

# PRO115 Series Stage

## User's Manual

P/N: EDS123 (Revision 1.05.00)



Dedicated to the Science of Motion  
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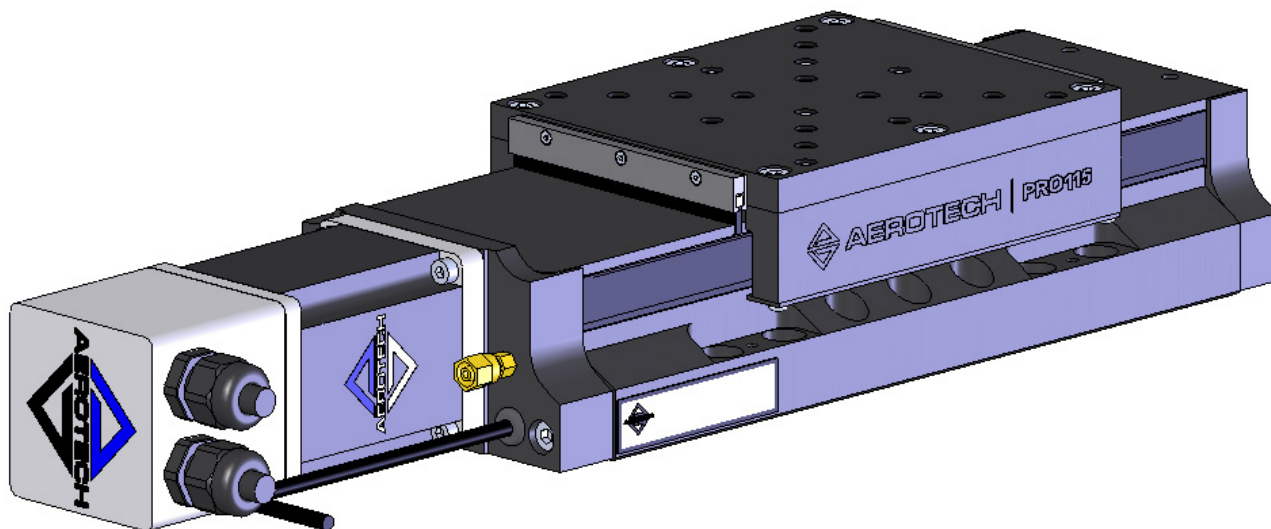
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## Chapter 1: Overview

Figure 1-1 shows a typical PRO115 positioning stage. The PRO115 series of ballscrew positioning stages have travel distances ranging from 50 to 600 mm.

This chapter introduces standard and optional features of the PRO115 stages, explains the model numbering system, and gives general safety precautions.



*Figure 1-1: Typical PRO115 Series Linear Positioning Stage*

**NOTE:** Aerotech continually improves its product offerings, and listed options may be superseded at any time. Refer to the most recent edition of the Aerotech Motion Control Product Guide for the most current product information at [www.aerotech.com](http://www.aerotech.com).

## 1.1. Standard Features

A precision ground ballscrew and Linear Motion Guide (LMG) are standard features on all PRO115 stages. The precision-ground, preloaded ballscrew ensures superior positioning resolution and accuracy while the LMG bearing system provides stiffness, good load carrying capabilities, and continuous load support over the entire range of travel. Other standard design features include an integral hardcover, side seals, and an air purge to keep contamination out of the interior of the stage, and integral wipers on the ballscrew nut and bearing trucks to further reduce contamination. Optical limit switches and mechanical end stops, which protect the carriage from over-travel, are also standard.

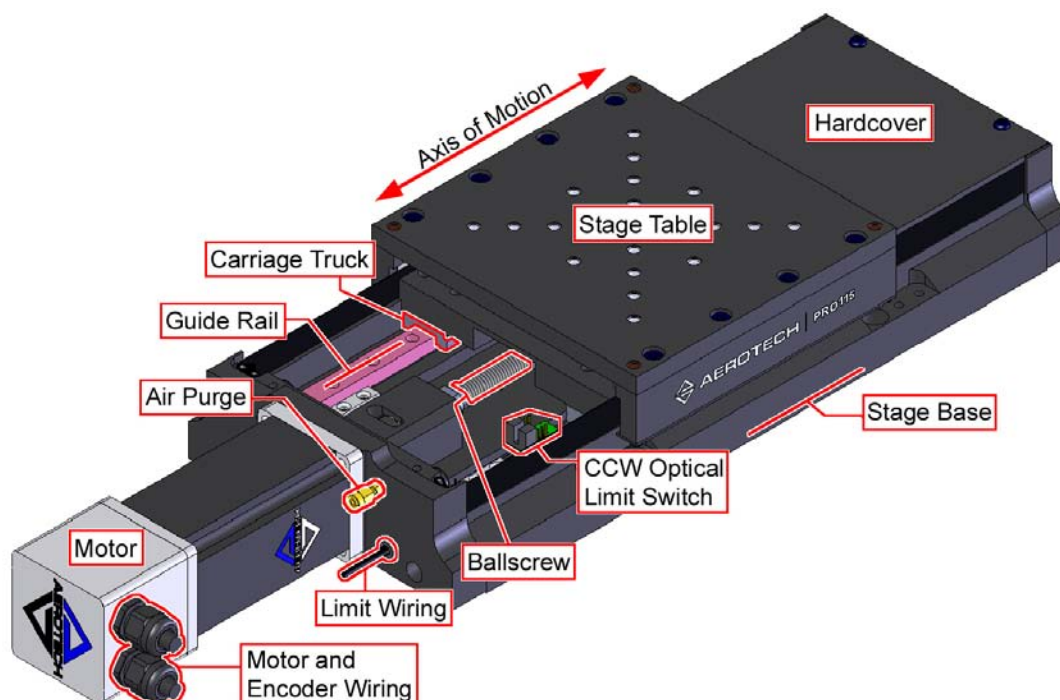


Figure 1-2: PRO115 with Cutaway View of Ballscrew

### 1.1.1. Optional Features

Available assembly options allow the PRO115 series stages to be configured for a variety of applications.

The standard motor for the PRO115 is the BMS60, which includes a 2500 line incremental squarewave encoder and is available with an optional brake. A foldback option is available for use in space-constrained applications. In addition, any motor with a NEMA 23 frame size and 6.35 mm (1/4") or 9.53 mm (3/8") shaft can be mounted to the stage or to the foldback.

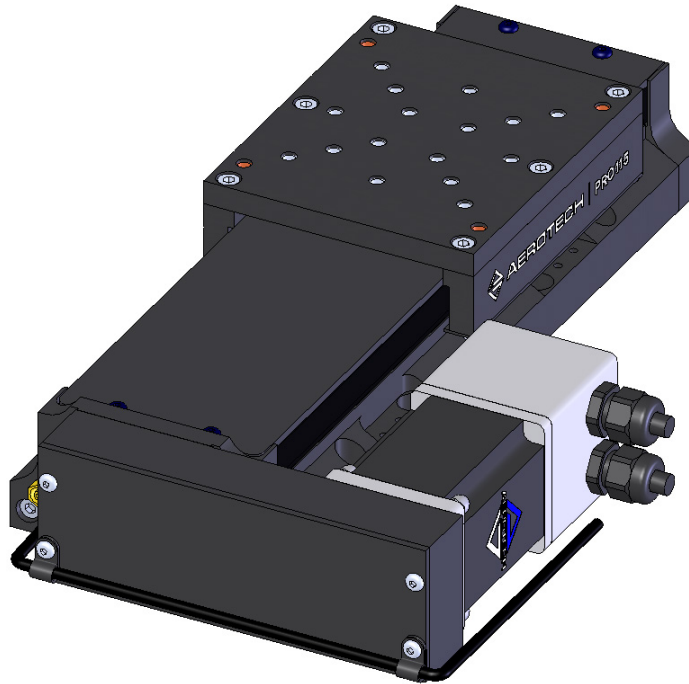


Figure 1-3: PRO115 Stage Shown with Foldback Option

The stage table is available with the mounting holes and grid pattern in either English (-TTU) or Metric (-TTM) dimensions. The -TT100 and -TT150 tabletop options provide quick mounting of an Aerotech ADRS-100 / ACS-100LP or ADRS-150 / ACS-150LP in horizontal or vertical applications. The -TTAGR tabletop option provides quick mounting of an Aerotech AGR-50 with horizontal or vertical axis of rotation, or AGR-75 with vertical axis of rotation only. Optional wipers can be installed on all tabletops (or to the stage base for XY applications) to prevent accumulation of debris on the hard cover.

PRO115 stages can easily be assembled in XY axis arrangements. The upper axis can be bolted directly to the lower axis' carriage, thereby reducing system height. Dedicated angle brackets are available to allow the stages to be mated to form XZ or XYZ axis arrangements. Multi-axis combinations can be optionally aligned to either 10 or 5-arc sec orthogonality. See Figure 1-4 and Figure 1-5 for examples of multi-axis arrangements.

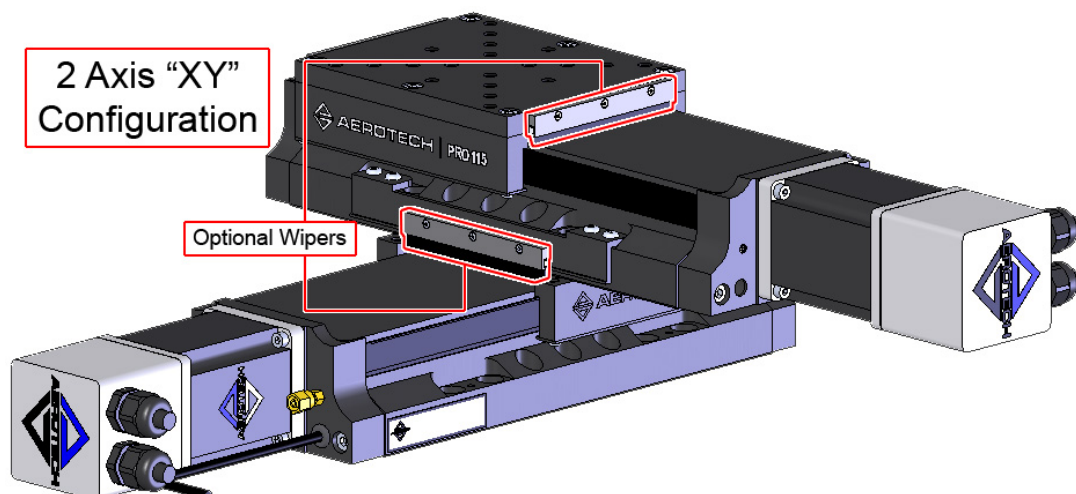


Figure 1-4: XY Axis Positioning System Configuration

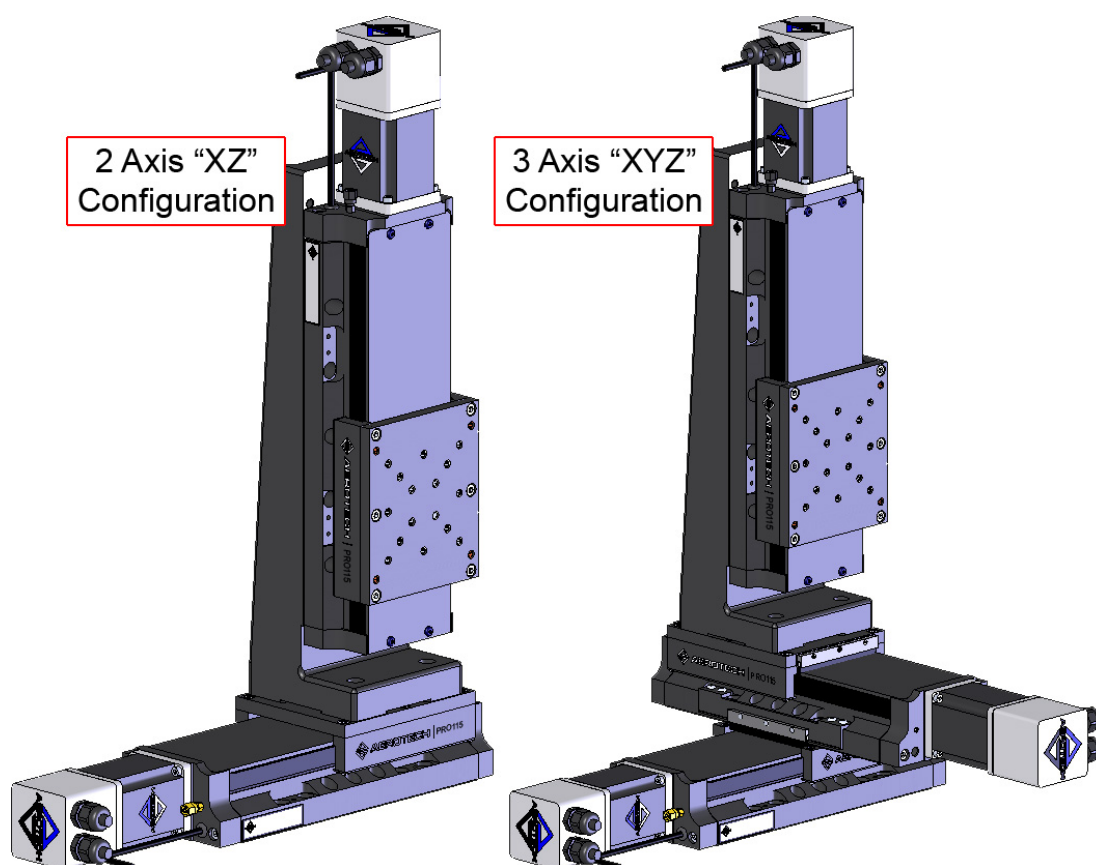


Figure 1-5: XZ and XYZ Axis Positioning System Configurations

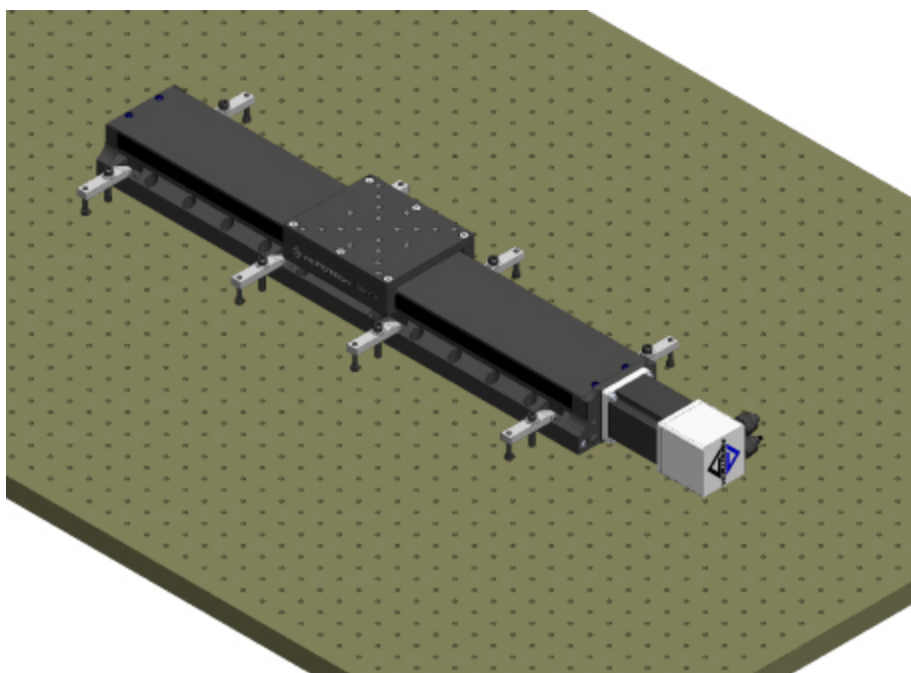
For vacuum applications, two vacuum preparation options are available upon request; one compatible with low vacuum environments (down to  $10^{-3}$  torr) and the other for high vacuum ( $10^{-3}$  to  $10^{-6}$  torr) applications. See Section 3.7. for more information.

