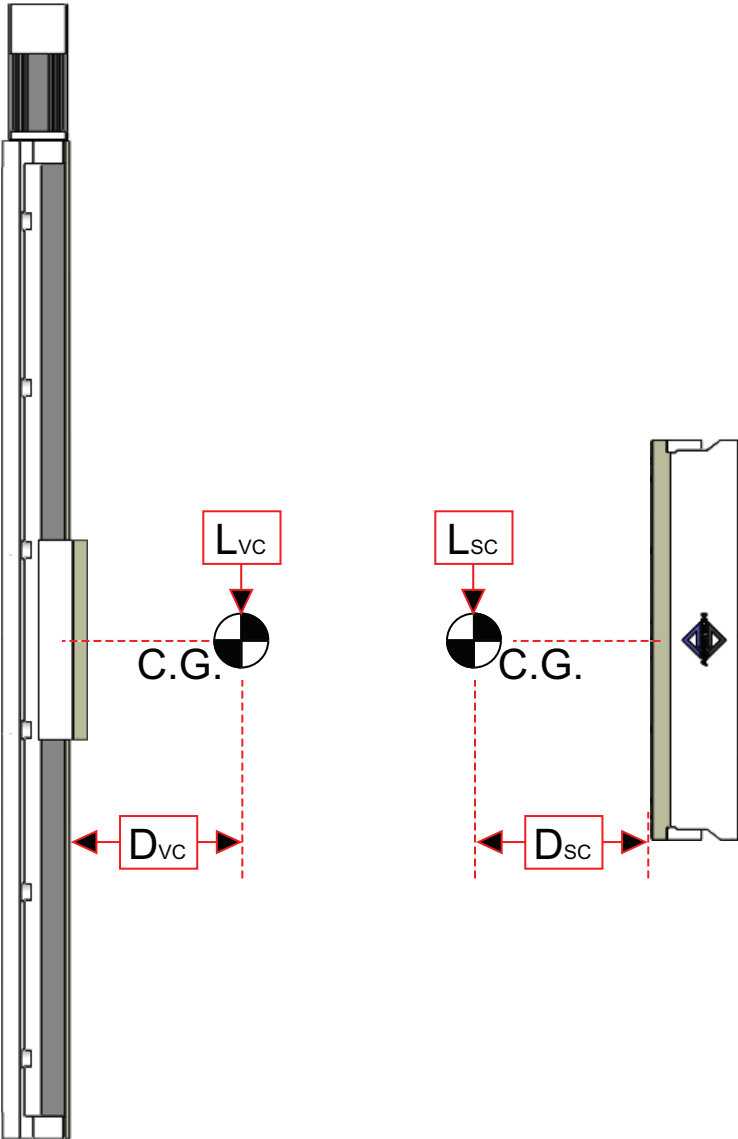


Figure 2-3: Load Orientations

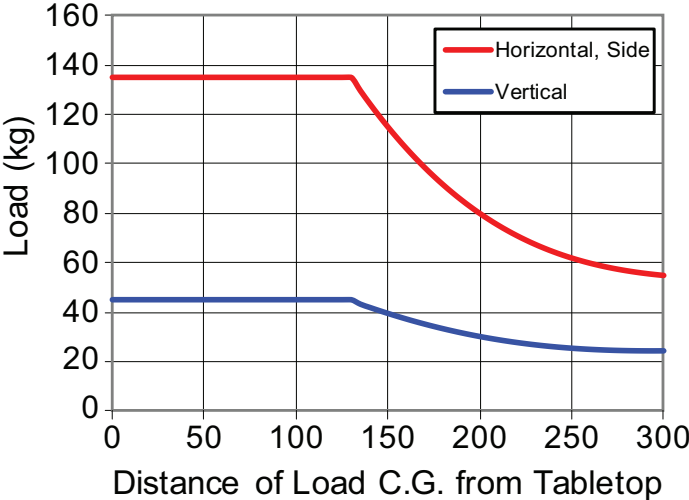


Figure 2-4: Cantilevered Load Capabilities

## Chapter 3: Electrical Specifications and Installation



**WARNING:** Electrical installation must be performed by properly qualified personnel.

Aerotech motion control systems are adjusted at the factory for optimum performance. When the ATS5000WB is part of a complete Aerotech motion control system, setup usually involves connecting a stage to the appropriate drive chassis with the cables provided. Labels on the system components usually indicate the appropriate connections.

If system level integration was purchased along with the stage, an electrical drawing showing system interconnects has been supplied with the system (separate from this documentation).

The electrical wiring from the motor and encoder are integrated at the factory. Refer to the following sections for standard motor wiring and connector pin assignments.



**WARNING:** Applications requiring access to the stage while it is energized will require additional grounding and safeguards. The System Integrator or qualified installer is responsible for determining and meeting all safety and compliance requirements necessary for the integration of this stage into the final application.



**DANGER:** Remove power before connecting or disconnecting electrical components or cables. Failure to do so may cause electric shock.



**WARNING:** Operator access to the base and table top must be restricted while connected to a power source. Failure to do so may cause electric shock.

**NOTE:** Refer to the controller documentation to adjust servo gains for optimum velocity and position stability.

### 3.1. Motor and Feedback Connectors

Stages fitted with standard motors and encoders come from the factory completely wired and assembled.

