ACS and ACS LP Series
Rotary Stages User's Manual

P/N: EDS103 (Revision 1.03.00)

Dedicated to the Science of Motion
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Chapter 1: Overview

Aerotech's ACS and ACS LP series rotary stages with integrated ER collet chuck or 3-jaw gripper configuration provide automated material handling capability for a wide range of materials and applications.

This manual describes Aerotech's ACS and ACS LP series direct drive rotary positioning stages.

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

1.1. Standard Features

All ACS and ACS LP stages come standard with a direct drive brushless motor. An integral non-contact rotary union is standard on the ACS-100, ACS-100LP, ACS-150, and ACS-150LP stages. These features combine to create a low friction, low maintenance rotary stage capable of high accelerations and low positioning error. With a non-contact rotary union, there are no seals to be replaced or lubricated allowing for a lifetime of maintenance free performance. The brushless, slotless motor design is useful for applications requiring good velocity control, as it allows for smooth rotation without the presence of a torque ripple. There are no brushes to wear, no belts to tension, and no gears to wear resulting in a completely maintenance-free motor.

All ACS LP stages come standard with ER collet chucking.

1.1.1. ACS Optional Features

The ACS series stages can be equipped with an integrated ER collet chuck or a three-jaw gripper chuck. See Table 1-1 for more information regarding available options for each stage.

Both the ACS-100 and ACS-150 have available ER collet chucks. Collets are available from machine-tool component suppliers in sizes that support tube diameters from 0.5 mm to 30 mm. The collet is retained with a threaded collet nut enabling quick-changeover. It is configured in a “fail-safe” normally-closed mode where full clamping force is applied when no air pressure is present. The ACS-100 accepts an ER8 collet capable of holding tube diameters from 0.5 mm to 5.0 mm. The ACS-150 can be configured to accept either ER25 or ER40 series collets. Aerotech recommends using an ER25 collet for holding requirements of 1 mm to 16 mm and using an ER40 collet for holding requirements of 15.5 mm to 30 mm. The ER25 also has an optional sealed “water-jacket” configuration that can be used for fluid delivery in wet laser cutting applications.

NOTE: While the ER40 collet can support tubes up to 30 mm in diameter, tubes greater than 24.5 mm in diameter cannot extend more than 70 mm below the top of the collet.

Both the ACS-150 and ACS-200 support three-jaw grippers with clear apertures for product feed-through. All gripper assemblies are configurable as either normally-open or normally-closed with various jaw strokes to support a wide range of material sizes. The gripper can be fitted with custom jaws for the handling of materials with non-round profiles such as square or hexagonal bar stock. The normally-open and normally-closed options also provide the ability to grip either the O.D. or I.D. of the material.

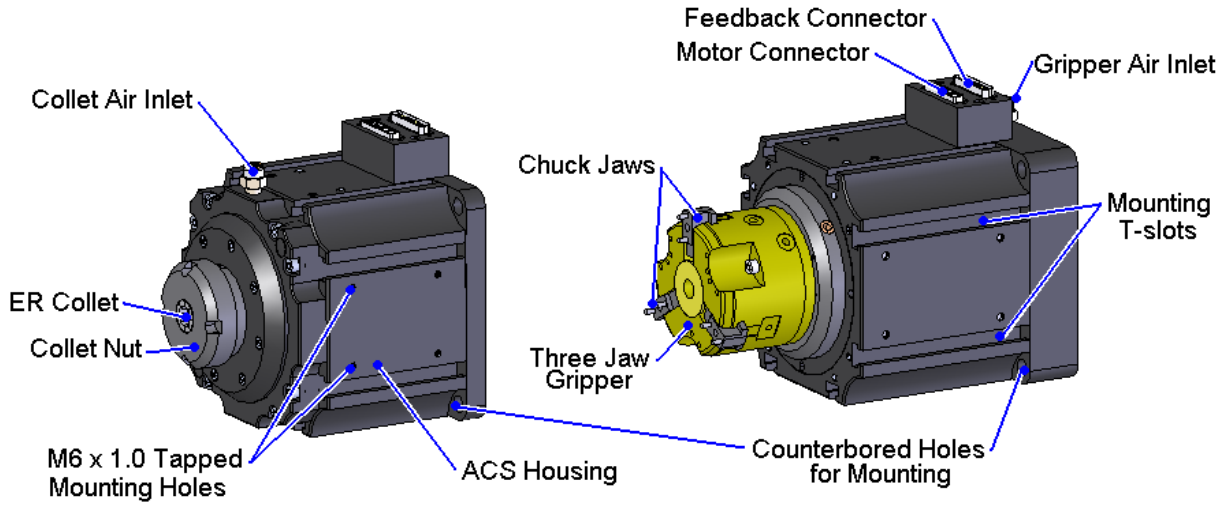


Figure 1-1: ACS-150 Rotary Stage with ER Collet and Three-Jaw Gripper

1.1.2. Model Numbers

The stage model number indicates the optional features on a particular stage. To determine the options on your stage, refer to Table 1-1 for an explanation of the ACS numbering system and Table 1-2 for an explanation of the ACS LP numbering system.

Example: ACS-150-115-3J-12-AS-NC-10-NS

This designates an ACS and ACS LP-150 stage with 150 mm direct drive motor, 1 Vpp amplified sine position transducer, normally closed 10 mm stroke three-jaw gripper, and no rear seal.

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.