### 1.1.2. Toe Clamp Accessory

PRO115 Series Stages can be ordered with toe clamps to mount the stages to English pattern breadboards. Figure 1-6 illustrates the use of these toe clamps. The recommended number of toe clamps per stage is given in Table 1-1.

**Table 1-1: Number of Recommended Toe Clamps for English Mounting of PRO115 Series Stages**

| Stage Configuration (5 mm) | Quantity | Stage Configuration (20 mm) | Quantity |
|----------------------------|----------|-----------------------------|----------|
| PRO115-05MM-0050           | 4        | PRO115-25MM-0100            | 4        |
| PRO115-05MM-0100           | 4        | PRO115-25MM-0150            | 4        |
| PRO115-05MM-0150           | 4        | PRO115-25MM-0200            | 8        |
| PRO115-05MM-0200           | 4        | PRO115-25MM-0250            | 8        |
| PRO115-05MM-0250           | 4        | PRO115-25MM-0300            | 8        |
| PRO115-05MM-0300           | 8        | PRO115-25MM-0400            | 8        |
| PRO115-05MM-0400           | 8        | PRO115-25MM-0500            | 8        |
| PRO115-05MM-0500           | 8        |                             |          |
| PRO115-05MM-0600           | 8        |                             |          |



*Figure 1-6: PRO115 Series Stage Mounted to Breadboard with Toe Clamps*

### 1.1.3. Model Numbers

Stage model number example: PRO115-05MM-050-TTM-5V-NC-BMS-3-FB025-PLOTS

The table below lists the available options in the order they appear in the example above. Aerotech continually improves its product offerings, and listed options may be superseded at any time. Refer to the most recent edition of the Aerotech Motion Control Product Guide for the most current product information at [www.aerotech.com](http://www.aerotech.com).

**Table 1-2: Model Numbering System**

| <b>Travel Options (5 mm lead ballscrew)</b>  |                                                                                                                               |
|----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|
| -05MM-050                                    | 50 mm (2 in) travel stage with ballscrew and limits                                                                           |
| -05MM-100                                    | 100 mm (4 in) travel stage with ballscrew and limits                                                                          |
| -05MM-150                                    | 150 mm (6 in) travel stage with ballscrew and limits                                                                          |
| -05MM-200                                    | 200 mm (8 in) travel stage with ballscrew and limits                                                                          |
| -05MM-250                                    | 250 mm (10 in) travel stage with ballscrew and limits                                                                         |
| -05MM-300                                    | 300 mm (12 in) travel stage with ballscrew and limits                                                                         |
| -05MM-400                                    | 400 mm (16 in) travel stage with ballscrew and limits                                                                         |
| -05MM-500                                    | 500 mm (20 in) travel stage with ballscrew and limits                                                                         |
| -05MM-600                                    | 600 mm (24 in) travel stage with ballscrew and limits                                                                         |
| <b>Travel Options (20 mm lead ballscrew)</b> |                                                                                                                               |
| -HS-20MM-100                                 | 100 mm (4 in) travel stage with ballscrew and limits                                                                          |
| -HS-20MM-150                                 | 150 mm (6 in) travel stage with ballscrew and limits                                                                          |
| -HS-20MM-200                                 | 200 mm (8 in) travel stage with ballscrew and limits                                                                          |
| -HS-20MM-250                                 | 250 mm (10 in) travel stage with ballscrew and limits                                                                         |
| -HS-20MM-300                                 | 300 mm (12 in) travel stage with ballscrew and limits                                                                         |
| -HS-20MM-400                                 | 400 mm (16 in) travel stage with ballscrew and limits                                                                         |
| -HS-20MM-500                                 | 500 mm (20 in) travel stage with ballscrew and limits                                                                         |
| <b>Tabletop Options</b>                      |                                                                                                                               |
| -NOTT                                        | No tabletop                                                                                                                   |
| -TTM                                         | Metric hole-pattern tabletop                                                                                                  |
| -TTU                                         | English hole-pattern tabletop                                                                                                 |
| -TT100                                       | Bolt-hole pattern to attach ADRS100 or ACS-100LP rotary stage with vertical or horizontal axis of rotation                    |
| -TT150                                       | Bolt-hole pattern to attach ADRS150 or ACS-150LP rotary stage with vertical or horizontal axis of rotation                    |
| -TTAGR                                       | Bolt-hole pattern to attach AGR-50 with horizontal or vertical axis of rotation or AGR-75 with vertical axis of rotation only |
| -WIPER                                       | Wiper option for English and Metric tabletops                                                                                 |
| <b>Limit Options</b>                         |                                                                                                                               |
| -5V-NC                                       | Normally-closed end of travel and home limit switches (standard)                                                              |
| -5V-NO                                       | Normally-open end of travel and home limit switches                                                                           |
| -24V-NC                                      | 24 volt normally-closed end of travel and home limit switches                                                                 |

**Table 1-2: Model Numbering System (continued)**

| <b>Motor Options</b>   |                                                                                                            |
|------------------------|------------------------------------------------------------------------------------------------------------|
| -NM                    | No motor                                                                                                   |
| -BMS                   | Brushless, slotless servomotor with 2500 line encoder (BMS60-A-D25-E2500H)                                 |
| -BMS-BRK               | Brushless, slotless servomotor with 2500 line encoder and brake (BMS-60-A-D25-E2500H-BK1)                  |
| -BM                    | Brushless servomotor with 2500 line encoder (BM75-D25-E2500H)                                              |
| -BM-BRK                | Brushless servomotor with 2500 line encoder and brake (BM75-D25-E2500H-BK1)                                |
| -BMS-AS                | Brushless, slotless servomotor with 1000 line amplified sine encoder (BMS60-A-D25-E1000ASH)                |
| -BMS-AS-BRK            | Brushless, slotless servomotor with 1000 line amplified sine encoder and brake (BMS-60-A-D25-E1000ASH-BK1) |
| -BM-AS                 | Brushless servomotor with 1000 line amplified sine encoder (BM75-D25-E1000ASH)                             |
| -BM-AS-BRK             | Brushless servomotor with 1000 line amplified sine encoder and brake (BM75-D25-E1000ASH-BK1)               |
| <b>Orientation</b>     |                                                                                                            |
| -0                     | No motor                                                                                                   |
| -2                     | Bottom cable exit                                                                                          |
| -3                     | Left cable exit                                                                                            |
| -4                     | Top cable exit                                                                                             |
| -5                     | Right cable exit                                                                                           |
| -8                     | Right side foldback                                                                                        |
| -12                    | Left side foldback                                                                                         |
| <b>Options</b>         |                                                                                                            |
| -FB025                 | Foldback kit for NEMA 23 motor with 1/4" diameter shaft                                                    |
| -FB025-BRK             | Foldback kit for NEMA 23 motor with 1/4" diameter shaft and stage mounted brake                            |
| -FB0375                | Foldback kit for NEMA 23 motor with 3/8" diameter shaft                                                    |
| -FB0375-BRK            | Foldback kit for NEMA 23 motor with 3/8" diameter shaft and stage mounted brake                            |
| -BASE WIPER            | Base wipers for upper stage in an XY assembly                                                              |
| <b>Coupling Option</b> |                                                                                                            |
| -C025                  | 1/4" Coupling                                                                                              |
| -C0375                 | 3/8" Coupling                                                                                              |
| -NONE                  | No Coupling                                                                                                |
| <b>Testing</b>         |                                                                                                            |
| -PLOTS                 | Accuracy, straightness, flatness plots                                                                     |
| -NO PLOTS              | No accuracy, straightness, or flatness plots                                                               |

**Table 1-2: Model Numbering System (continued)**

| <b>Accessories (to be ordered as separate line item)</b> |                                                            |
|----------------------------------------------------------|------------------------------------------------------------|
| ALIGNMENT-NPA                                            | Non-precision XY assembly                                  |
| ALIGNMENT-NPAZ                                           | Non-precision XZ or XY 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  |
| HDZ115                                                   | Right angle L-bracket for PRO115-050, -100 and -150 only   |
| TC-PRO115                                                | Toe clamps for mounting stage to English spaced breadboard |