**NOTE:** Refer to the other documentation accompanying your Aerotech equipment. Call your Aerotech representative if there are any questions on system configuration.

The ATS5000WB's protective ground connection provides motor frame ground protection only. Additional grounding and safety safeguards are required for applications requiring access to the stage while it is energized. The System Integrator or qualified installer is responsible for determining and meeting all safety and compliance requirements necessary for the integration of this stage into the final application.



**DANGER:** Remove power before connecting or disconnecting electrical components or cables. Failure to do so may cause electric shock.



**WARNING:** The protective ground connection must be properly installed to minimize the possibility of electric shock.

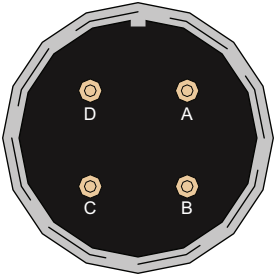


**WARNING:** Operator access to the base and table top must be restricted while connected to a power source. Failure to do so may cause electric shock.

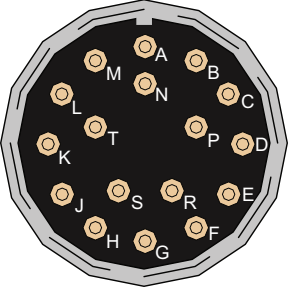


**CAUTION:** The stage controller must provide over-current and over-speed protection. Failure to do so may result in permanent damage to the motor and stage components.

**Table 3-1: Motor Wiring Connector**

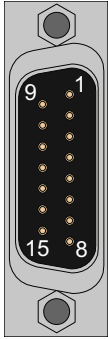
Pin	Function	Connector
A	MTR ØA (Motor Phase A)Motor Phase A	
B	MTR ØB (Motor Phase B)Motor Phase B	
C	MTR ØC (Motor Phase C)Motor Phase C	
D	Frame groundMotor Frame Ground	
Backshell	Motor Cable Shield	

**Table 3-2: Feedback Wiring Connector (BM/BMS Motor Configuration)**

Pin	Function	Connector
A	Cosine	
B	Cosine-N	
C	Sine	
D	Sine-N	
E	Marker	
F	Marker-N	
G	Common ground	
H	+5 V power supply input	
J	Signal shield connection (no connection to frame)	
K	Hall Effect sensor, phase A	
L	Over-Temperature Thermistor sensor <sup>(1)</sup>	
M	Hall Effect sensor, phase B	
N	Reserved	
P	Hall Effect sensor, phase C	
R	Reserved	
S	Brake + <sup>(2)</sup>	
T	Brake - <sup>(2)</sup>	

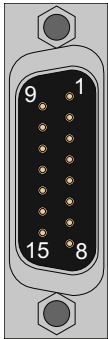
1. BMS motors only. Reserved on all other motors.  
 2. 24 VDC @ 1 A max ; With Brake option only

**Table 3-3: 15-Pin Linear Encoder Connector (AS)**

Pin	-AS Option	Connector
1	Sine	
2	Cosine	
3	Marker	
4	+5 V power supply input	
5	Reserved	
6	Limit	
7	Reserved	
8	Reserved	
9	Sine-N	
10	Cosine-N	
11	Marker-N	
12	Common ground	
13	Setup	
14	Reserved	
15	Reserved	

Mating Connector	Aerotech P/N	Third Party P/N
15-Pin D-Connector	ECK00326	Cinch DE-15S
Backshell	ECK01022	Amphenol 17-1725-2

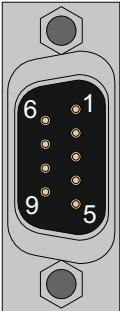
**Table 3-4: 15-Pin Linear Encoder Connector (LT)**

Pin	-LT Option	Connector
1	Sine	
2	Cosine	
3	Marker	
4	+5 V power supply input	
5	Reserved	
6	Limit	
7	Alarm	
8	Reserved	
9	Sine-N	
10	Cosine-N	
11	Marker-N	
12	Common ground	
13	Setup	
14	Alarm-N	
15	Reserved	

Mating Connector	Aerotech P/N	Third Party P/N
15-Pin D-Connector	ECK00326	Cinch DE-15S
Backshell	ECK01022	Amphenol 17-1725-2

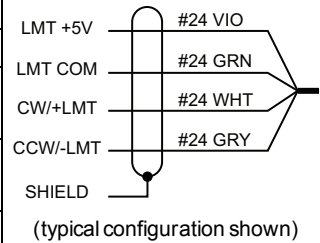


**Table 3-5: 9-Pin Limit Connector (-NC-9DU or -NO-9DU Option)**

Pin #	Description	Connector
Case	Signal shield connection	
1	+5V supply input for optical limit switch boards	
2	Common ground to limit switch.	
3	Signal indicating maximum travel produced by positive/CW stage direction.	
4	Reserved	
5	Signal indicating stage maximum travel produced by negative/CCW stage direction.	
6	Reserved	
7	Common ground	
8	Reserved	
9	Reserved	

Mating Connector	Aerotech P/N	3rd Party P/N
Backshell	ECK01021	Amphenol DE24657
Connector	ECK00340	Cinch DE-9S

**Table 3-6: Limits with Flying Leads (-NC-FLY or -NO-FLY Option)**

Typical	-FB Option	Description	Flying Leads
Violet		+5V supply input for optical limit switch boards	
Green		Common ground to limit switch.	
Gray	White	Signal indicating stage maximum travel produced by negative/CCW stage direction.	
White	Gray	Signal indicating maximum travel produced by positive/CW stage direction.	
Case		Signal shield connection	

1. CW and CCW limit wire colors swap if the -FB025 or -FB025-BRK Option has been chosen

### 3.2. Motor and Feedback Wiring

All motor and controller manufacturers have their own designations for motor  $\emptyset A/\emptyset B/\emptyset C$  and Hall signals A/B/C (refer to [Section 3.5](#) for motor phasing). Shielded cables are required for the motor and feedback connections.