Table 1-1: ACS Model Numbering System

ACS Series Direct Drive Rotary Stage	
ACS	Direct-drive rotary stage with integral pneumatic collet chuck or 3-jaw gripper and rotary union.
Frame Size	
-100-85	100 mm diameter direct drive rotary stage with 0.4 N-m continuous torque and integral rotary union
-100-135	100 mm diameter direct drive rotary stage with 1.9 N-m continuous torque and integral rotary union
-150-115	150 mm diameter direct drive rotary stage with 3.6 N-m continuous torque and integral rotary union
-150-135	150 mm diameter direct drive rotary stage with 6.5 N-m continuous torque and integral rotary union
-150-185	150 mm diameter direct drive rotary stage with 11.4 N-m continuous torque and integral rotary union
-200-155	200 mm diameter direct drive rotary stage with 16.9 N-m continuous torque and integral rotary union
-200-285	200 mm diameter direct drive rotary stage with 24.9 N-m continuous torque and integral rotary union
Fixture Type	
-ER8	Air-actuated ER8 collet holder, normally closed, supports tube diameters from 0.5 mm to 5 mm; only available on ACS-100-XXX
-ER25	Air-actuated ER25 collet holder, normally closed, supports tube diameters from 1 mm to 16 mm; only available on ACS-150-XXX
-ER40	Air-actuated ER40 collet holder, normally closed, supports tube diameters from 15.5 mm to 30 mm; only available on ACS-150-XXX
-3J-12	Air-actuated 3-jaw gripper with 12 mm clear aperture, ±20 micron repeatability; available on ACS-150 and ACS-200
-3J-25	Air-actuated 3-jaw gripper with 25 mm clear aperture, ±20 micron repeatability; only available on ACS-200

Table 1-1: Model Numbering System (continued)

Position Transducer(1)	
-AS	1 Vpp sine wave output; 360 arc-sec resolution on ACS-150 and 240 arc-sec resolution on ACS-200
-X5	Square wave digital output; 18 arc-sec resolution on ACS-150 and 12 arc-sec resolution on ACS-200
-X10	Square wave digital output; 9 arc-sec resolution on ACS-150 and 6 arc-sec resolution on ACS-200
-X25	Square wave digital output; 3.6 arc-sec resolution on ACS-150 and 2.4 arc-sec resolution on ACS-200
-X50	Square wave digital output; 1.8 arc-sec resolution on ACS-150 and 1.2 arc-sec resolution on ACS-200
Gripper Options(2)	
-NC-10	Normally closed 3J-12 gripper with 10 mm jaw stroke, 240 N (52 lb) peak grip force
-NO-10	Normally open 3J-12 gripper with 10 mm jaw stroke, 240 N (52 lb) peak grip force
-NC-13	Normally closed 3J-25 gripper with 13 mm jaw stroke, 450 N (102 lb) peak grip force
-NO-13	Normally open 3J-25 gripper with 13 mm jaw stroke, 450 N (102 lb) peak grip force
-NC-16	Normally closed 3J-12 gripper with 16 mm jaw stroke, 150 N (33 lb) peak grip force
-NO-16	Normally open 3J-12 gripper with 16 mm jaw stroke, 150 N (33 lb) peak grip force
-NC-20	Normally closed 3J-25 gripper with 20 mm jaw stroke, 270 N (60 lb) peak grip force
-NO-20	Normally open 3J-25 gripper with 20 mm jaw stroke, 270 N (60 lb) peak grip force
ER Collet Seal Options	
-NS	No rear seal (standard)
-S	Rear shaft seal
-W	Water jacket assembly for wet cutting applications; seal diameter specified with Water Jacket Seal option; only available with ER25 collet configuration.
ER Collet Size	
-XX-YYMM	Electro-polished DIN6499AA ER style collet; supports tube diameters from XX to YY mm
Water Jacket Seal	
-X.XXMM	Water jacket seal assembly for nominal tube diameter X.XX mm; consult factory for available sizes
Tooling	
-WRENCH	Spanner wrench set for changing ER collet
Air Purge	
-AP	Air purge fitting to positive pressurize ACS stage to limit ingress of airborne particulates
Connector options for ACS-100	
-HPD	4 pin D-style motor power and 25 pin D-style feedback
-25D	25 pin D-style motor power and 25 pin D-style feedback

(1) Digital output encoder signals are synthesized with a 16 MHz clock. Care must be taken to ensure that the encoder sample rate on the controller is at least 16 MHz or higher. Slower clock rates are available on request.

(2) Available only with 3-jaw gripper option.