## 1.2. Dimensions

### PRO115

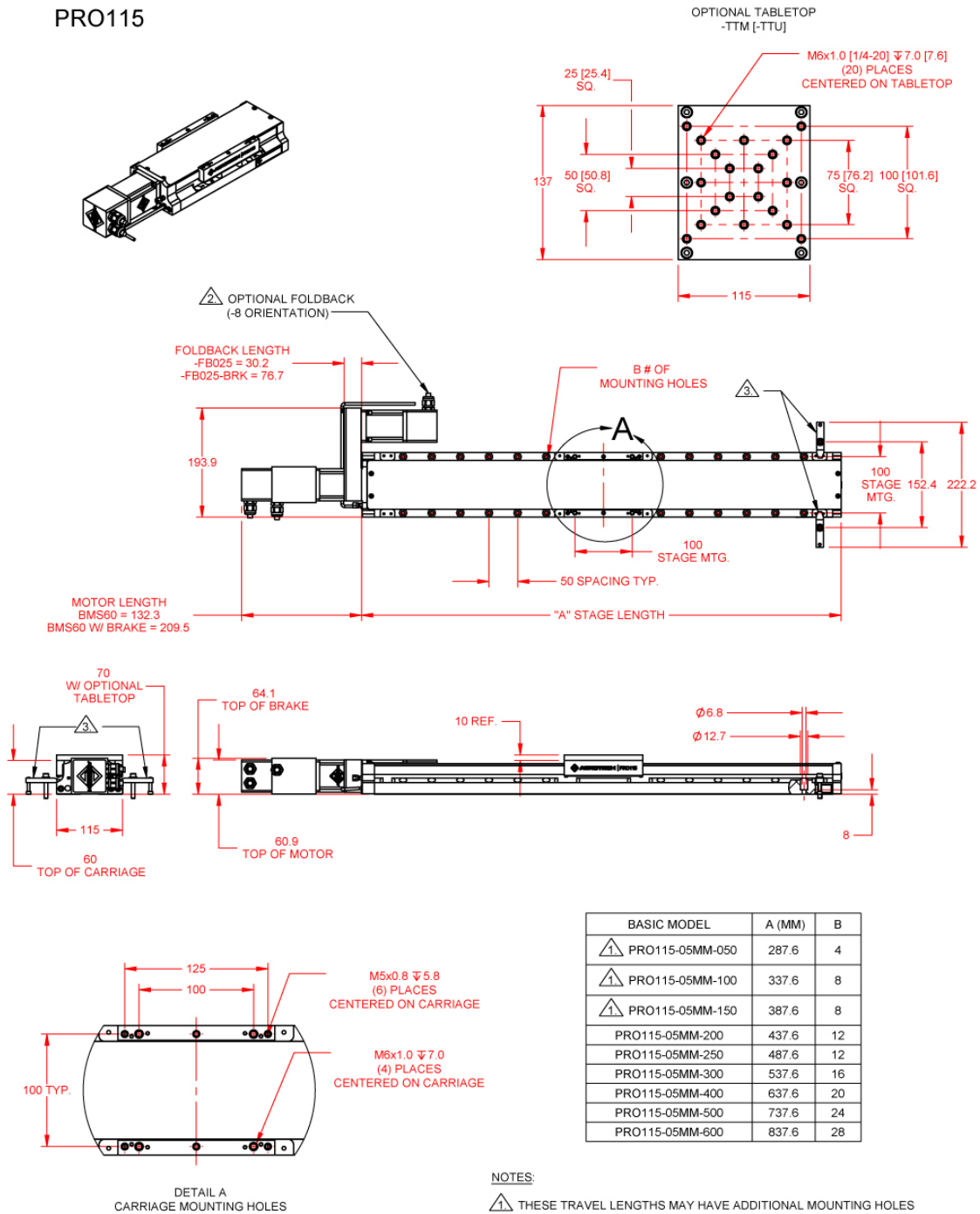


Figure 1-7: PRO115 Dimensions

## PRO115-HS

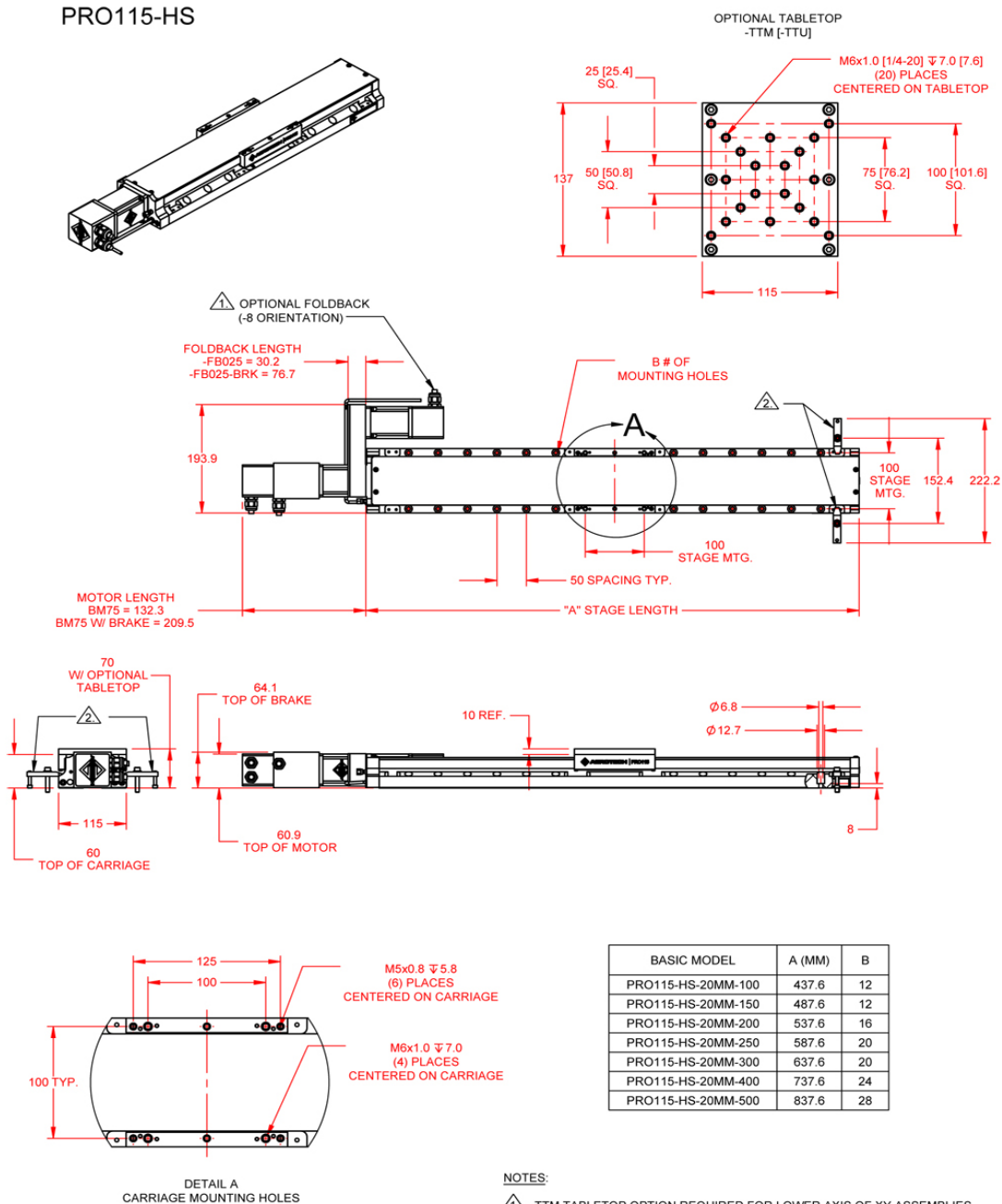


Figure 1-8: PRO115-HS Dimensions

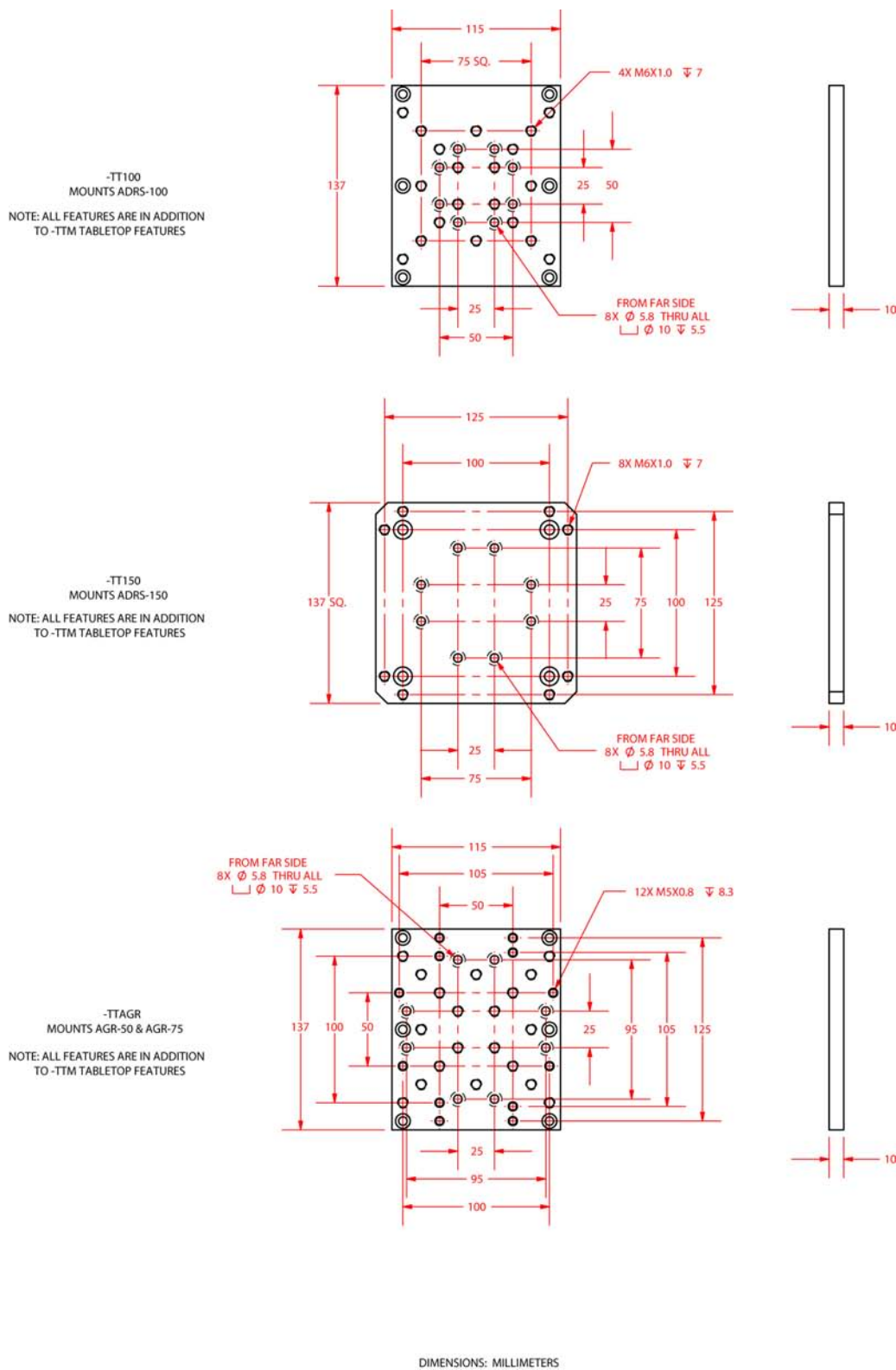


Figure 1-9: PRO115 Tabletop Dimensions

### 1.3. Safety Procedures and Warnings

The following statements apply throughout this manual. Failure to observe these precautions could result in serious injury to those performing the procedures and damage to the equipment.

This manual and any additional instructions included with the stage should be retained for the lifetime of the stage.



To minimize the possibility of electrical shock and bodily injury or death, disconnect all electrical power prior to making any electrical connections.



To minimize the possibility of electrical shock and bodily injury or death when any electrical circuit is in use, ensure that no person comes in contact with the circuitry when the stage is connected to a power source.



To minimize the possibility of bodily injury or death, disconnect all electrical power prior to making any mechanical adjustments.



Moving parts of the stage can cause crushing or shearing injuries. All personnel must remain clear of any moving parts.



Improper use of the stage can cause damage, shock, injury, or death. Read and understand this manual before operating the stage.



If the stage is used in a manner not specified by the manufacturer, the protection provided by the stage can be impaired.



Stage cables can pose a tripping hazard. Securely mount and position all stage cables to avoid potential hazards.

**WARNING**

Do not expose the stage to environments or conditions outside the specified range of operating environments. Operation in conditions other than those specified can cause damage to the equipment.

**WARNING**

The stage must be mounted securely. Improper mounting can result in injury and damage to the equipment.

**WARNING**

Use care when moving the stage. Manually lifting or transporting stages can result in injury.

**WARNING**

Only trained personnel should operate, inspect, and maintain the stage.

**WARNING**

This stage is intended for light industrial manufacturing or laboratory use. Use of the stage for unintended applications can result in injury and damage to the equipment.

**WARNING**

Before using this stage, perform an operator risk assessment to determine the needed safety requirements.

## 1.4. EC Declaration of Incorporation

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



**herewith declares that the product:**

Aerotech, Inc. PRO115 Stage

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

**does therefore not in every respect comply with the provisions of this directive;**

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

EN ISO 12100-1,-2:2003+A1:2009

*Safety of machinery - Basic concepts, general principles for design*

ISO 14121-1:2007

*Safety of machinery - Risk assessment - Part 1: Principles*

EN 60204-1:2005

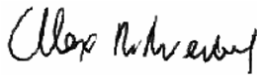
*Safety of machinery - Electrical equipment of machines - Part 1: General requirements*

**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.**

**Authorized Representative:** Manfred Besold  
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Alex Weibel /   
Engineer Verifying Compliance

**Position:**

**Location:**

Pittsburgh, PA

**Date:**

March 25, 2011

## Chapter 2: Installation

This chapter describes the installation procedure for the PRO115 stage, including handling the stage properly, preparing the mounting surface to accept the stage, securing the stage to the mounting surface, attaching the payload, and making the electrical connections.



Installation must follow the instructions in this chapter. Failure to follow these instructions could result in injury and damage to the equipment.

### 2.1. Unpacking and Handling the Stage

Carefully remove the stage from the protective shipping container. Set the stage on a smooth, flat, and clean surface. This is a simple, yet very important step in maintaining the integrity of the stage. Each stage 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. If any damage has occurred during shipping, report it immediately.



Improper stage handling could adversely affect the stage's performance. Use care when moving the stage. Manually lifting or transporting stages can result in injury.



Lift the stage only by the base.



Do not use the ballscrew or motor as lifting points

## 2.2. Preparing the Mounting Surface

The mounting surface should be flat and have adequate stiffness in order to achieve the maximum performance from the PRO115. When an PRO115 series stage is mounted to a non-flat surface, the stage can be distorted as the mounting screws are tightened (see Figure 2-1).

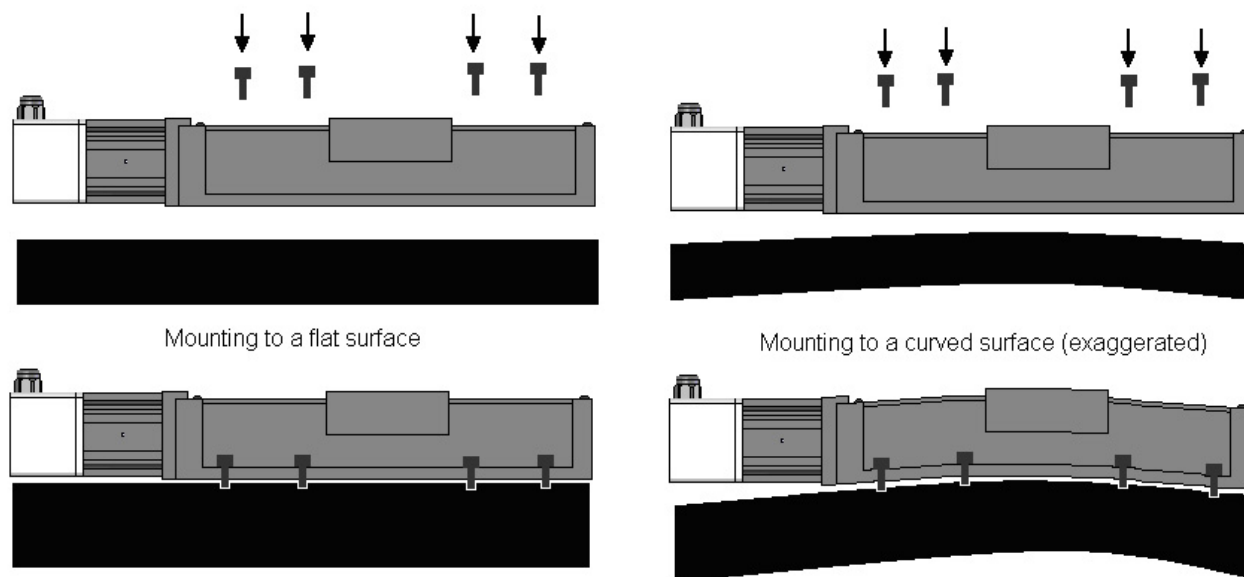


Figure 2-1: Mounting to a Flat Surface

**NOTE:** To maintain accuracy, the mounting surface should be flat, as specified in Table 2-1.

Any distortion will decrease the overall accuracy of the stage. Adjustments to the mounting surface must be done before the stage is secured.