### 3.3. Motor and Feedback Specifications

**Table 3-7: Feedback Specifications**

Hall-Effect Sensors Specifications [BM and BMS motors options only]	
Supply Voltage	5 V
Supply Current	50 mA
Output Type	Open Collector
Output Voltage	24 V max (pull up)
Output Current	5 mA (sinking)

Thermistor Specifications [BMS motors options only]	
Polarity	Logic "0" (no fault)
	Logic "1" (over-temperature fault)
Cold Resistance	100 $\Omega$
Hot Resistance	10 K
<b>Note:</b> 1K pull-up to +5V recommended	

Encoder Specifications	
Supply Voltage	5 V $\pm$ 10%
Supply Current	250 mA
Output Signals	<b>Sinusoidal Type (Incremental Encoder):</b> 1V <sub>pk-pk</sub> into 120 $\Omega$ Load (differential signals SIN+, SIN-, COS+, COS- are .5V <sub>pk-pk</sub> relative to ground.)
	<b>Digital Output (Incremental Encoder):</b> RS422/485 compatible

Limit Switch Specifications	
Supply Voltage	5 V
Supply Current	25 mA
Output Type	Open Collector
Output Voltage	5 V
Output Current	10 mA (sinking)
Output Polarity	Normally Closed (NC) <ul style="list-style-type: none"> <li>Sinks current to ground (Logic "0") when not in limit</li> <li>High impedance (Logic "1") when in limit</li> <li>Requires external pull-up to +5 V (10 k<math>\Omega</math> recommended)</li> </ul>
	Normally Open (NO) <ul style="list-style-type: none"> <li>Sinks current to ground (Logic "0") when in limit</li> <li>High impedance (Logic "1") when not in limit</li> <li>Requires external pull-up to +5 V (10 k<math>\Omega</math> recommended)</li> </ul>
1. If the ATS5000WB is driven beyond the electrical limit, it will encounter a mechanical stop. Impacting the mechanical stop could cause damage to the stage even at low speeds.	

Brake Specifications	
Supply Voltage	24 V
Supply Current (typical)	500 mA (current required to release the brake and allow motion)

**Table 3-8: Motor Specifications [BMS280]**

		BMS280
<b>Winding Designation</b>		-A
<b>Performance Specifications (1, 5)</b>		
Stall Torque, Continuous (2)	N·m (oz·in)	1.60 (227.0)
Peak Torque (3)	N·m (oz·in)	6.41 (908.0)
Rated Power Output, Continuous	W	381
<b>Electrical Specifications (5)</b>		
BEMF Constant (Line-Line, Max)	$V_{pk}/k_{rpm}$	57
Continuous Current, Stall (2)	$A_{pk} (A_{rms})$	3.8 (2.7)
Peak Current, Stall (3)	$A_{pk} (A_{rms})$	15.2 (10.7)
Torque Constant (4, 8)	$N·m/A_{pk}$ (oz·in/ $A_{pk}$ )	0.42 (59.7)
	$N·m/A_{rms}$ (oz·in/ $A_{rms}$ )	0.60 (84.5)
Motor Constant (2, 4)	$N·m/\sqrt{W}$ (oz·in/ $\sqrt{W}$ )	0.179 (25.34)
Resistance, 25°C (Line-Line)	$\Omega$	5.7
Inductance (Line-Line)	mH	1.10
Maximum Bus Voltage	$V_{DC}$	340
Thermal Resistance	$^{\circ}C/W$	0.93
Number of Poles	--	14
1. Performance is dependent upon heat sink configuration, system cooling conditions, and ambient temperature. 2. Values shown @ 75°C rise above a 25 °C ambient temperature, with housed motor mounted to a 250 mm x 250 mm x 6 mm aluminum heat sink 3. Peak torque assumes correct rms current; consult Aerotech. 4. Force constant and motor constant specified at stall. 5. All performance and electrical specifications +/- 10% 6. Maximum winding temperature is 100 °C (thermistor trips at 100 °C) 7. Ambient operating temperature range 0°C - 25°C; consult Aerotech for performance in elevated ambient temperatures. 8. All Aerotech amplifiers are rated Apk; use torque constant in N·m/Apk when sizing.		