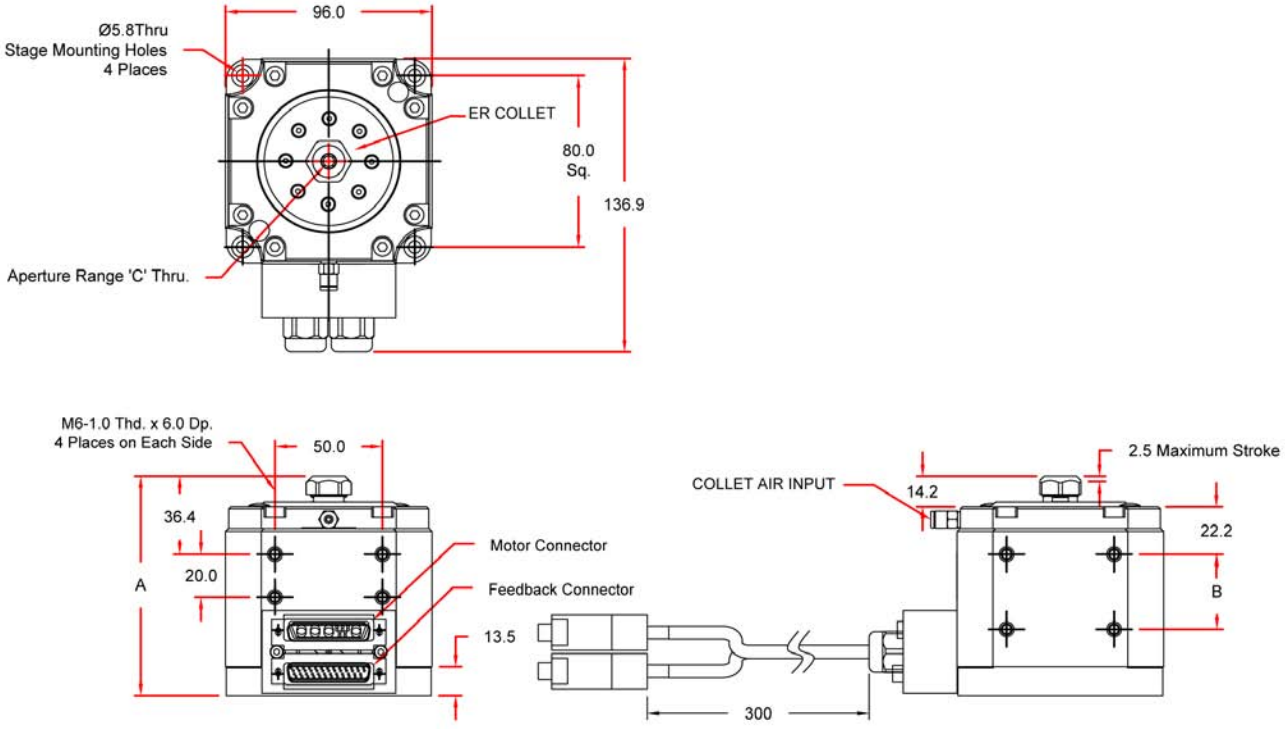
Table 1-2: ACS LP Model Numbering System

ACS LP Series Direct Drive Rotary Stage	
ACS	Direct-drive rotary stage with integral pneumatic collet chuck Frame Size and Fixture Type
Frame Size and Fixture Type	
-100LP	100 mm wide direct-drive rotary stage with 1.8 N-m peak torque output and integral rotary union, air-actuated ER8(1) collet holder, normally closed, supports tube diameters from 0.7 mm to 5 mm
-150LP	150 mm wide direct-drive rotary stage with 11.7 N-m peak torque output and integral rotary union, air-actuated ER25(1) collet holder, normally closed, supports tube diameters from 1 mm to 16 mm
-200LP	200 mm wide direct-drive rotary stage with 30 N-m peak torque output and integral rotary union, air-actuated ER40(1) collet holder, normally closed, supports tube diameters from 16 mm to 30 mm. Tubes with a diameter greater than 24.5 mm cannot extend more than 70 mm below the top of the collet.
Winding Options	
-A	Standard motor winding
-B	Optional motor winding (consult Aerotech for availability)
Position Transducer	
-AS	Standard feedback device; 1 Vpp sine wave output; 360 arc-sec resolution on ACS-100LP and 240 arc-sec on ACS-150/200LP
-X5(2)	Square wave digital output; 18 arc-sec resolution on ACS-100LP and 6 arc-sec resolution on ACS-150/200LP
-X10(2)	Square wave digital output; 9 arc-sec resolution on ACS-100LP and 3 arc-sec resolution on ACS-150/200LP
-X25(2)	Square wave digital output; 3.6 arc-sec resolution on ACS-100LP and 2.4 arc-sec resolution on ACS-150/200LP
-X50(2)	Square wave digital output; 1.8 arc-sec resolution on ACS-100LP and 1.2 arc-sec resolution on ACS-150/200LP
Construction Options	
-WRENCH SET	Spanner wrench for changing ER collets
-XMM	DIN6499 AA collet. Consult factory for available sizes

(1) Collet holder requires dry (0°C dewpoint), oil-less, filtered air (0.25 micron) or 99.99% pure filtered nitrogen (0.25 micron).