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

Table 2-1: Stage Mounting Surface Flatness Requirement

| Stage Travel | Flatness Requirement |
|--------------|----------------------|
| 50-150 mm    | 5 $\mu\text{m}$      |
| 200-400 mm   | 7.5 $\mu\text{m}$    |
| 500-600 mm   | 10 $\mu\text{m}$     |

## 2.3. Securing the Stage to the Mounting Surface

If necessary, manually move the stage table to access the 6.5 mm (0.28 in) diameter mounting holes along the edges of the stage (refer to Figure 2-2). This stage is designed to use socket head cap screws (SHCS) to secure the base to the mounting surface. Use M6 x 22 mm or ¼ x 7/8" long SHCS with flat washers to achieve 1.5x diameter thread engagement. Torque the mounting screws to 8.1 N\*m (6 ft\*lb).

**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.

**NOTE:** If the stage is not connected to a power source, and not equipped with an optional brake, it should be possible to move the stage table by hand with steady even pressure. Do not attempt to manually move the stage if it is connected to a power source or includes an integrated brake.



**WARNING**

The stage must be mounted securely. Improper mounting can result in injury and damage to the equipment.

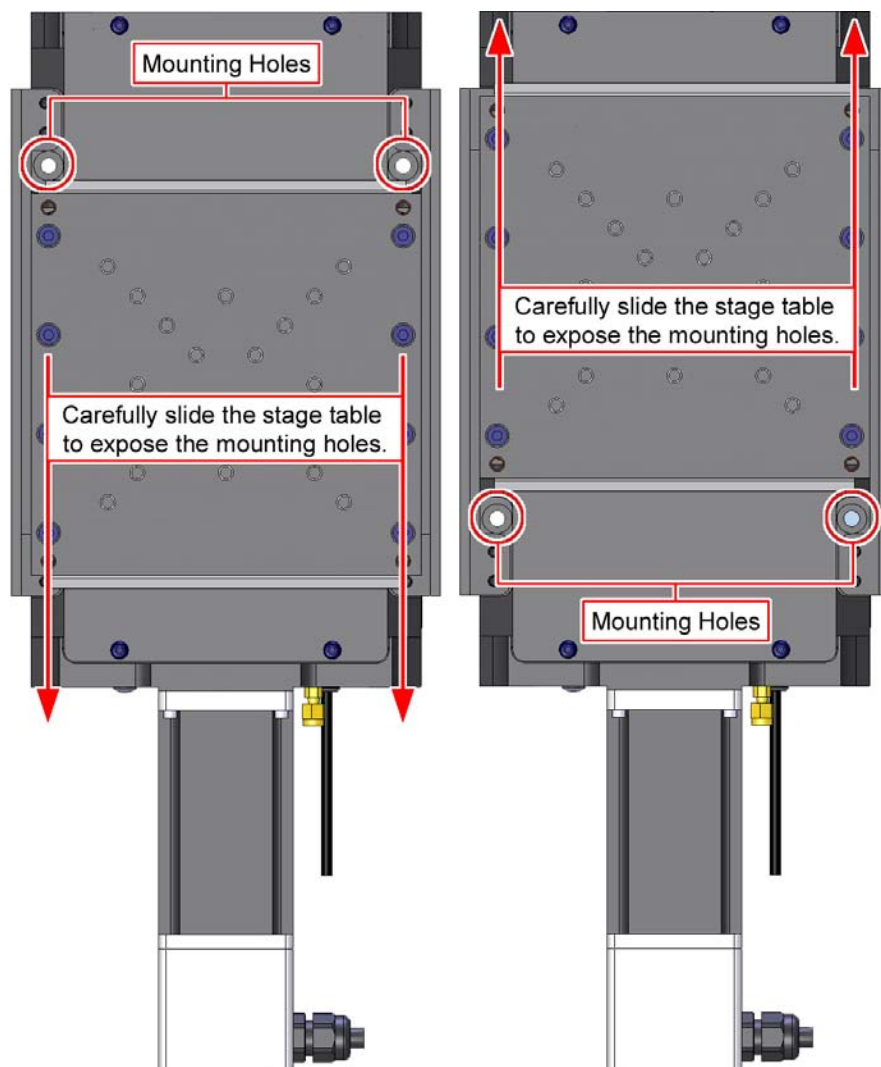


Figure 2-2: Mounting Hole Locations

## 2.4. Attaching the Payload to the Stage

To prevent damage to the stage or parts, test the operation of the stage before any payload is mounted to the stage tabletop. 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 connections, refer to the Electrical Installation section later in this chapter, the documentation of the motion control system delivered with the stage, and the wiring drawings in Chapter 3: Operating Specifications.

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

**NOTE:** For valid accuracies, the mounting interface should be flat within 1  $\mu\text{m}$  per 50 mm.

Refer to Section 3.4. for information on cantilevered loads and load positioning.

**NOTE:** Do not attach a payload to the stage table with screws that are too long. A screw passing through the stage table can come into contact with the hardcover, affecting travel and possibly damaging the stage.

## 2.5. Electrical Installation

Electrical installation requirements will vary depending on stage options. Installation instructions in this section are for stages equipped with standard Aerotech motors intended for use with an Aerotech motion control system. Contact Aerotech for further information regarding stages that are otherwise configured.

Aerotech motion control systems are adjusted at the factory for optimum performance. When the PRO115 series stage is part of a complete Aerotech motion control system, setup involves connecting a stage and motor combination to the appropriate drive chassis with the cables provided. Connect the provided cables to the appropriate electrical connectors on the stage shown in Figure 2-3. Labels on the drive indicate the appropriate connector locations. Refer to your drive manuals and documentation for additional installation and operation information. In some cases, if the system is uniquely configured, a drawing showing system interconnects is supplied.

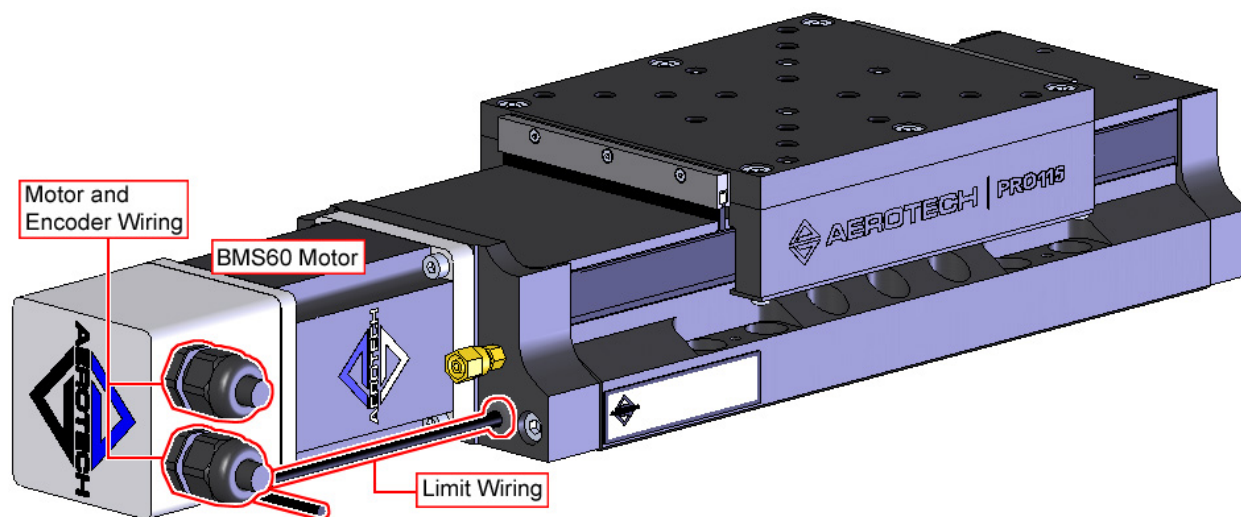


Figure 2-3: Electrical Components of a Typical PRO115 Stage



WARNING

Never connect or disconnect any electrical component or connecting cable while power is applied, or serious damage can result.



WARNING

The stage's protective ground is located on pin A4 of the Motor Wiring connection. If you are using cables other than those provided by Aerotech, you must connect pin A4 to a ground connection.

### 2.5.1. Standard Aerotech Motor Options

The BMS60, one of Aerotech's high performance brushless, slotless rotary motors, is the standard motor for the PRO115 stage. The electrical wiring from the motor and encoder to the "connectorized" ports on the motor can is contained within the rear motor housing and has been completed at the factory. The motor cables and limit cable convey motor power, encoder feedback, and limit switch signals to an appropriate hardware device (e.g. axis controller or amplifier). Refer to Section 3.6. for standard motor wiring and connector pin outputs.

### 2.5.2. Motor Foldback Options

When the foldback option is chosen, any motor with a standard NEMA 23 frame size may be used. Either a 6.35 mm (1/4") shaft or a 9.53 mm (3/8") shaft size can be specified when ordering the stage. The belt pulleys are attached to the motor shaft with two set screws. See Figure 4-5 and Figure 4-6 for illustrations showing the locations of the set screws as well as the entire pulley and belt power transfer system. Refer to Section 4.3. for more information about the foldback option.

### 2.5.3. Optical Limit Switches

The PRO115 is equipped with optical limit switches, which can be configured as a 5 volt normally closed (5V-NC), 5 volt normally open (5V-NO), or 24 volt normally closed (24V-NC). The limit cable exits the stage on the same side as the motor and is bundled with the motor cables. The customer has the option of flying leads or a 9-pin D connector for the end of the limit cable. Refer to Section 3.5. for a description of limit switch operation and wiring.



## Chapter 3: Operating Specifications

The surrounding environment and operating conditions can affect the performance and service life of the stage. This chapter provides information on ideal environmental and operating conditions. Also included are instructions for estimating load capability and torque required to turn the ballscrew given various loadings.

### 3.1. Environmental Specifications

The environmental specifications for the PRO115 are listed in the following table.

**Table 3-1: Environmental Specifications**

|                            |                                                                                                                                                                                                                                                                                                                |
|----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Ambient Temperature</b> | Operating: 10° to 35° C (50° to 95° F)<br>The optimal operating temperature is 20° C $\pm$ 2° C (68° F $\pm$ 4° F). If at any time the operating temperature deviates from 20° C degradation in performance could occur. Contact Aerotech for information regarding your specific application and environment. |
|                            | Storage: 0° to 40° C (32° to 104° F) in original shipping packaging                                                                                                                                                                                                                                            |
| <b>Humidity</b>            | Operating: 40 percent to 60 percent RH<br>The optimal operating humidity is 50 percent RH.                                                                                                                                                                                                                     |
|                            | Storage: 30 percent to 60 percent RH, non-condensing in original packaging                                                                                                                                                                                                                                     |
| <b>Altitude</b>            | Operating: 0 to 2,000 m (0 to 6,562 ft) above sea level<br>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 stage and system performance. Contact Aerotech for information regarding your specific application.                                                                                                          |
| <b>Dust Exposure</b>       | The PRO115 stages have limited protection against dust, but not water. This equates to an ingress protection rating of IP50.                                                                                                                                                                                   |
| <b>Use</b>                 | Indoor use only                                                                                                                                                                                                                                                                                                |



Do not expose the stage to environments or conditions outside the specified range of operating environments. Operation in conditions other than those specified can cause damage to the equipment.

### 3.2. Accuracy and Temperature Effects

The accuracy specification of PRO115 series stages is measured at the center of travel 25 mm above the table with the stage in a horizontal position. The stage is assumed to be fully supported by a mounting surface meeting or exceeding the specification in Table 2-1.

The accuracy of the ballscrew is a key element in the overall positioning accuracy. A scale error can be expected if temperature of the ballscrew differs from 20° C (68° F). The greater the temperature difference, the greater the error. The temperature of the ballscrew 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 ballscrew is  $11.7 \times 10^{-6}$  ppm/°C.

### 3.3. Basic Specifications

Basic PRO115 series positioning stage specifications are shown in Table 3-2 and Table 3-3. Resolution is dependent on ballscrew pitch, encoder resolution, and controller interpolation. For all stages in Table 3-2, the ballscrew pitch is 5 mm per revolution. For all stages in Table 3-3, the ballscrew pitch is 20 mm per revolution. Table 3-4 shows resolutions available assuming a x4 controller multiplication. Table 3-5 shows the standard motor specifications for the PRO115.