**Table 3-9: Motor Specifications [BM250]**

		BM250
<b>Performance Specifications (1,5)</b>		
Stall Torque, Continuous <sup>(2,8)</sup>	N·m (oz·in)	2.4 (336)
Peak Torque <sup>(3)</sup>	N·m (oz·in)	5.9 (840)
Rated Power Output, Continuous	W	671
<b>Electrical Specifications (5)</b>		
BEMF Constant (Line-Line, Max)	$V_{pk}/k_{rpm}$	28
Continuous Current, Stall <sup>(2,8)</sup>	$A_{pk} (A_{rms})$	10.7 (7.6)
Peak Current, Stall <sup>(3)</sup>	$A_{pk} (A_{rms})$	26.8 (18.9)
Torque Constant <sup>(4,9)</sup>	$N·m/A_{pk}$ (oz·in/ $A_{pk}$ )	0.22 (31.4)
	$N·m/A_{rms}$ (oz·in/ $A_{rms}$ )	0.31 (44.4)
Motor Constant <sup>(2,4)</sup>	$N·m/\sqrt{W}$ (oz·in/ $\sqrt{W}$ )	0.198 (28.04)
Resistance, 25°C (Line-Line)	$\Omega$	1.1
Inductance (Line-Line)	mH	2.74
Maximum Bus Voltage	$V_{DC}$	340
Thermal Resistance	°C/W	0.91
Number of Poles	--	8
<p>1. Performance is dependent upon heat sink configuration, system cooling conditions, and ambient temperature.</p> <p>2. Values shown @ 130°C rise above a 25 °C ambient temperature, with housed motor mounted to a 250 mm x 250 mm x 6 mm aluminum heat sink</p> <p>3. Peak torque assumes correct rms current; consult Aerotech.</p> <p>4. Torque constant and motor constant specified at stall.</p> <p>5. All performance and electrical specifications <math>\pm 10\%</math>.</p> <p>6. Maximum winding temperature is 155 °C</p> <p>7. Ambient operating temperature range 0°C - 25°C; consult Aerotech for performance in elevated ambient temperatures.</p> <p>8. All Aerotech amplifiers are rated Apk; use torque constant in N·m/ Apk when sizing.</p>		

**Table 3-10: Encoder Specifications**

Rotary Encoder Option	Fundamental Signal Period	Digital Resolution	
		4 mm Lead	0.2" Lead
1000H	4000 lines/rev	1 $\mu\text{m}/\text{count}$	1.27 $\mu\text{m}/\text{count}$ (50 $\mu\text{in}/\text{count}$ )

Linear Encoder Option	Fundamental Signal Period	Digital Resolution
-LTAS	20 $\mu\text{m}$	--
-LTAS (with x16 interpolation) <sup>1</sup>	20 $\mu\text{m}$	1.25 $\mu\text{m}/\text{count}$
-LTAS (with x20 interpolation) <sup>1</sup>	20 $\mu\text{m}$	1 $\mu\text{m}/\text{count}$
-LTX5	20 $\mu\text{m}$	1 $\mu\text{m}/\text{count}$

1. Quadrature decoding included in interpolated resolution calculations

### 3.4. Limits, Marker, and Machine Direction

Aerotech stages are configured to have positive and negative "machine" directions. The machine direction defines the phasing of the feedback and motor signals and is dictated by the stage wiring (refer to [Section 3.5](#) for Motor and Feedback phasing information). Programming direction of a stage is set by the controller that is used to move the stage. Programming direction is typically selectable in the controller, while machine direction is hardwired in the stage. [Figure 3-2](#) shows the machine direction of ATS5000WB stages.