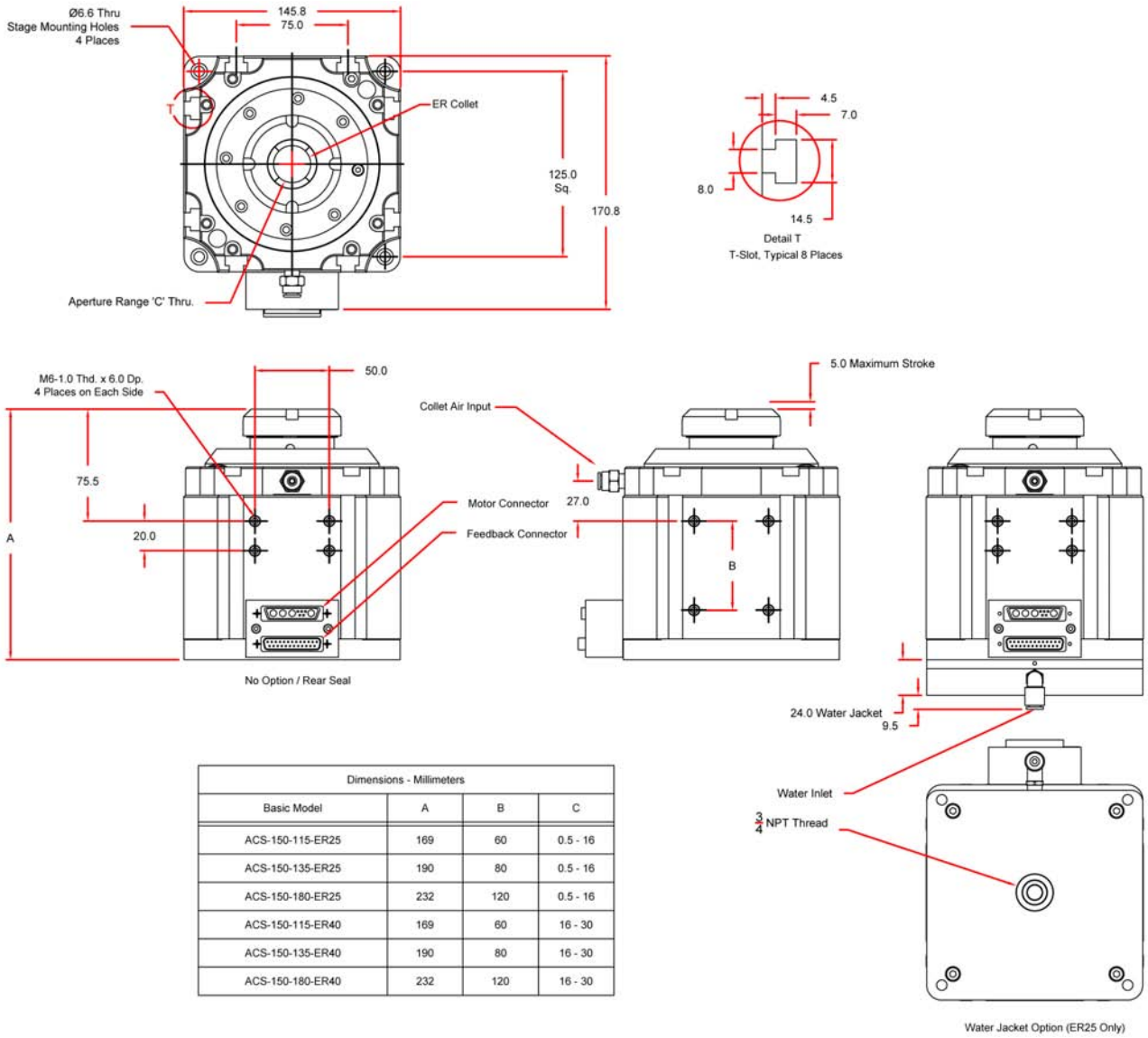
(2) Requires a controller with a 16 MHz encoder sample rate.

1.2. Dimensions



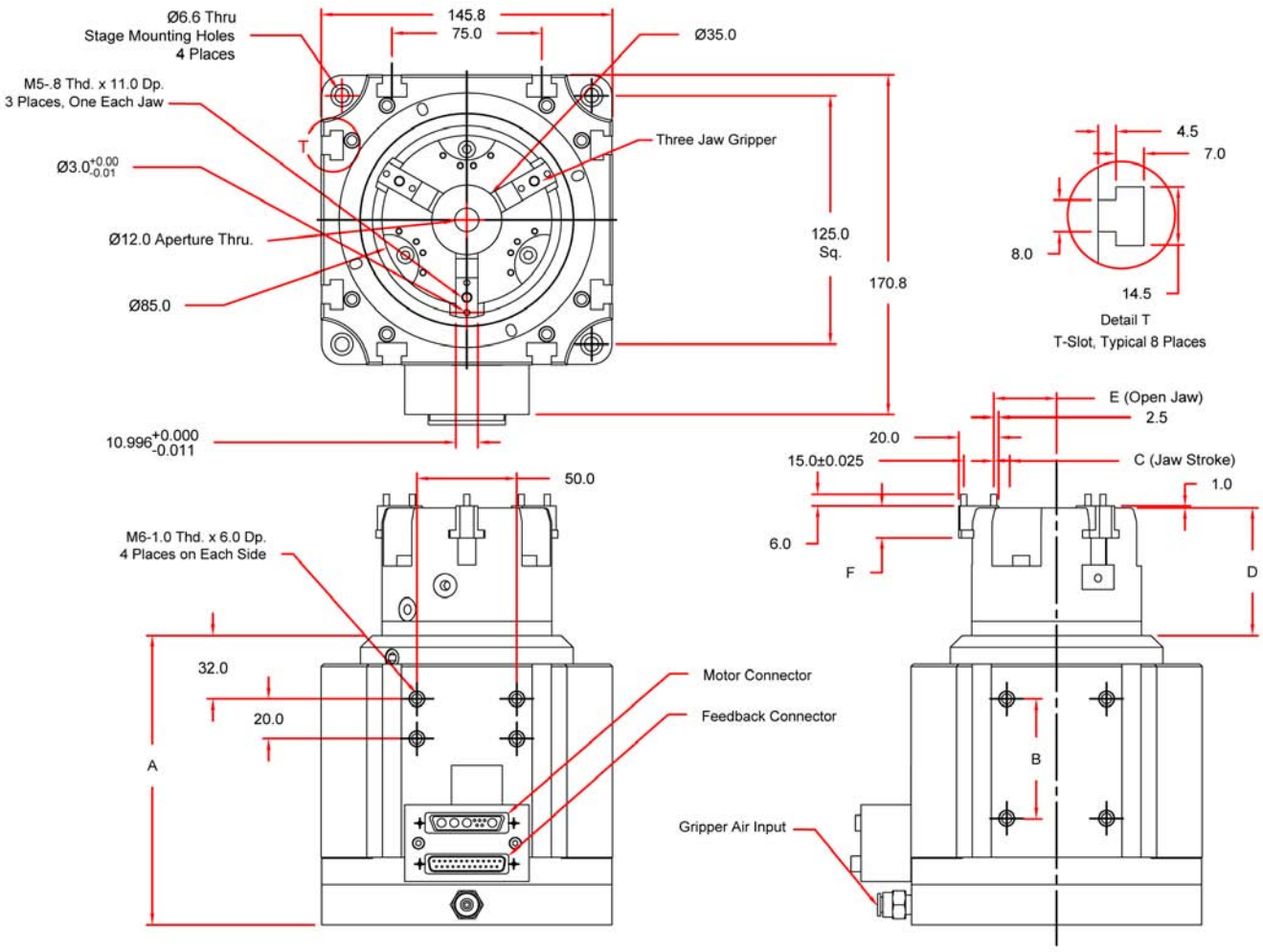
Dimensions - Millimeters			
Basic Model	A	B	C
ACS-100-85-ER8	102.4	35	0.7 - 5
ACS-100-135-ER8	152.4	85	0.7 - 5