**Table 3-2: PRO115 Series Specifications (5 mm lead ballscrew)**

| Travel                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 50                    | 100                  | 150                  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|----------------------|----------------------|
| Bidirectional Repeatability                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | $\pm 1.0 \mu\text{m}$ |                      |                      |
| Straightness and Flatness                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | $3 \mu\text{m}$       | $5 \mu\text{m}$      | $6 \mu\text{m}$      |
| Accuracy                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | $\pm 6 \mu\text{m}$   | $\pm 6 \mu\text{m}$  | $\pm 8 \mu\text{m}$  |
| Horizontal Load                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 45 kg (99 lb)         |                      |                      |
| Axial Load                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 18.2 kg (40 lb)       |                      |                      |
| Stage Mass                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 5.1 kg (11.2 lb)      | 5.5 kg (12.1 lb)     | 5.9 kg (13.0 lb)     |
| Moving Mass                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1.2 kg (2.6 lb)       |                      |                      |
| Maximum Acceleration                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 0.5 g                 |                      |                      |
| Maximum Speed                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 300 mm/sec            |                      |                      |
| Travel                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 200                   | 250                  | 300                  |
| Bidirectional Repeatability                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | $\pm 1.0 \mu\text{m}$ |                      |                      |
| Straightness and Flatness                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | $10 \mu\text{m}$      | $10 \mu\text{m}$     | $12 \mu\text{m}$     |
| Accuracy                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | $\pm 8 \mu\text{m}$   | $\pm 8 \mu\text{m}$  | $\pm 10 \mu\text{m}$ |
| Horizontal Load                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 45 kg (99 lb)         |                      |                      |
| Axial Load                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 25 kg (55 lb)         |                      |                      |
| Stage Mass                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 6.4 kg (14.1 lb)      | 6.9 kg (15.2 lb)     | 7.3 kg (16.1 lb)     |
| Moving Mass                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1.2 kg (2.6 lb)       |                      |                      |
| Maximum Acceleration                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 0.5 g                 |                      |                      |
| Maximum Speed                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 300 mm/sec            |                      |                      |
| Travel                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 400                   | 500                  | 600                  |
| Bidirectional Repeatability                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | $\pm 1.0 \mu\text{m}$ |                      |                      |
| Straightness and Flatness                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | $16 \mu\text{m}$      | $18 \mu\text{m}$     | $20 \mu\text{m}$     |
| Accuracy                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | $\pm 12 \mu\text{m}$  | $\pm 14 \mu\text{m}$ | $\pm 16 \mu\text{m}$ |
| Horizontal Load                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 45 kg (99 lb)         |                      |                      |
| Axial Load                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 25 kg (55 lb)         |                      |                      |
| Stage Mass                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 8.2 kg (18.0 lb)      | 9.0 kg (19.8 lb)     | 9.9 kg (21.8 lb)     |
| Moving Mass                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1.2 kg (2.6 lb)       |                      |                      |
| Maximum Acceleration                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 0.5 g                 |                      |                      |
| Maximum Speed                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 300 mm/sec            | 250 mm/sec           | 250 mm/sec           |
| <ul style="list-style-type: none"> <li>• All performance specifications assume a fully supported single axis stage.</li> <li>• Repeatability and accuracy include linearity correction and minimum thermal change during measurement.</li> <li>• Vertical and axial loads subject to cantilever load restriction.</li> <li>• Selected motor and drive will limit performance specifications.</li> <li>• Consult factory for XY and alternate mounting configurations.</li> <li>• Stage mass includes motor.</li> </ul> |                       |                      |                      |

**Table 3-3: PRO115 Series Specifications (20 mm lead ballscrew)**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                  |                  |                  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|------------------|------------------|
| Travel                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 100              | 150              | 200              |
| Bidirectional Repeatability                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | ±1.0 μm          |                  |                  |
| Straightness and Flatness                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 5 μm             | 6 μm             | 10 μm            |
| Accuracy                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | ±8 μm            | ±10 μm           | ±10 μm           |
| Horizontal Load                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 45 kg (99 lb)    |                  |                  |
| Axial Load                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 18.2 kg (40 lb)  |                  |                  |
| Stage Mass                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 6.4 kg (14.1 lb) | 6.8 kg (15.0 lb) | 7.2 kg (15.8 lb) |
| Moving Mass                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 1.2 kg (2.6 lb)  |                  |                  |
| Maximum Acceleration                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0.5 g            |                  |                  |
| Maximum Speed                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 625 mm/sec       | 775 mm/sec       | 900 mm/sec       |
| Travel                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 250              | 300              | 400              |
| Bidirectional Repeatability                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | ±1.0 μm          |                  |                  |
| Straightness and Flatness                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 10 μm            | 12 μm            | 16 μm            |
| Accuracy                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | ±12 μm           | ±12 μm           | ±28 μm           |
| Horizontal Load                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 45 kg (99 lb)    |                  |                  |
| Axial Load                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 25 kg (55 lb)    |                  |                  |
| Stage Mass                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 7.7 kg (16.9 lb) | 8.1 kg (17.8 lb) | 9.0 kg (19.8 lb) |
| Moving Mass                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 2.0 kg (4.4 lb)  |                  |                  |
| Maximum Acceleration                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0.5 g            |                  |                  |
| Maximum Speed                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1000 mm/sec      | 1100 mm/sec      | 1200 mm/sec      |
| Travel                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 500              |                  |                  |
| Bidirectional Repeatability                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | ±1.0 μm          |                  |                  |
| Straightness and Flatness                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 18 μm            |                  |                  |
| Accuracy                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | ±32 μm           |                  |                  |
| Horizontal Load                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 45 kg (99 lb)    |                  |                  |
| Axial Load                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 25 kg (55 lb)    |                  |                  |
| Stage Mass                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 9.9 kg (21.8 lb) |                  |                  |
| Moving Mass                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 1.2 kg (2.6 lb)  |                  |                  |
| Maximum Acceleration                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0.5 g            |                  |                  |
| Maximum Speed                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 900 mm/sec       |                  |                  |
| <ul style="list-style-type: none"><li>• All performance specifications are measured on a single axis basis.</li><li>• Repeatability and accuracy include linearity correction and minimum thermal change during measurement.</li><li>• Vertical and axial loads subject to cantilever load restriction.</li><li>• Selected motor and drive will limit performance specifications.</li><li>• Consult factory for XY and alternate mounting configurations.</li><li>• Stage mass includes motor.</li></ul> |                  |                  |                  |

**Table 3-4: PRO115 Series Resolution Information**

| Encoder                                          | Travel/Step <sup>(1)</sup> | Steps/Revolution <sup>(1)</sup> |
|--------------------------------------------------|----------------------------|---------------------------------|
| 2500 line driver                                 | .5 $\mu\text{m}$           | 10000                           |
| (1) Assumes times-4 interpolation by controller. |                            |                                 |

**Table 3-5: PRO115 Series Standard Motor Specifications**

| Stage                            | Standard Motor | Current (A <sub>pk</sub> ) |      | Maximum Drive Output Voltage (VDC) | Wire Gauge (Leads) |
|----------------------------------|----------------|----------------------------|------|------------------------------------|--------------------|
|                                  |                | Continuous                 | Peak |                                    |                    |
| PRO115 with 5 mm lead ballscrew  | BMS60          | 2.3                        | 9.2  | 340                                | 24                 |
| PRO115 with 20 mm lead ballscrew | BM75           | 10.0                       | 25.0 | 340                                | 20                 |

### 3.4. Load Capability

It is recommended that application loads 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). With the stage lying flat (horizontal) and the application load vertically applied and symmetrically distributed, the maximum vertical load carrying capacity of PRO115 stages is 40 kg. If cantilevered loads are applied, refer to Figure 3-1 to find the maximum allowable load.

In Figure 3-1, three curves are shown for different loading conditions. The Vertical curve is for situations where the stage is mounted in a vertical orientation and the payload is mounted to the table top with its center of gravity extended outward (5 mm lead version only). The Horizontal curve assumes a horizontal stage orientation. If a cantilevered load situation is used, first determine if it is a vertical cantilever or side cantilever system based on Figure 3-2. Measure the cantilever length, then find the corresponding load value from Figure 3-1.

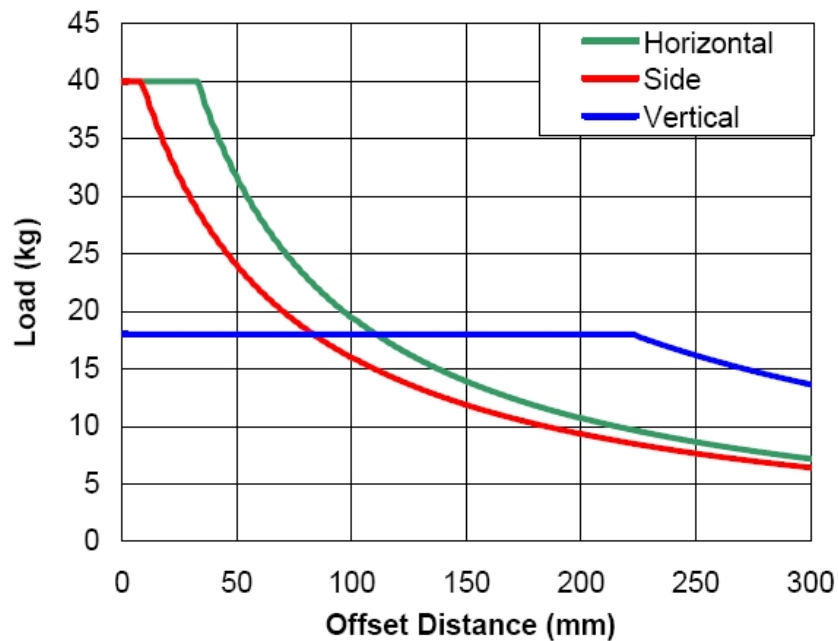


Figure 3-1: Load Capability of PRO115 Series Stages

**NOTE:** The Vertical curve only applies to the 5 mm lead version. The 20 mm lead version cannot be used vertically.

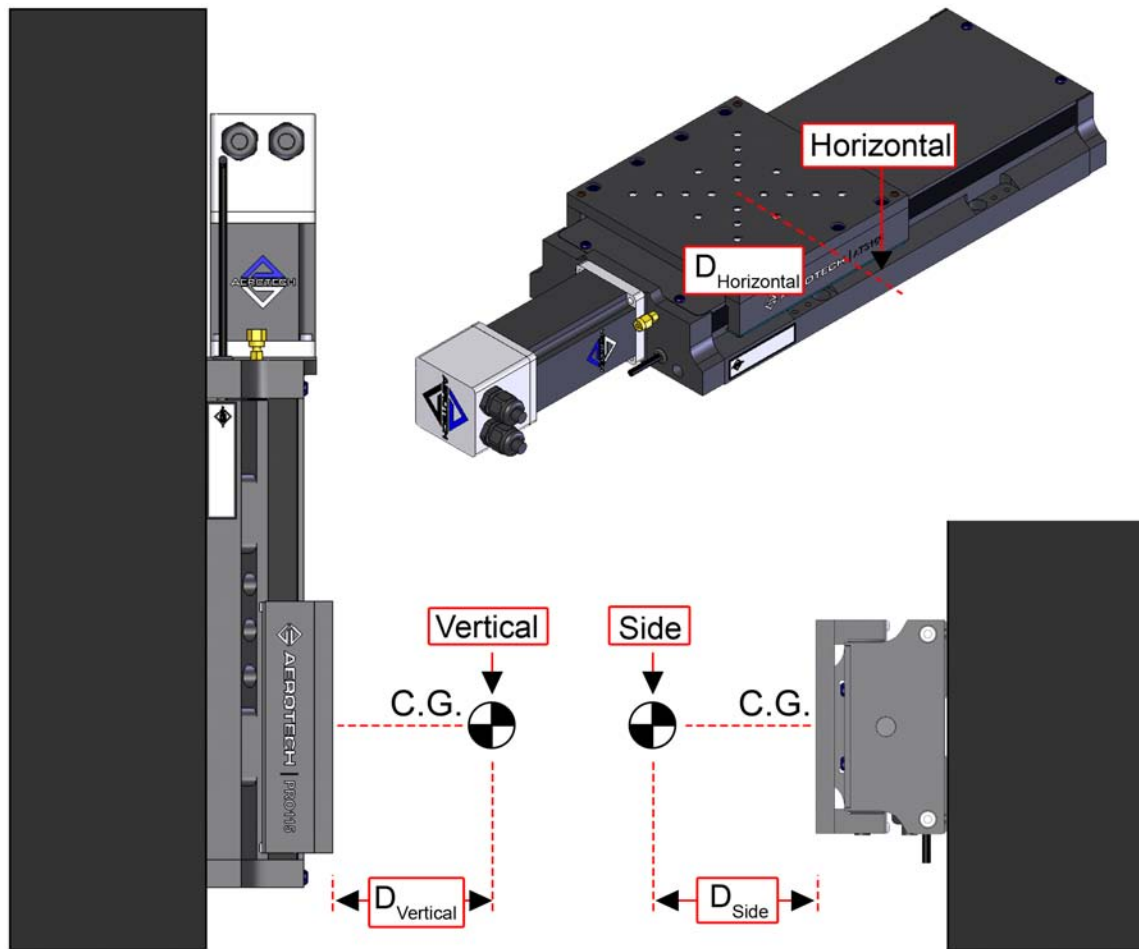


Figure 3-2: Stage Orientations

The approximate amount of torque required to turn the ballscrew of an PRO115 series stage can be found from Figure 3-3 or the following equation:

$$Torque_{REQ} = \frac{(AxialLoad) \times (LeadofScrew)}{2 \times \pi \times (Efficiency)}$$

For PRO115 series stages, the ballscrew efficiency is rated at 90% (0.90). Refer to Figure 3-3.

The maximum axial load carrying capacity of PRO115 stages is 18.2 kg (40 lb).

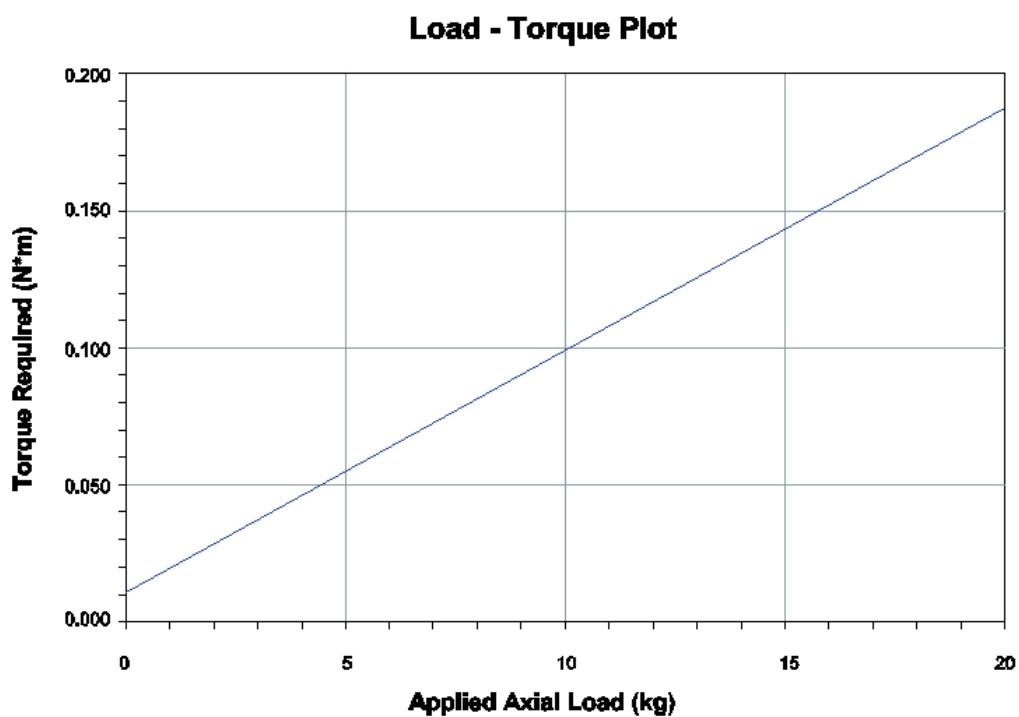


Figure 3-3: Torque Required to Turn Ballscrew in Vertical Orientation

### 3.5. Optical Limit Switch

PRO115 series stages are provided with a pair of optical limit switch assemblies mounted to the base of the stage. The limit switches signal when the stage has reached its maximum useable travel distance in both directions.