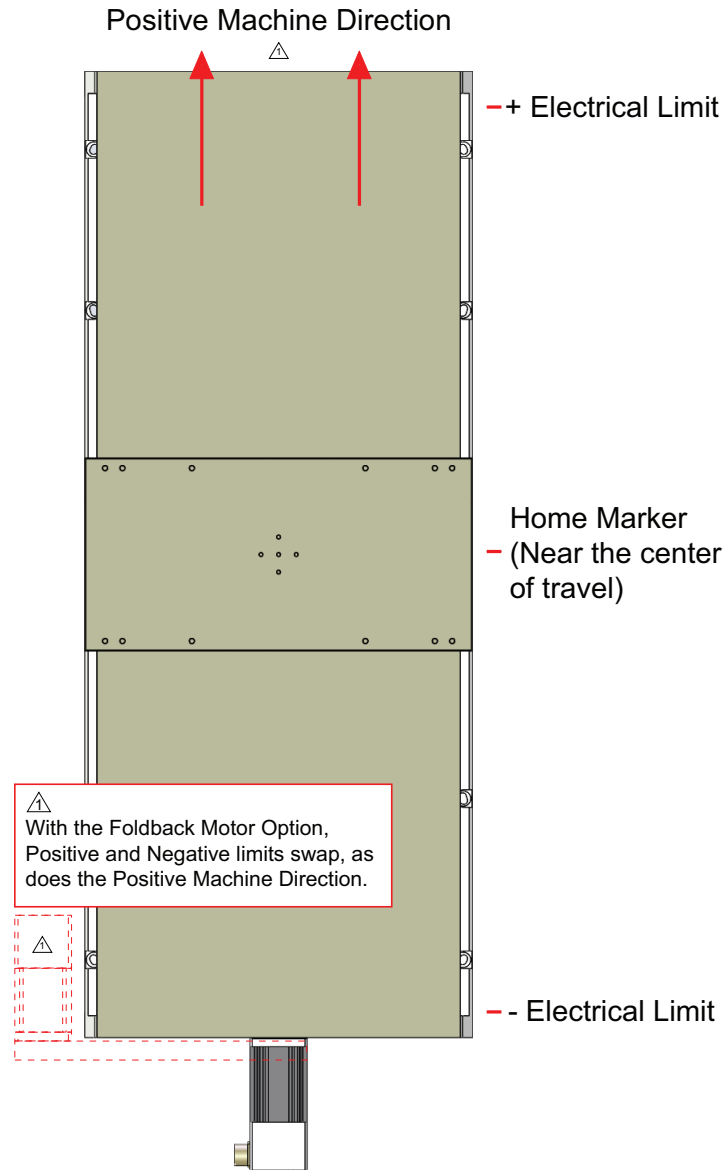
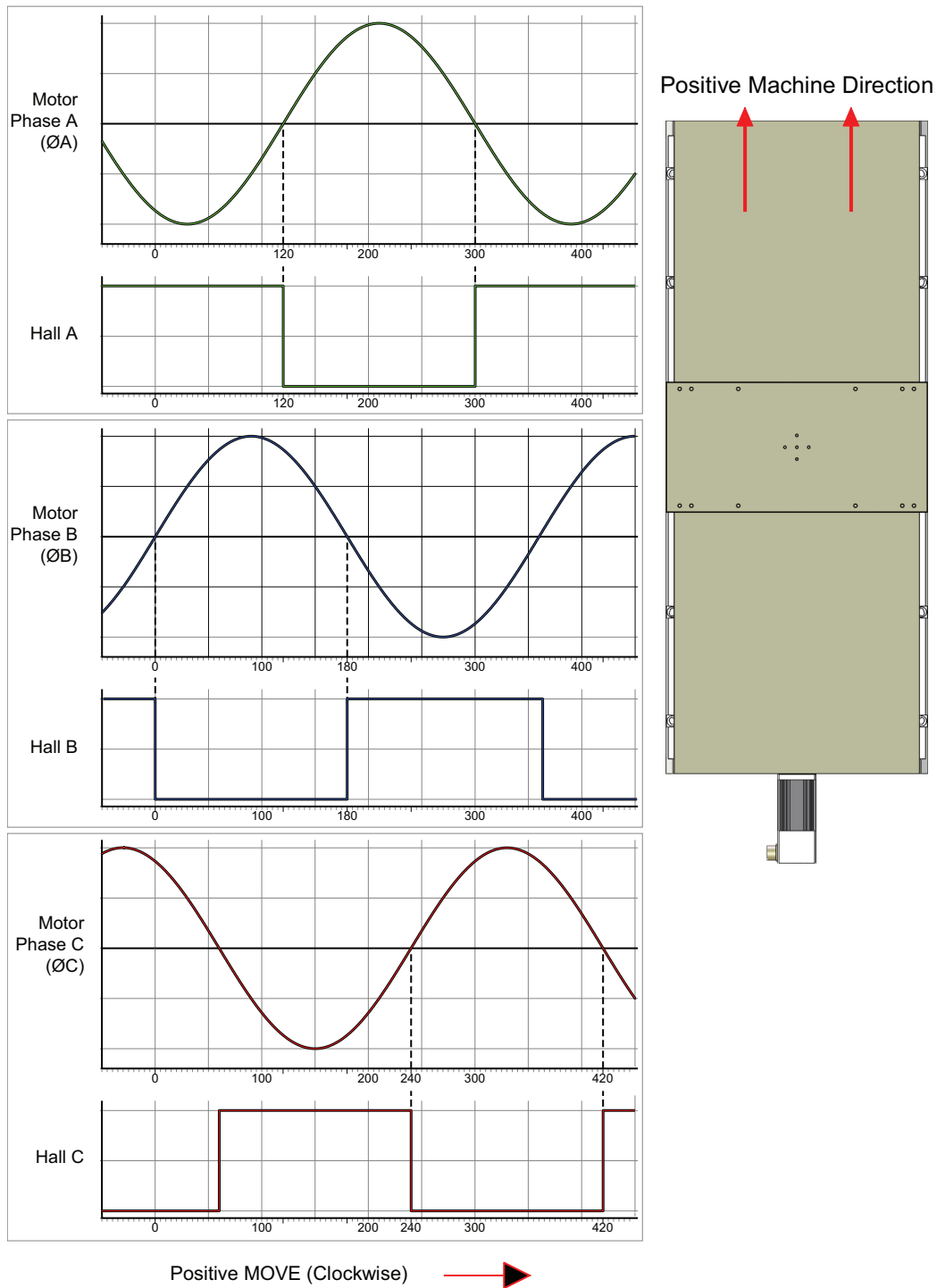