Figure 1-2: ACS-100 Dimensions



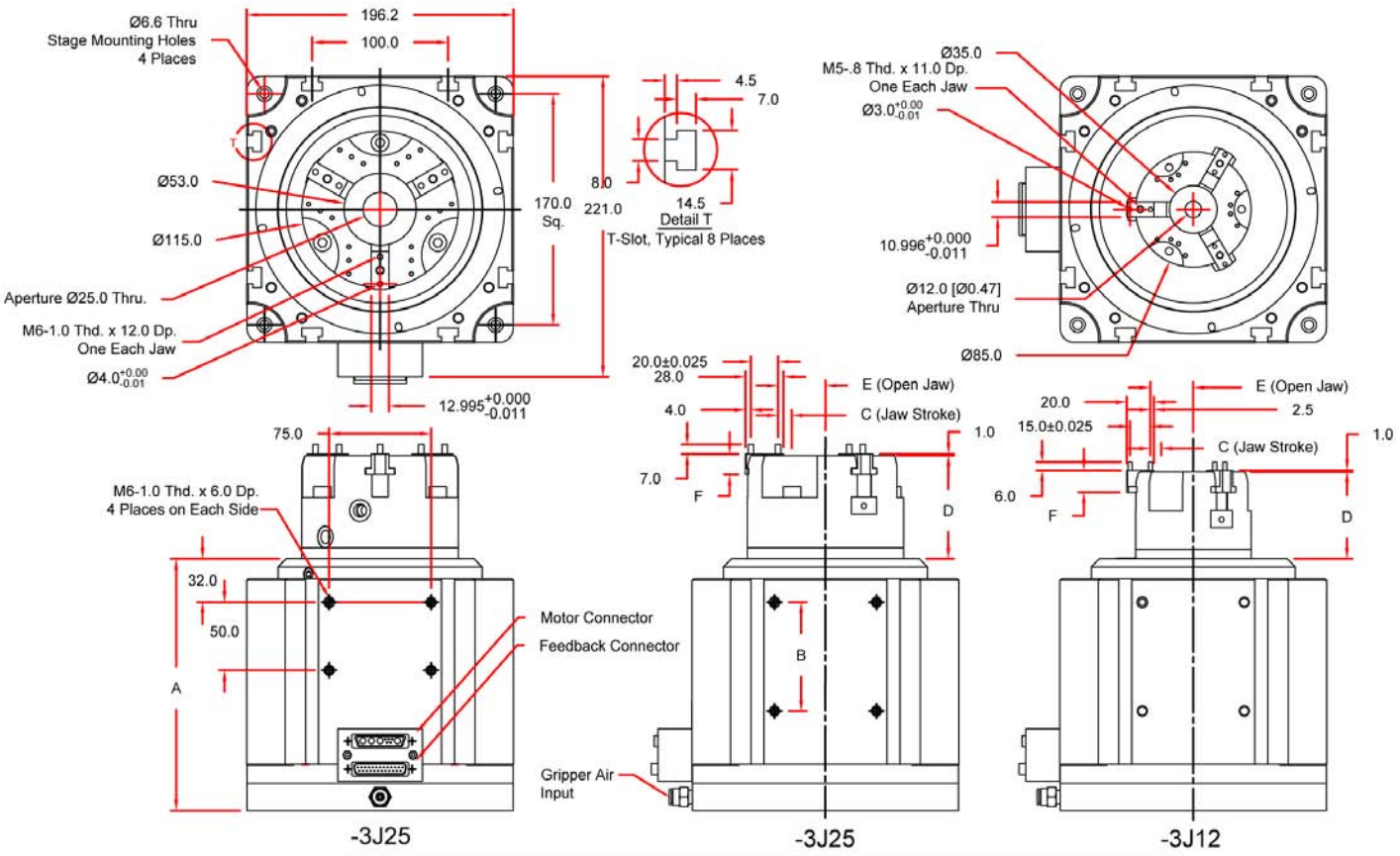
Dimensions - Millimeters			
Basic Model	A	B	C
ACS-150-115-ER25	169	60	0.5 - 16
ACS-150-135-ER25	190	80	0.5 - 16
ACS-150-180-ER25	232	120	0.5 - 16
ACS-150-115-ER40	169	60	16 - 30
ACS-150-135-ER40	190	80	16 - 30
ACS-150-180-ER40	232	120	16 - 30