#### 3.5.1. Limit Switch Operation

Each limit switch has a light source and detector mounted to a small printed circuit board. Each limit switch board is mounted at an end of the stage with its emitter–detector axes perpendicular to the direction of table motion. On a standard stage, the clockwise (CW) switch is located at the end opposite the motor. When movement of the stage table causes the blade mounted to the stage carriage to break the light beam from the emitter to the detector, a CW or counterclockwise (CCW) limit signal is generated. The limit switch itself can be configured as normally closed (NC) or normally open (NO). The -24V-NC option is a factory option only.



If the stage is driven past the electrical limit, it will encounter the hard stop. Where the hard limit occurs is dependent on stage travel. In stages with a 5 mm lead ballscrew, the hard limit occurs ~2 revolutions (10 mm) for the 50 mm travel stage and ~1 revolution (5 mm) for the 600 mm travel stage. In stages with a 20 mm lead ballscrew, the hard limit occurs ~2.8 revolutions (57 mm). Although the operating speed of the stage may be relatively slow, and the stage's rubber bumpers will provide some protection, damage to the stage could result.

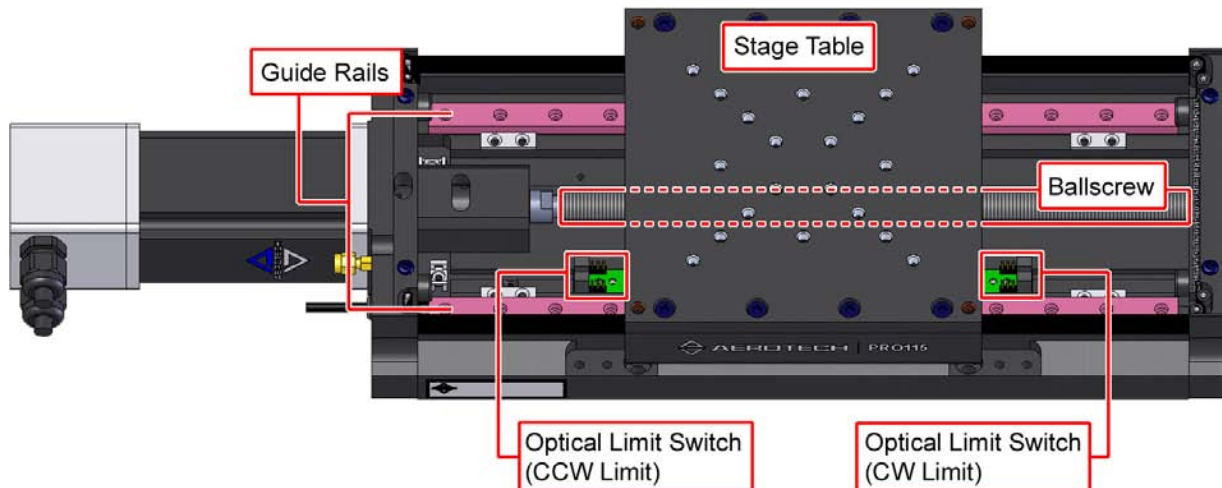


Figure 3-4: Internal View of a Typical Stage Showing Limit Switches

**NOTE:** Clockwise (CW) and counterclockwise (CCW) refer to the direction of motor rotation while looking into the shaft of the motor. For the PRO115, a CW rotation of the motor causes the stage table to move away from the motor. CCW rotation of the motor causes the stage table to move toward the motor. If an optional "foldback" option is used, the directions are reversed.

### 3.5.2. Limit Switch Wiring

Limit switches are open-collector, TTL-compatible, electro-optical devices that change output states when the stage approaches its maximum travel distance and breaks the light beam. Since they are open-collector devices, they may be interfaced to 5-24 Volt logic inputs. Each limit switch is mounted on a small printed circuit board. Standard PRO115 stages include wiring in a separate 9-pin limit switch connector, detailed in Figure 3-5.

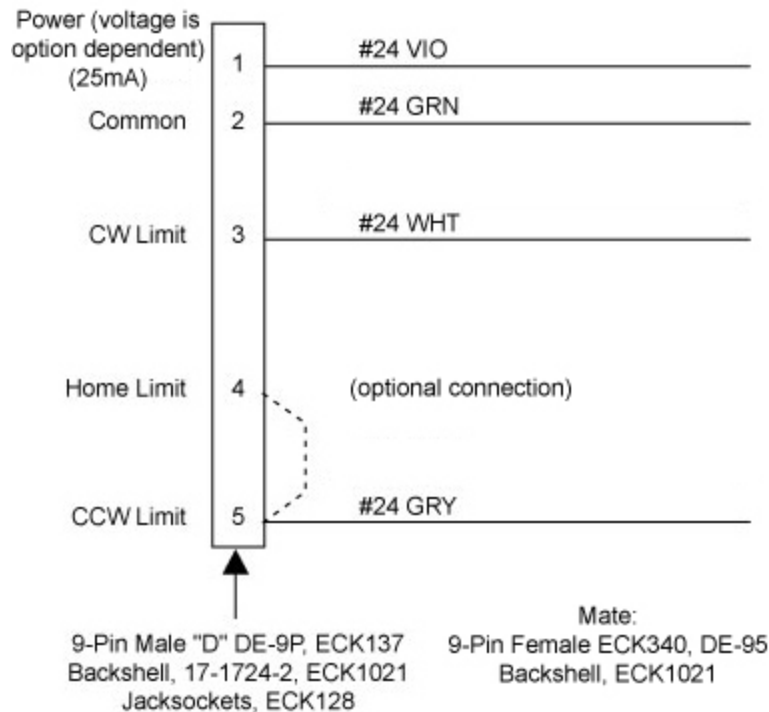


Figure 3-5: PRO115 Series 9-pin Limit Switch Wiring



In all PRO115 Series Stages with the -24V-NC limit option, pin 1 of the 9-pin Limit Switch will always be the power for the limits. You must connect either 5V DC or 24V DC based on the option you have purchased.

Assuming a -5V-NC limit configuration, the input to the controller is seen as a logic 0 (typical 0.4V @ 12.8 mA) when no limit condition is present. When the limit switch is activated, a 5V source through a pull-up resistor, on the controller, causes a logic 1 (typically 4.8-5 V) to be seen by the controller input. The limit switch operation for a NO limit configuration is the exact opposite as described above. See Figure 3-6 for a diagram of limit switch wiring. The switch shown in Figure 3-6 is a PNP transistor (NPN for the -24V-NC option).

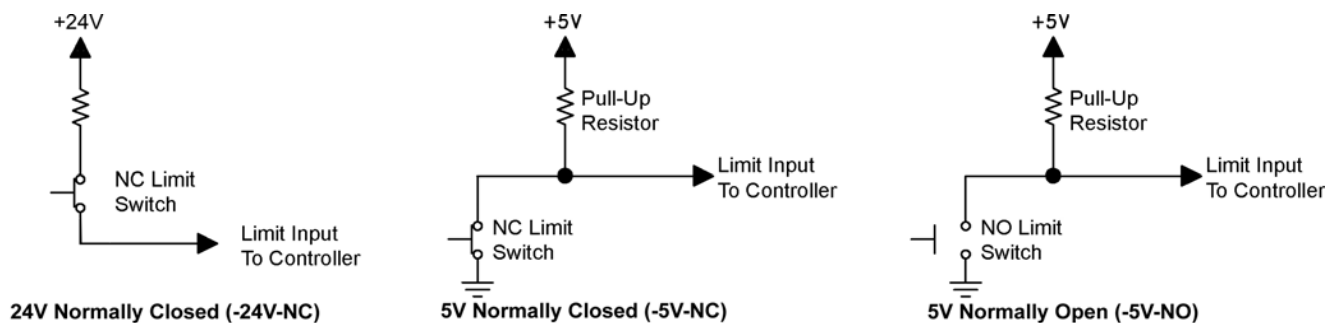


Figure 3-6: Limit Switch Wiring

### 3.6. Standard Motor Wiring

Stages fitted with standard motors and encoders come from the factory completely wired and assembled. For reference, connector pin outputs and general wiring information is given in the following figures. Pin outputs are defined in Table 3-6.

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

**NOTE:** If you are using your own cables to connect the stage, ensure that motor and ground wires can handle current higher than the continuous motor current listed in Table 3-5. The voltage rating of the wire insulation must be greater than the maximum drive output voltage.