Figure 3-2: Machine Direction



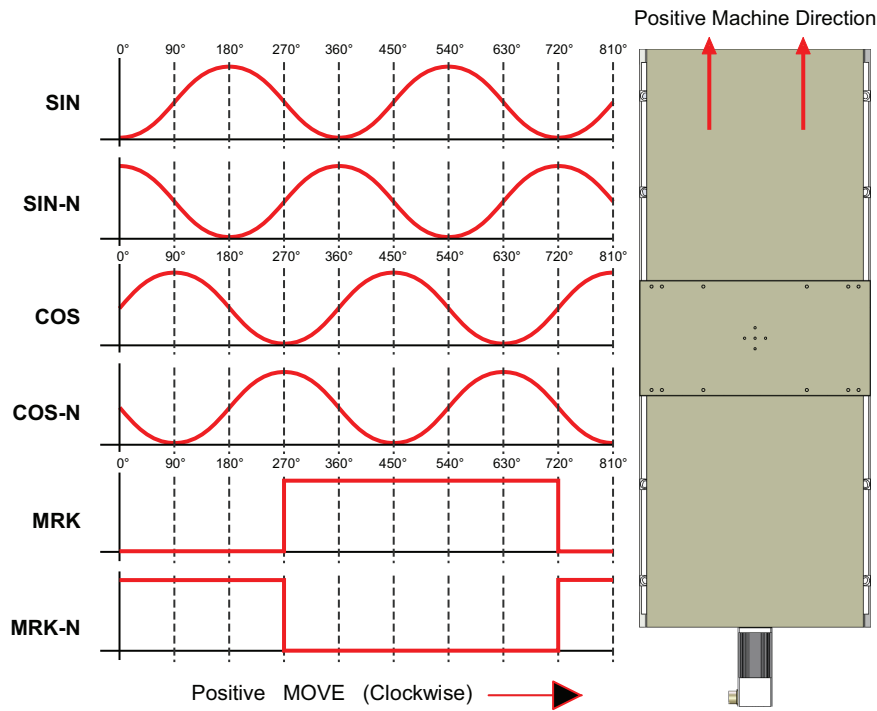
### 3.5. Motor and Feedback Phasing

Motor phase voltage is measured relative to the virtual wye common point.



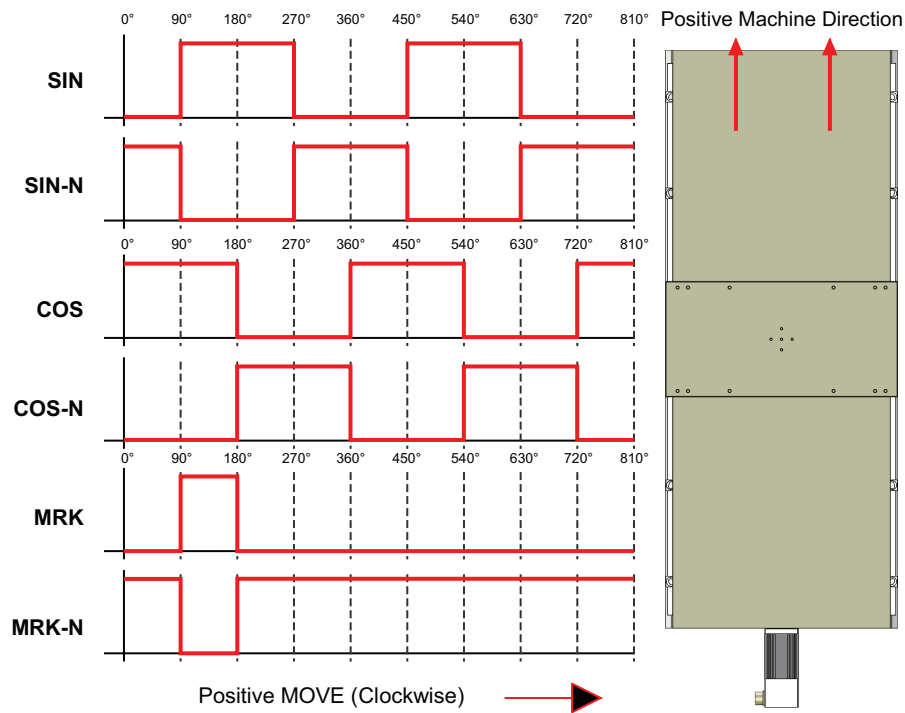
⚠ With the Foldback Motor Option, Positive and Negative limits swap, as does the Positive Machine Direction.

**Figure 3-3: Hall Phasing**



⚠ With the Foldback Motor Option, Positive and Negative limits swap, as does the Positive Machine Direction.

**Figure 3-4: Analog Encoder Phasing Reference Diagram**



⚠ With the Foldback Motor Option, Positive and Negative limits swap, as does the Positive Machine Direction.

**Figure 3-5: Encoder Phasing Reference Diagram (Standard)**

## Chapter 4: Maintenance

**NOTE:** The bearing area must be kept free of foreign matter and moisture; otherwise, the performance and life expectancy of the stage will be reduced.



**DANGER:** To minimize the possibility of bodily injury or death, disconnect all electrical power prior to performing any maintenance or making adjustments to the equipment.

### 4.1. Service and Inspection Schedule

Inspect the ATS5000WB once per month. A longer or shorter inspection interval may be required depending on the specific application, and conditions such as the duty cycle, speed, and environment.

In general, stages operating in a clean environment should be cleaned and lubricated annually or every 500 km (whichever comes first). For stages operating under conditions involving excessive debris, stages should be cleaned every six months. For high-speed applications (those near max speed at a duty cycle of 50%), frequent maintenance with standard lubricants is required.