Figure 1-3: ACS-150-ER Dimensions



Dimensions - Millimeters						
Basic Model	A	B	C	D	E	F
ACS-150-115-3J12-10	145.5	60	5	65	25.5	16
ACS-150-135-3J12-10	166.5	80	5	65	25.5	16
ACS-150-180-3J12-10	208.5	120	5	65	25.5	16
ACS-150-115-3J12-16	145.5	60	8	69	31.5	20
ACS-150-134-3J12-16	166.5	80	8	69	31.5	20
ACS-150-180-3J12-16	208.5	120	8	69	31.5	20

Figure 1-4: ACS-150-3J Dimensions



Dimensions - Millimeters						
Base Model	A	B	C	D	E	F
ACS-200-155-3J12-10	185.3	80	5	65	25.5	16
ACS-200-155-3J12-16	185.3	80	8	69	31.5	20
ACS-200-155-3J25-13	185.3	80	6.5	76	37.5	15
ACS-200-155-3J25-20	185.3	80	10	81	44.5	20
ACS-200-185-3J12-10	210.3	100	5	65	25.5	16
ACS-200-185-3J12-16	210.3	100	8	69	31.5	20
ACS-200-185-3J25-13	210.3	100	6.5	76	37.5	15
ACS-200-185-3J25-20	210.3	100	10	81	44.5	20