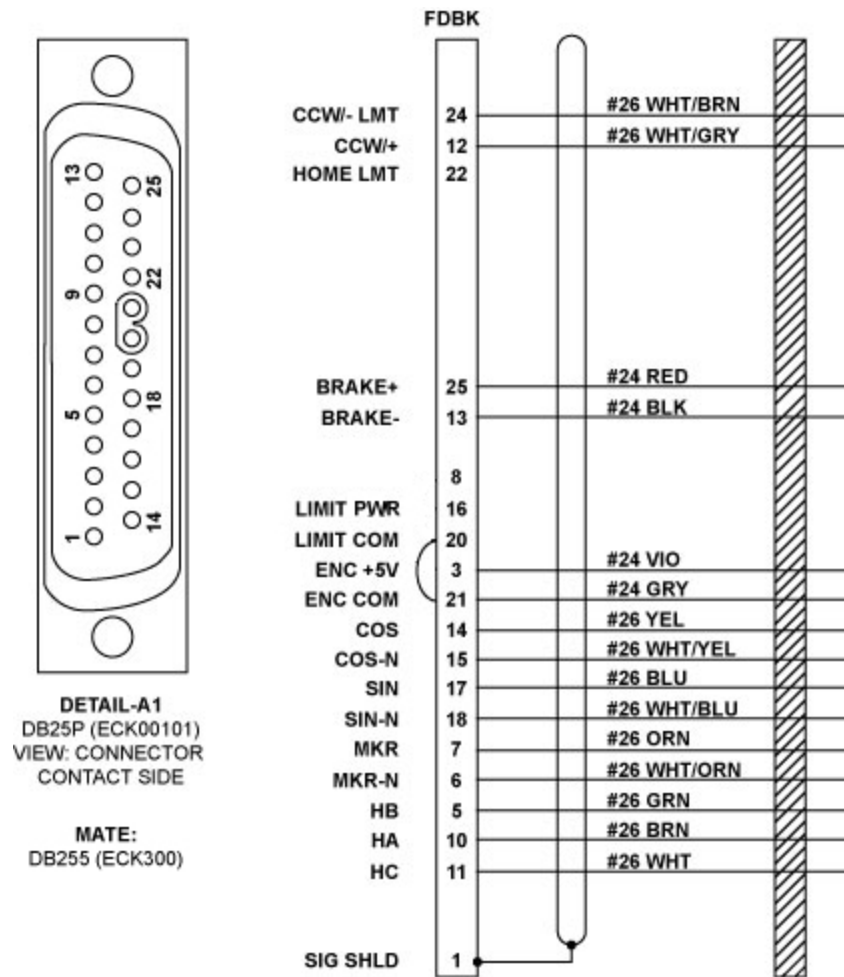


Figure 3-7: Limit, Brake, and Encoder Wiring for Standard PRO115 Stages

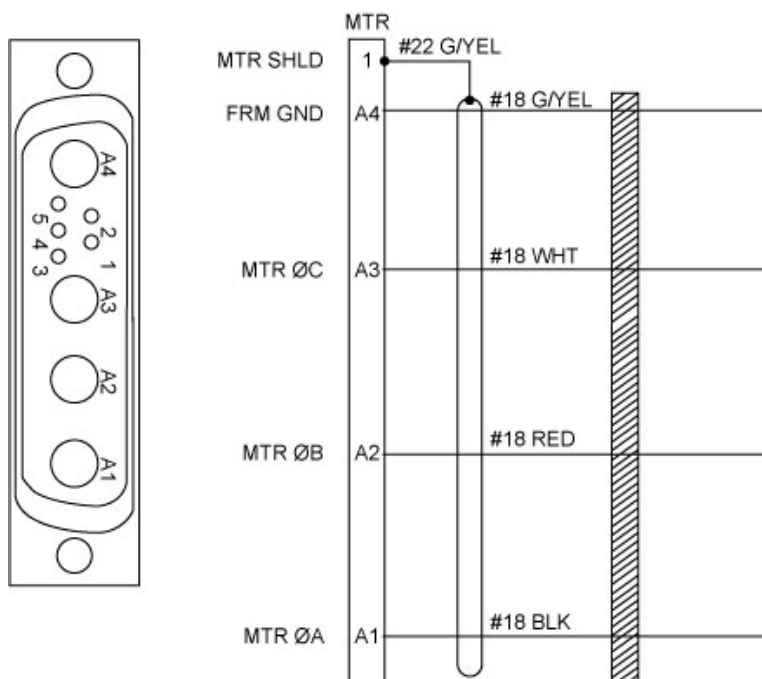


Figure 3-8: Motor Wiring Connector for all PRO115 Stages

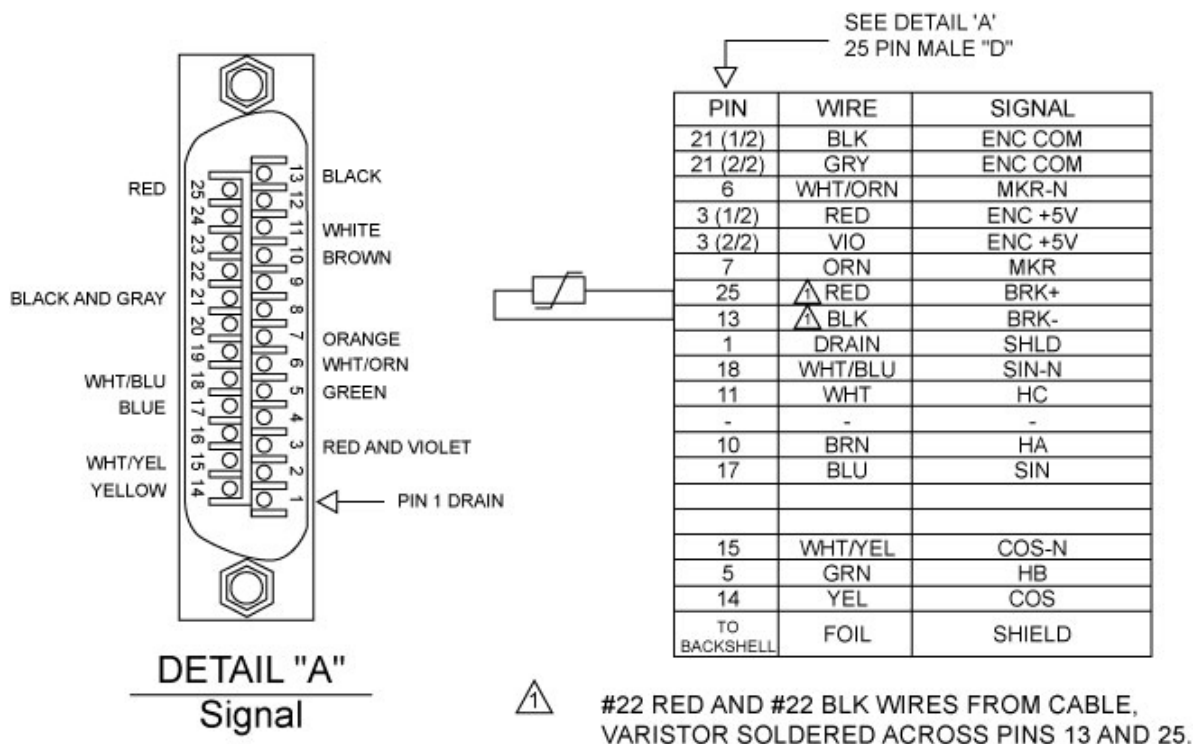


Figure 3-9: Brake and Encoder Connector for Stage with Foldback Options

**Table 3-6: Motor Wiring Pinout Descriptions**

| Pin Output                      | Description                                                                                                                                                    |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Clockwise (CW/+) Limit          | Signal indicating maximum travel produced by CW motor rotation. Normally not used on PRO115 stage with standard limit switch wiring.                           |
| COS                             | Cosine. Incremental encoder output; either TTL line driven or amplified sine wave type signal.                                                                 |
| COS-N                           | Incremental encoder output. Complement of cos.                                                                                                                 |
| Counter-clockwise (CCW/-) Limit | Signal indicating stage maximum travel produced by CCW motor rotation.                                                                                         |
| HOME LMT                        | Home Limit. Paralleled with CCW/- (with Standard Jumper) or CW/+ (Optional Jumper) limit. Typically not used.                                                  |
| ENC +5V                         | +5 V supply input for optical encoders. Typical requirement is 250 mA.                                                                                         |
| ENC COM                         | +5 V return for optical encoders (ground).                                                                                                                     |
| HA                              | Hall Effect A. Brushless motor commutation track output. TTL line driven signal with rotary motor.                                                             |
| HB                              | Hall Effect B. Brushless motor commutation track output. TTL line driven signal with rotary motor.                                                             |
| HC                              | Hall Effect C. Brushless motor commutation track output. TTL line driven signal with rotary motor.                                                             |
| LMT PWR                         | PWR supply input for optical limit switch boards. Typical requirement is 50 mA.                                                                                |
| LMT COM                         | Common ground for limit switch                                                                                                                                 |
| MKR                             | Marker. Incremental encoder output pulse given once per revolution. Typically used for home reference cycle.                                                   |
| MKR-N                           | Incremental encoder output; either the compliment of Marker with a line driven, TTL type encoder or 2.5 V DC bias level with amplified sine wave type encoder. |
| SIN                             | Sine. Incremental encoder output; either TTL line driven or amplified sine wave type signal.                                                                   |
| SIN-N                           | Incremental encoder output. Complement of sin.                                                                                                                 |
| MTR ØA                          | Motor Phase A.                                                                                                                                                 |
| MTR ØB                          | Motor Phase B.                                                                                                                                                 |
| MTR ØC                          | Motor Phase C.                                                                                                                                                 |
| BRAKE +                         | Optional brake +24 VDC, 250 mA                                                                                                                                 |
| BRAKE -                         | Optional brake 24 VDC Common                                                                                                                                   |

### 3.7. Vacuum Operation

Aerotech can specially prepare the PRO115 series stage 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 stages with optimal performance in vacuum applications. This chapter will outline preparation techniques for stages that will operate in a vacuum. Some techniques covered are:

- Lubrication with vacuum-compatible lubricants
- Use of materials, fasteners, and coatings with vacuum outgas performance compatible with the level of vacuum specified
- For high vacuum stages, elimination of situations that may allow gases to become temporarily trapped during pump down
- Extensive cleaning prior to assembly in a clean environment and packaging in a special polyethylene bag

#### 3.7.1. Special Guidelines

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

1. Do not remove the stage from the sealed bag until it is ready for use.
2. Always handle the stage in a clean environment and use powder-free polyethylene gloves to prevent any contaminants from adhering to the surface of the stage.
3. During installation, use cleaned, vented, stainless steel fasteners when securing the stage.
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 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.

## Chapter 4: Maintenance

This chapter will cover information about intervals between lubrications, detail the lubrication and inspection process, and cover which lubricants are recommended for use. Also included is a section on belt tension and adjustment on stages with the foldback option.

**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. Always operate the stage with the hard cover and side seals in place to help keep dirt out..



To minimize the possibility of bodily injury, confirm that all electrical power is disconnected prior to making any mechanical adjustments.

### 4.1. Service and Inspection Schedule

Lubricant inspection and replenishment in PRO115 series stages depends on conditions such as duty cycle, speed, and the environment. An inspection interval of once per month is recommended until a trend develops for the application. Longer or shorter intervals may be required to maintain the film of lubricant on the bearing surfaces. In general, it is recommended that stages operating in a clean environment be lubricated annually, or every 500 km, whichever comes first. For stages operating under conditions involving excessive debris, lubrication every six months is recommended. If the application process uses only a small portion of travel for most of the duty cycle, it is recommended that the stage be periodically driven through full travel to redistribute the lubrication in the bearings and ballscrew. The ballscrew end bearings and motor bearings are sealed, and should not need to be relubricated under normal use.

## 4.2. Cleaning and Lubrication

### 4.2.1. Recommended Cleaning Solvents

For standard ballscrew assemblies and LMG guide rails, THK AFE-CA grease is recommended.

If a solvent is necessary for cleaning the stage, it is recommended that isopropyl alcohol be used. Harsher solvents, such as acetone, may damage the plastic and rubber seals on the ballscrew or LMG trucks. If acetone is required, avoid the screw and bearing seals.

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

### 4.2.2. Important Notes on Lubrication

When cleaning and/or lubricating components of the PRO115 series stages:

1. Be sure to use a clean, dry, soft, lint-free cloth for cleaning.
2. Take the opportunity during the lubrication procedure to inspect the linear motion guides for any damage or signs of wear.
3. In applications that have multiple stages bolted together to form multiaxis 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.
4. Further disassembly of the stage is not recommended because proper assembly and calibration can only be done at the factory. In addition, a laser interferometer is required for post assembly verification to maintain warranties.

### 4.2.3. Lubrication and Cleaning Process

The lubrication and cleaning process is outlined in the steps that follow. Before beginning lubrication, see Section 4.2.1. for recommended lubricants.

1. Drive the stage table to one end of travel (Figure 4-1) and remove power to the stage.
2. Remove the screws on the edges of the hard cover (Figure 4-2) and slide it out from the side opposite of the motor (Figure 4-3). 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 ballscrew. Use a clean, lint-free cloth with a side-to-side motion. Manually turn the ballscrew to clean its entire circumference. A swab soaked in Isopropyl Alcohol may be used to remove stubborn debris.
5. Clean the end of the ballscrew 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 ballscrew 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 ballscrew 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.
11. Restore power to the stage; drive the stage table back to its original position to redistribute lubricants.



To minimize the possibility of bodily injury, confirm that all electrical power is disconnected prior to making any mechanical adjustments.

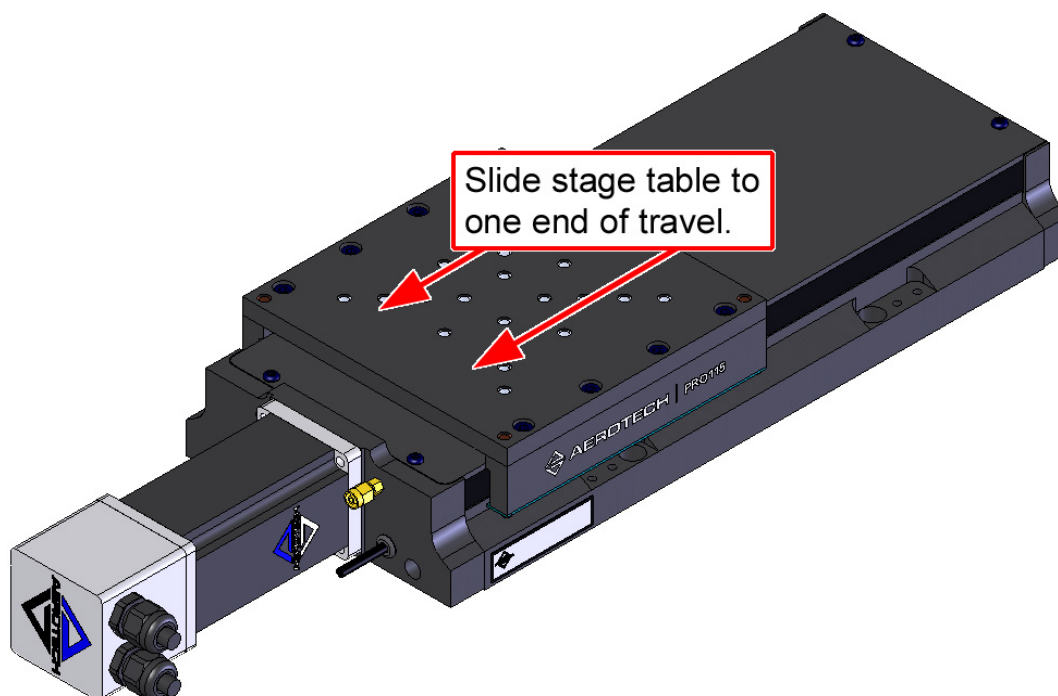


Figure 4-1: Hardcover Removal Procedure (Step 1)

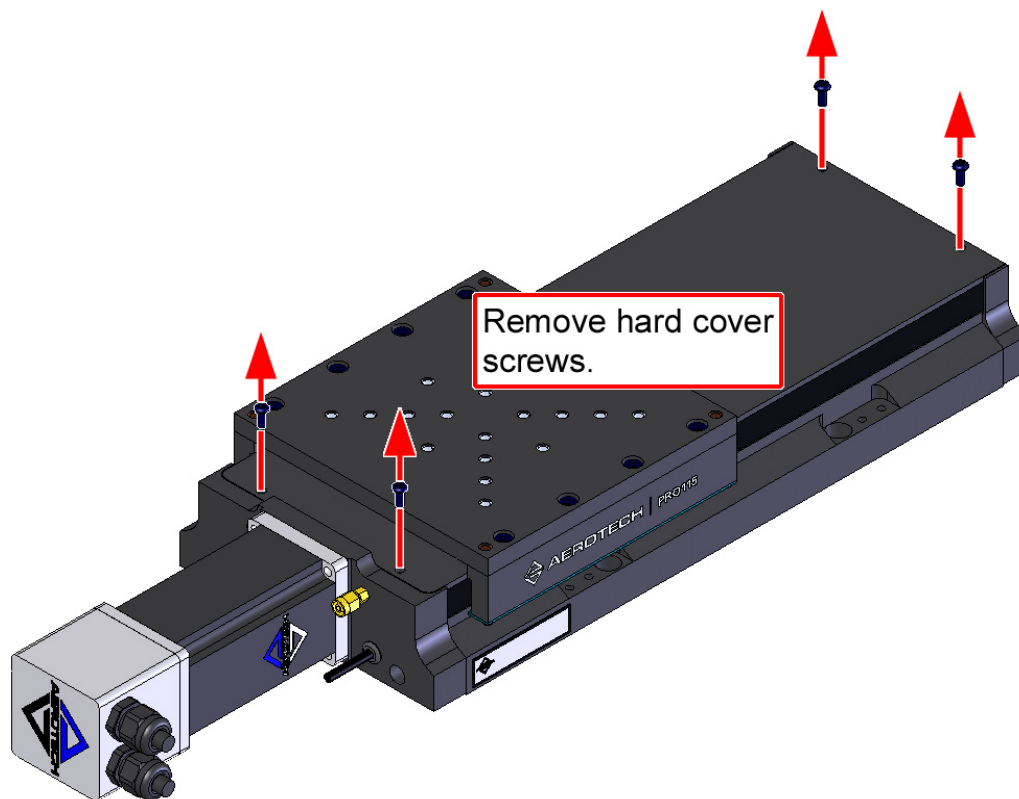


Figure 4-2: Hardcover Removal Procedure (Step 2)