Monthly inspections should include but not be limited to:

- Visually inspect the stage, motor, and cables
- Re-tighten loose connectors.
- Replace or repair damaged cables.
- Clean the ATS5000WB and any components and cables if needed.
- Repair any damage before operating the ATS5000WB.
- Inspect and perform an operational check on all safeguards and protective devices

## 4.2. Cleaning and Lubrication

When cleaning and/or lubricating components of the ATS5000WB series stages:

1. Be sure to use a clean, dry, soft, lint-free cloth for cleaning.
2. Before using a cleaning solvent on any part of the ATS5000WB, blow away small particles and dust with clean, dry, compressed air.
3. Take the opportunity during the lubrication procedure to inspect the motion guides or bearings for any damage or signs of wear.
4. In applications that have multiple stages bolted together to form multi-axis systems, the orthogonality may be lost if the stage tables of the support stages are loosened. Precision aligned stages should not be loosened or disassembled.
5. Further disassembly of the stage is not recommended because proper assembly and calibration can only be done at the factory. In addition, an autocollimator is required for post assembly verification to maintain warranties. Contact Aerotech for more information.



**DANGER:** To minimize the possibility of bodily injury or death, disconnect all electrical power prior to performing any maintenance or making adjustments to the equipment.

### Cleaning

If a solvent is necessary for cleaning the stage, Aerotech recommends using isopropyl alcohol. Harsher solvents, such as acetone, may damage the plastic and rubber seals on the ball screw and LMG trucks. If acetone is required, avoid contact the ball screw and bearing seals.



**WARNING:** Make sure that all solvent has completely evaporated before attempting to move the stage.

### Lubrication

Aerotech recommends using Dow Corning BR2-Plus grease for standard ATS5000WB stages.

For high-speed applications (i.e., near maximum speed at a duty cycle of 50%), frequent maintenance with standard lubricants is required.

If the application process uses only a small portion of travel for most of the duty cycle, periodically drive the stage through full travel to redistribute the lubrication in the bearings.

**NOTE:** During the lubrication procedure, inspect the linear motion guides for any damage or signs of wear.

1. Drive the stage table to one end of travel and remove power to the stage.



**DANGER:** To minimize the possibility of bodily injury or death, disconnect all electrical power prior to performing any maintenance or making adjustments to the equipment.

2. Remove the screws on the edges of the hardcover and slide it out from the side opposite of the motor. This can be done without removing the table.

3. Remove any accumulated dust or debris from the inside of the assembly.
4. Remove any dirty or dried lubricant from the ball screw. Use a clean, lint-free cloth with a side-to-side motion. Manually turn the ball screw to clean its entire circumference. A swab soaked in Isopropyl Alcohol may be used to remove stubborn debris.
5. Clean the end of the ball-screw nut and wiper with a clean, lint-free cloth or swab.
6. Clean the linear bearing guides using a similar technique.
7. Apply a thin, continuous film of lubricant to the ball-screw threads and linear bearing guides. A good quality, natural bristle artist's brush makes an excellent applicator.
8. For stages without an optional brake, manually move the stage to the opposite end of travel. This will work the grease into the ball screw and linear bearing guides. If the stage has an optional brake, the stage cannot be moved by hand. In this case, restore power to the stage, drive it to the desired position, then remove power and continue to Step 9. Be sure to use extreme caution while operating the stage temporarily without the hardcover installed.
9. Repeat steps 3 through 7 for any areas covered by the original table position.
10. Refasten the hardcover. Torque the hardcover screws to 36 - 42 in-lbs to ensure proper support.
11. Restore power to the stage; drive the stage table back to its original position to redistribute lubricants.

### 4.3. Troubleshooting

Symptom	Possible Cause and Solution
Stage will not move	Brake not released (if equipped with brake; refer to stage documentation). In Limit condition. Check limits (refer to <a href="#">Chapter 3</a> ) and refer to controller documentation for polarity and compatibility requirements (Example: voltage requirements). Controller trap or fault (refer to controller documentation).
Stage moves uncontrollably	Encoder (sine and cosine) signal connections (refer to <a href="#">Chapter 3</a> and Controller documentation). Motor Connections (refer to <a href="#">Chapter 3</a> and Controller documentation).
Stage oscillates or squeals	Gains misadjusted (refer to the controller documentation). Encoder signals (refer to the controller documentation).

## Appendix A: Warranty and Field Service

Aerotech, Inc. warrants its products to be free from harmful defects caused by faulty materials or poor workmanship for a minimum period of one year from date of shipment from Aerotech. Aerotech's liability is limited to replacing, repairing or issuing credit, at its option, for any products that are returned by the original purchaser during the warranty period. Aerotech makes no warranty that its products are fit for the use or purpose to which they may be put by the buyer, whether or not such use or purpose has been disclosed to Aerotech in specifications or drawings previously or subsequently provided, or whether or not Aerotech's products are specifically designed and/or manufactured for buyer's use or purpose. Aerotech's liability on any claim for loss or damage arising out of the sale, resale, or use of any of its products shall in no event exceed the selling price of the unit.

THE EXPRESS WARRANTY SET FORTH HEREIN IS IN LIEU OF AND EXCLUDES ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, BY OPERATION OF LAW OR OTHERWISE. IN NO EVENT SHALL AEROTECH BE LIABLE FOR CONSEQUENTIAL OR SPECIAL DAMAGES.