Figure 1-5: ACS-200-3J Dimensions

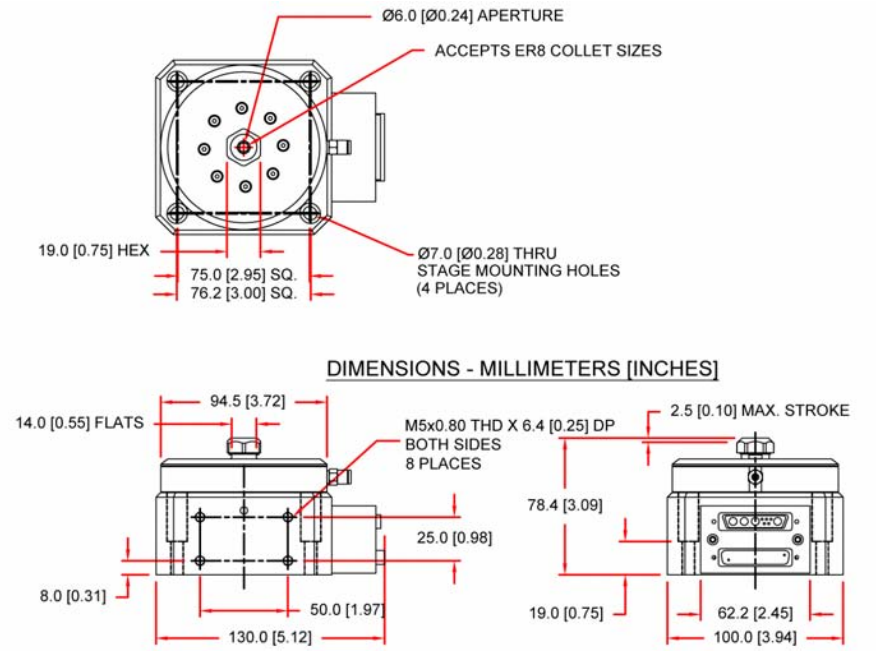


Figure 1-6: ACS-100LP Dimensions

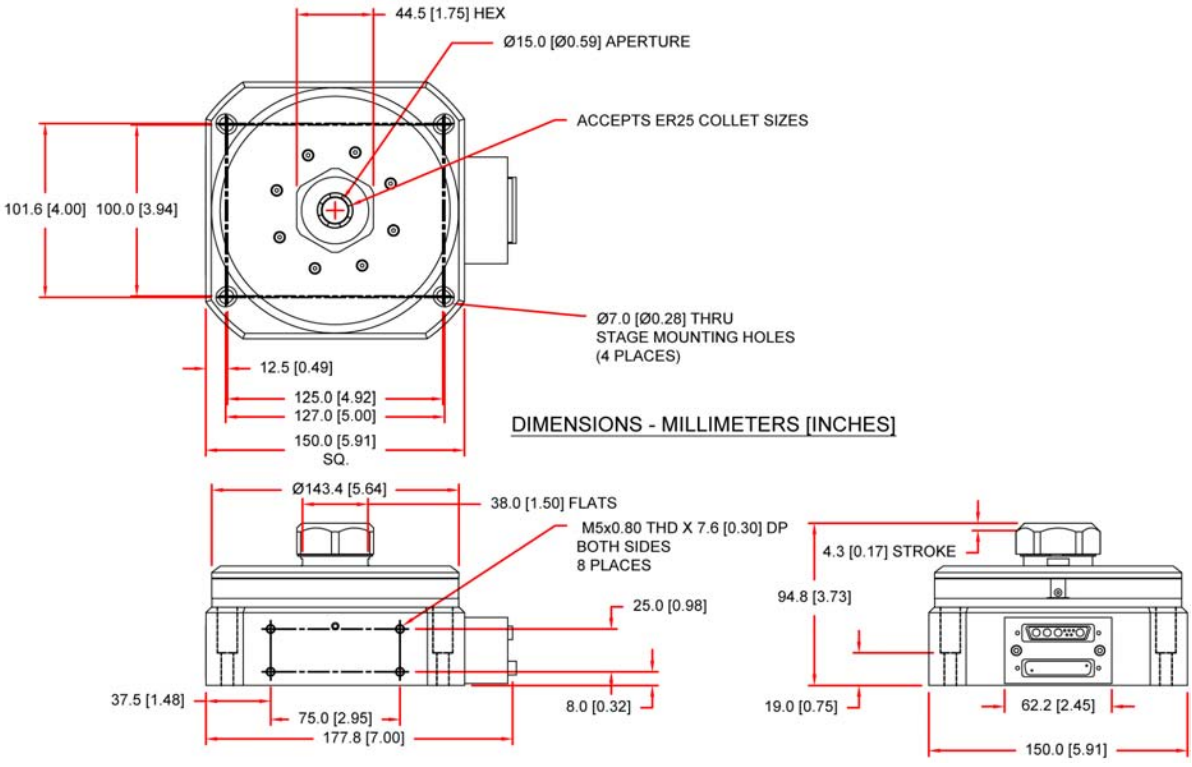


Figure 1-7: ACS-150LP Dimensions

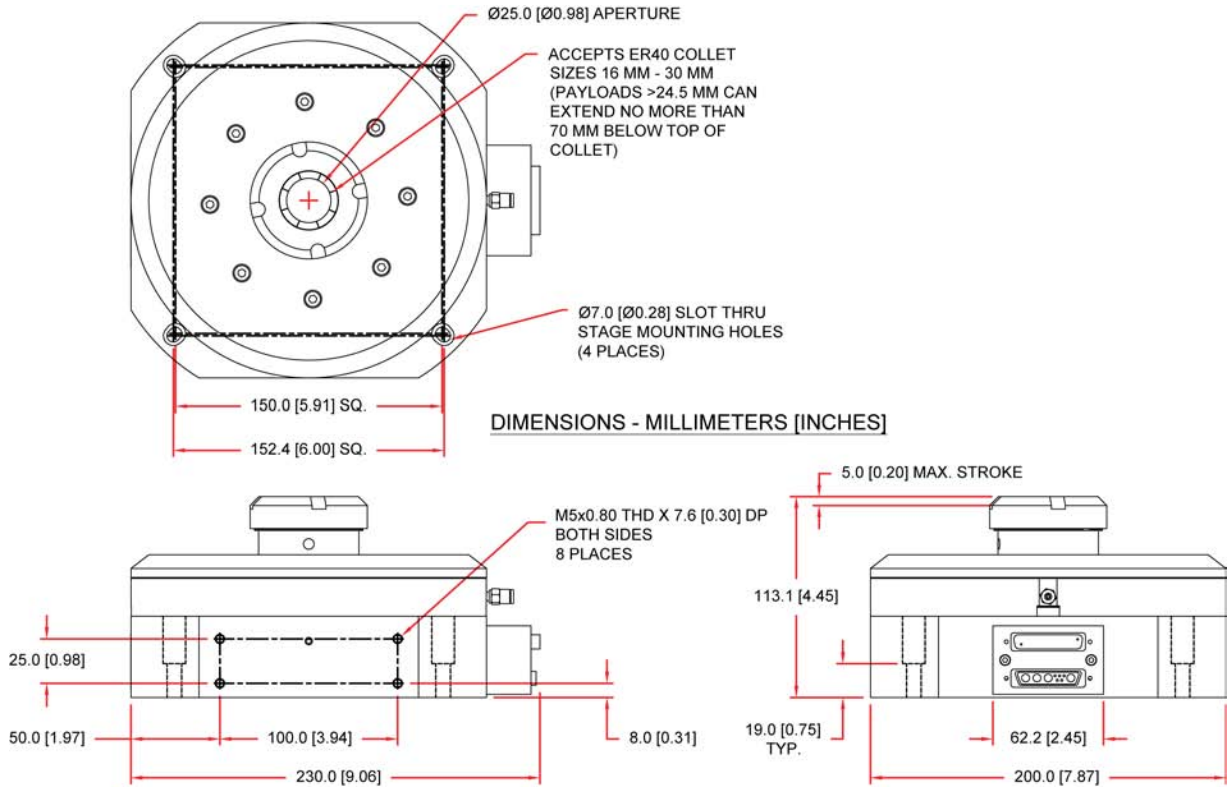


Figure 1-8: ACS-200LP Dimensions

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.

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.

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

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

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

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.

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

1.4. EC Declaration of Incorporation

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

herewith declares that the product:
Aerotech, Inc. ACS and ACS LP 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 - Par 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
Address: AEROTECH GmbH
Süd-West-Park 90
D-90449 Nürnberg

Name: Alex Weibel /
Position: Engineer Verifying Compliance
Location: Pittsburgh, PA
Date: April 5, 2011

Chapter 2: Installation

This chapter describes the installation procedure for the ACS and ACS LP stages, 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 instruction 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. Use compressed nitrogen or clean, dry air to remove any dust or debris that has collected during shipping.

Before operating the stage, it is important to let the stage stabilize at room temperature for at least 12 hours. This soak-out time is required because of thermal expansion and contraction of the parts used to build the stage. Allowing the stage to stabilize at room temperature will ensure that all of the alignments, preloads, and tolerances are the same as they were when tested at Aerotech. Set the stage on a smooth, flat, and clean surface.

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 cause 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 ACS and ACS LP. When an ACS or ACS LP series stage is mounted to a non-flat surface, the stage can be distorted as the mounting screws are tightened. This distortion will decrease the overall accuracy of the stage.

To maintain accuracy, the mounting surface should be flat within 1 µm per 25 mm.

Adjustments to the mounting surface must be done before the stage is secured. The effects of flatness on mounting are illustrated in Figure 2-1.