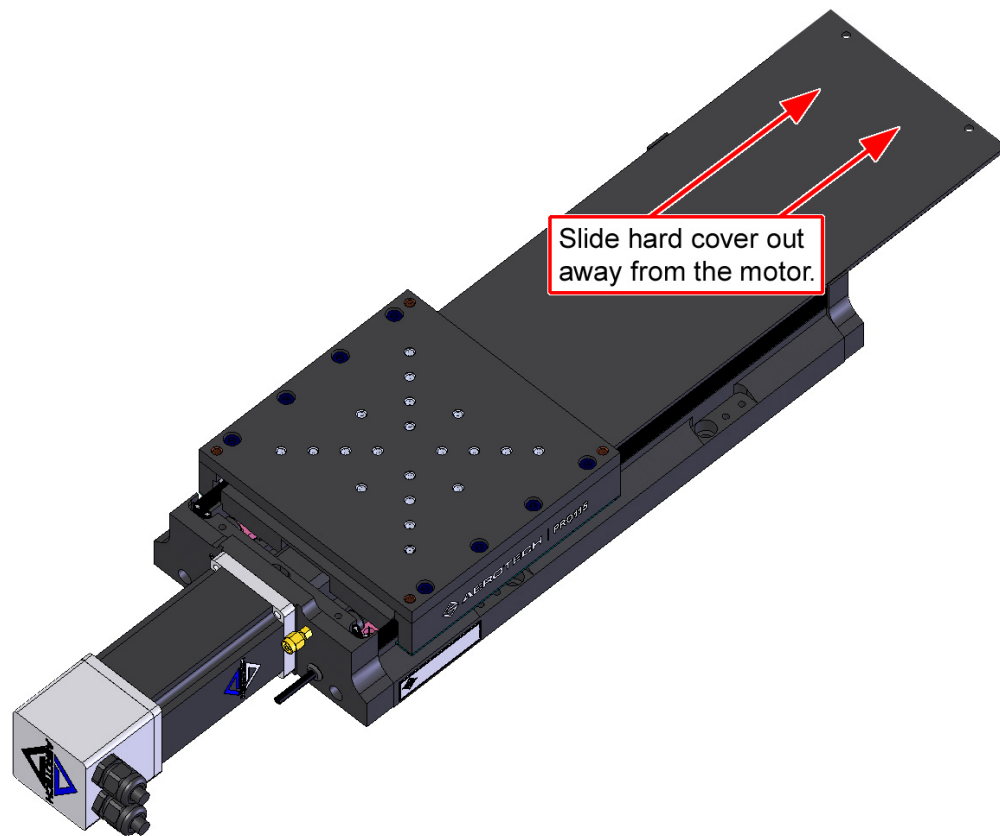


Figure 4-3: Hardcover Removal Procedure (Step 3)

### 4.3. Belt Adjustment

This section applies only to stages equipped with foldback motor options. On foldback stages, the motor torque is transferred to the ballscrew via a timing belt. Belt tension is critical to stage performance and accuracy.

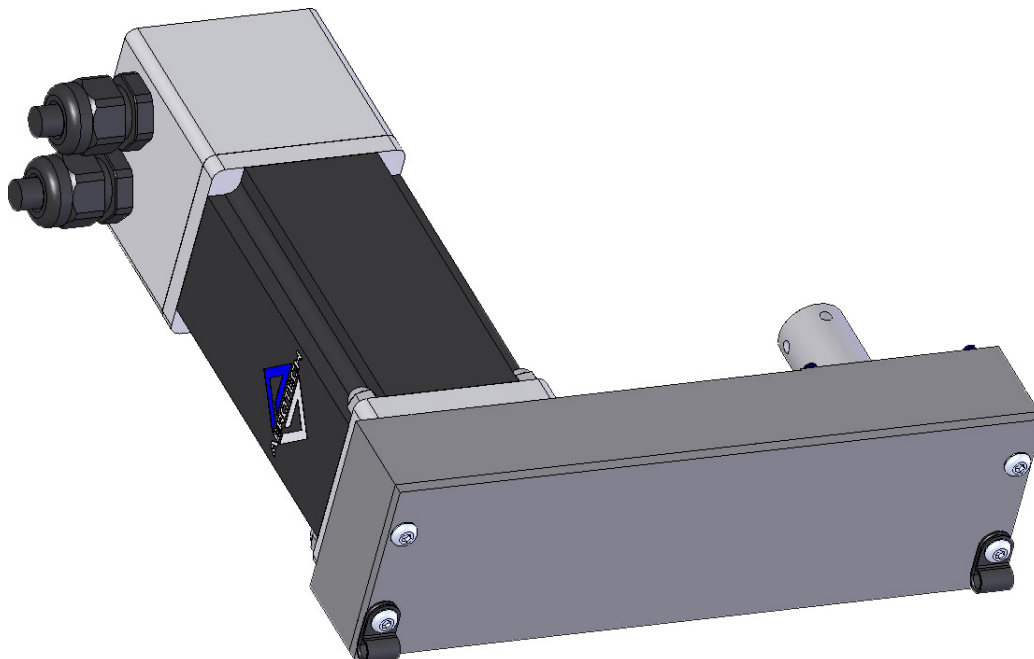


Figure 4-4: Foldback Motor Option Example

When lubricating and cleaning the stage, it is recommended that belt tension be checked. Deflection in the belt should be less than 5 mm when applying a downward force directly between the pulleys (Figure 4-5) of approximately 5 N. If deflection exceeds this range, the belt tension should be adjusted. The method of adjustment is outlined below.

1. Remove power to the stage.
2. Remove the four mounting screws for the foldback cover (Figure 4-5).
3. Check the tension in the belt to determine if adjustment is necessary.
4. If adjustment is required, loosen (but do not remove) the four motor mounting screws (Figure 4-5).
5. The motor mounting holes are slotted to allow for belt adjustment (Figure 4-6). With all four screws loose, pull the motor away from the stage by hand until achieving the necessary belt tension.
6. Tighten motor mounting screws and re-check the tension in the belt. Belt tension may change after the mounting screws are tightened, so if necessary repeat step 5 until desired tension is reached.
7. While adjusting tension, it is advisable to verify that the pulleys are tight on their respective shafts. Each pulley is held in position with two set screws (Figure 4-6). If a pulley is loose, it may be necessary to tighten one or both of these screws.
8. Once tension adjustment is complete, replace the foldback cover and mounting screws. Restore power to the stage.

**NOTE:** If the stage has been calibrated (HALAR), note the orientation of the two pulleys within regard to each other or recalibration might be required.

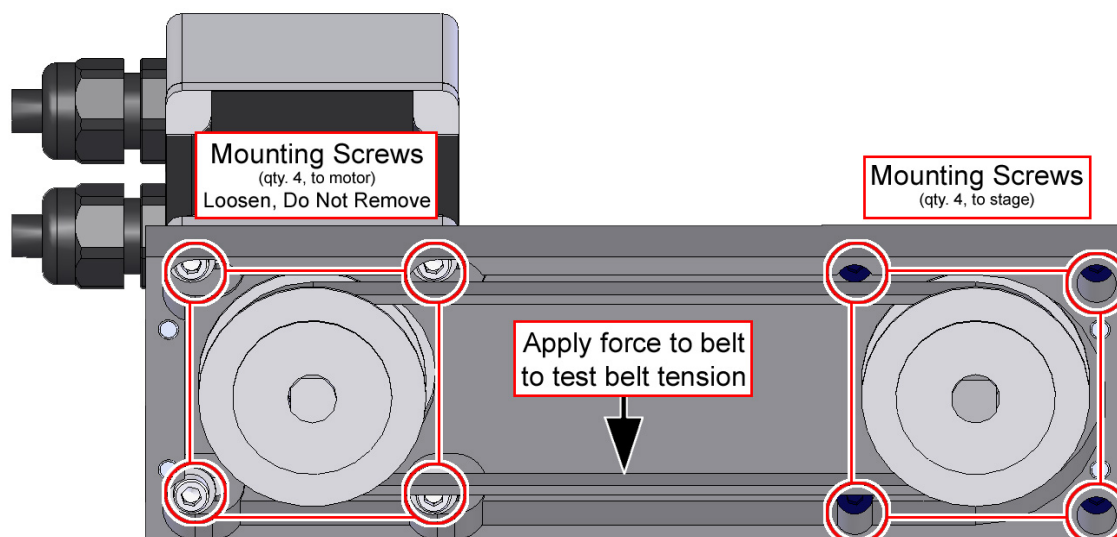


Figure 4-5: Belt Access and Adjustment on Foldback Models (Mounting Screws)

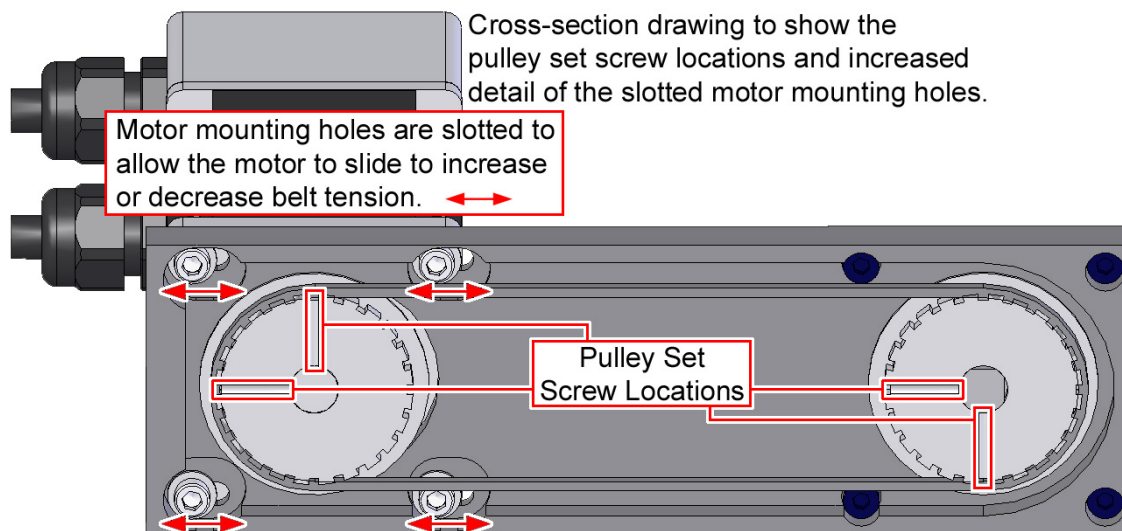


Figure 4-6: Belt Access and Adjustment on Foldback Models (Pulley Set Screws)



## Appendix A: Warranty and Field Service

Aerotech, Inc. warrants its products to be free from 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, where 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 or 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.

Aerotech, Inc. warrants its laser products to the original purchaser for a minimum period of one year from date of shipment. This warranty covers defects in workmanship and material and is voided for all laser power supplies, plasma tubes and laser systems subject to electrical or physical abuse, tampering (such as opening the housing or removal of the serial tag) or improper operation as determined by Aerotech. This warranty is also voided for failure to comply with Aerotech's return procedures.

### ***Laser Products***

Claims for shipment damage (evident or concealed) must be filed with the carrier by the buyer. Aerotech must be notified within (30) days of shipment of incorrect materials. 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. Any returned product(s) must be accompanied by a return authorization number. The return authorization number may be obtained by calling an Aerotech service center. 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 (30) days after the issuance of a return authorization number will be subject to review.

### ***Return Procedure***

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 airfreight return, the product(s) will be shipped collect. Warranty repairs do not extend the original warranty period.

### ***Returned Product Warranty Determination***

After Aerotech's examination, 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 (30) days of notification will result in the product(s) being returned as is, at the buyer's expense. Repair work is warranted for (90) days from date of shipment. Replacement components are warranted for one year from date of shipment.

### ***Returned Product Non-warranty Determination***

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.

### ***Rush Service***

**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 service 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.

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## Appendix B: Technical Changes

Table B-1: Current Changes (1.05.00)

| Section(s) Affected | General Information                                   |
|---------------------|-------------------------------------------------------|
| Section 3.5.2.      | Added statement about transistor type of limit switch |

**Table B-2: Archived Changes**

| Revision | Section(s) Affected                                                                                   | General Information                                                                                              |
|----------|-------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|
| 1.04.00  | Section 1.2.                                                                                          | Added Tabletop dimensions                                                                                        |
| 1.04.00  | Section 3.3.                                                                                          | Added Motor specifications                                                                                       |
| 1.04.00  | Section 1.1.3.                                                                                        | Added new Foldback kit option                                                                                    |
| 1.04.00  | Section 1.4.                                                                                          | Added Section                                                                                                    |
| 1.04.00  | Section 3.1.                                                                                          | Added Section                                                                                                    |
| 1.04.00  | Chapter 2: Installation, Section 2.1. , Section 2.3. , Section 2.5. , Section 3.6. , and Section 1.3. | Added Safety Information and Warnings                                                                            |
| 1.03.00  | Section 3.3.                                                                                          | Added Maximum Speed and Maximum Acceleration, removed Maximum Screw Speed, and updated Stage Mass specifications |
| 1.02.00  | Section 1.1.2.                                                                                        | Added Toe Clamp Accessory section                                                                                |
| 1.01.00  | Section 1.2.                                                                                          | Dimensions section added                                                                                         |
| 1.01.00  | Section 1.1.3.                                                                                        | -NC limit option is now -5V-NC and -NO limit option is now -5V-NO                                                |
| 1.01.00  | Multiple                                                                                              | Added -24V-NC limit option                                                                                       |
| 1.01.00  | Multiple                                                                                              | Added -TTAGR tabletop option                                                                                     |
| 1.01.00  | Section 1.1.3.                                                                                        | Added new motor and foldback options                                                                             |
| 1.00.00  | --                                                                                                    | New Manual                                                                                                       |

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# Reader's Comments

**PRO115 Series Stage Manual**

**P/N: EDS123, March 25, 2011**

**Revision 1.05.00**

Please answer the questions below and add any suggestions for improving this document.



| Is the manual:          | Yes | No |
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| Well organized          |     |    |
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|                             | Stage/Product Details |  | Name         |  |
|-----------------------------|-----------------------|--|--------------|--|
| <b>Model #</b>              |                       |  | Title        |  |
| <b>Serial #</b>             |                       |  | Company Name |  |
| Date Shipped                |                       |  | Address      |  |
| Customer Order #            |                       |  |              |  |
| Aerotech Subsidiary Order # |                       |  | Email        |  |

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