### Return Products Procedure

Claims for shipment damage (evident or concealed) must be filed with the carrier by the buyer. Aerotech must be notified within thirty (30) days of shipment of incorrect material. No product may be returned, whether in warranty or out of warranty, without first obtaining approval from Aerotech. No credit will be given nor repairs made for products returned without such approval. A "Return Materials Authorization (RMA)" number must accompany any returned product(s). The RMA number may be obtained by calling an Aerotech service center or by submitting the appropriate request available on our website ([www.aerotech.com](http://www.aerotech.com)). Products must be returned, prepaid, to an Aerotech service center (no C.O.D. or Collect Freight accepted). The status of any product returned later than thirty (30) days after the issuance of a return authorization number will be subject to review.

Visit <http://www.aerotech.com/service-and-support.aspx> for the location of your nearest Aerotech Service center.

### Returned Product Warranty Determination

After Aerotech's examination, warranty or out-of-warranty status will be determined. If upon Aerotech's examination a warranted defect exists, then the product(s) will be repaired at no charge and shipped, prepaid, back to the buyer. If the buyer desires an expedited method of return, the product(s) will be shipped collect. Warranty repairs do not extend the original warranty period.

**Fixed Fee Repairs** - Products having fixed-fee pricing will require a valid purchase order or credit card particulars before any service work can begin.

**All Other Repairs** - After Aerotech's evaluation, the buyer shall be notified of the repair cost. At such time the buyer must issue a valid purchase order to cover the cost of the repair and freight, or authorize the product(s) to be shipped back as is, at the buyer's expense. Failure to obtain a purchase order number or approval within thirty (30) days of notification will result in the product(s) being returned as is, at the buyer's expense.

Repair work is warranted for ninety (90) days from date of shipment. Replacement components are warranted for one year from date of shipment.

### Rush Service

At times, the buyer may desire to expedite a repair. Regardless of warranty or out-of-warranty status, the buyer must issue a valid purchase order to cover the added rush service cost. Rush service is subject to Aerotech's approval.

### On-site Warranty Repair

If an Aerotech product cannot be made functional by telephone assistance or by sending and having the customer install replacement parts, and cannot be returned to the Aerotech service center for repair, and if Aerotech determines the problem could be warranty-related, then the following policy applies:

Aerotech will provide an on-site Field Service Representative in a reasonable amount of time, provided that the customer issues a valid purchase order to Aerotech covering all transportation and subsistence costs. For warranty field repairs, the customer will not be charged for the cost of labor and material. If service is rendered at times other than normal work periods, then special rates apply.

If during the on-site repair it is determined the problem is not warranty related, then the terms and conditions stated in the following "On-Site Non-Warranty Repair" section apply.

### On-site Non-Warranty Repair

If any Aerotech product cannot be made functional by telephone assistance or purchased replacement parts, and cannot be returned to the Aerotech service center for repair, then the following field service policy applies:

Aerotech will provide an on-site Field Service Representative in a reasonable amount of time, provided that the customer issues a valid purchase order to Aerotech covering all transportation and subsistence costs and the prevailing labor cost, including travel time, necessary to complete the repair.

### Service Locations

<http://www.aerotech.com/contact-sales.aspx?mapState=showMap>

USA, CANADA, MEXICO	CHINA	GERMANY
Aerotech, Inc. Global Headquarters Phone: +1-412-967-6440 Fax: +1-412-967-6870	Aerotech China Full-Service Subsidiary Phone: +86 (21) 3319 7715	Aerotech Germany Full-Service Subsidiary Phone: +49 (0)911 967 9370 Fax: +49 (0)911 967 93720
JAPAN	TAIWAN	UNITED KINGDOM
Aerotech Japan Full-Service Subsidiary Phone: +81 (0)50 5830 6814 Fax: +81 (0)43 306 3773	Aerotech Taiwan Full-Service Subsidiary Phone: +886 (0)2 8751 6690	Aerotech United Kingdom Full-Service Subsidiary Phone: +44 (0)1256 855055 Fax: +44 (0)1256 855649

Have your customer order number ready before calling.



## Appendix B: Revision History

Revision	Date	Description
1.00.00	November 25, 2015	New Manual

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# Index

			<b>M</b>	
	<b>A</b>		mounting surface	9
acetone (caution)		28	multiaxis combinations	28
Altitude		3		
Ambient Temperature		3	<b>P</b>	
	<b>B</b>		part number	7
Brake Specifications		20	Possible Cause	30
Braycote® 602EF		5	Protection Rating	3
	<b>C</b>		protective ground connection	14
Cleaning		28	<b>S</b>	
cleaning solvent		28	serial number	7
	<b>D</b>		Shimming	9
Dow Corning BR2-Plus grease		28	Solution	30
	<b>E</b>		stabilize	7
Encoder Specifications		20	stage distortion	9
encoders		14	Symptom	30
	<b>G</b>		<b>T</b>	
grease		5,28	thermal expansion coefficient	3
	<b>H</b>		Thermistor Specifications	20
Hall-Effect Sensors Specifications		20	<b>V</b>	
Humidity		3	vacuum	5
	<b>I</b>		vacuum guidelines	5
inspect		27	Vibration	3
isopropyl alcohol		28	<b>W</b>	
	<b>L</b>		Warranty and Field Service	31
label		7		
Limit Switch Specifications		20		
linear motion guide				
lubrication		29		
lubricants				
vacuum operation		5		
Lubrication		28		

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