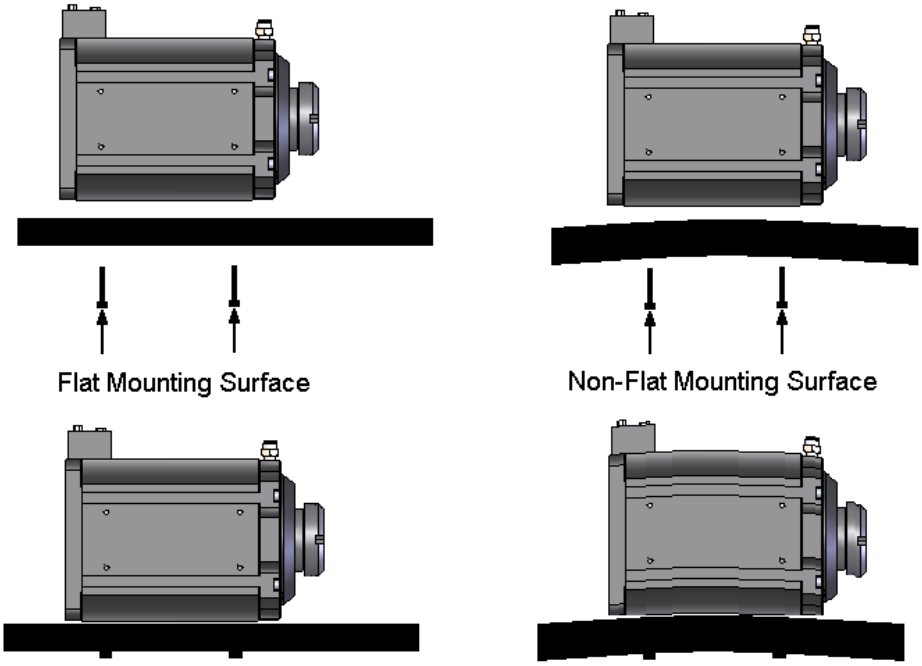


Figure 2-1: Results of Flat Versus Non-Flat Mounting

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.

2.3. Securing the Stage to the Mounting Surface

ACS and ACS LP series stages have numerous mounting holes available to secure the stage to the mounting surface. Figure 2-2 shows the mounting holes at the rear of the stage. On ACS-150, ACS-150LP, ACS-200 and ACS-200LP stages, these are 7 mm diameter holes designed for either 6 mm or ¼ inch socket head cap screws. The sides of the stage are equipped with several M6 x 1.0 tapped holes. Eight T-slots are included as a standard feature on the ACS-150, ACS-150LP, ACS-200 and ACS-200LP models. The dimensions of these T-slots are identical for ACS-150, ACS-150LP, ACS-200 and ACS-200LP stages and are detailed in Figure 2-3.

On ACS-100 and ACS-100 LP stages, the rear mounting holes are designed for either a 5 mm or #10 socket head cap screw, and the side holes are tapped M5 x 0.8 x 5 mm deep. T-slots are not available on the ACS-100 and ACS-100 LP series stages.

Figure 2-2 and Figure 2-3 show ACS stages. On ACS LP stages, the mounting holes are located in equivalent places.

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

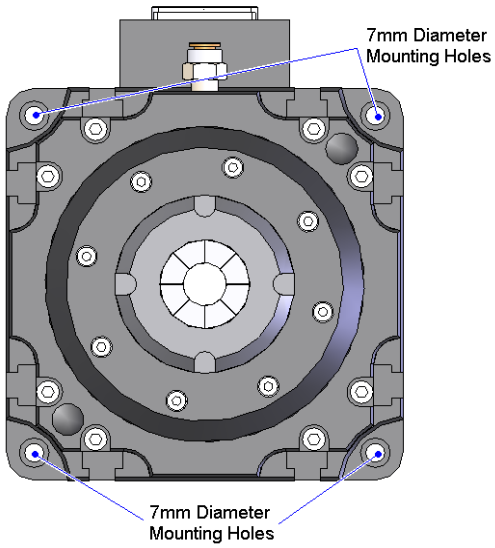


Figure 2-2: Front view of a Typical ACS-150 Stage Showing End Mounting Holes

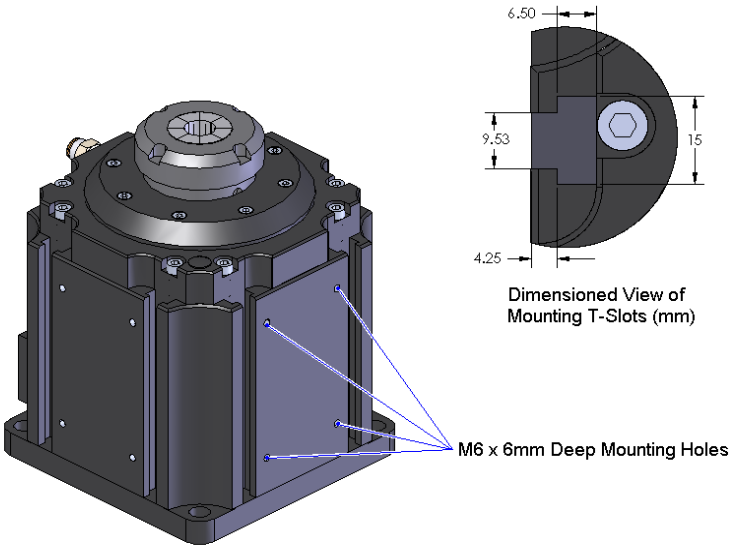


Figure 2-3: Typical ACS-150 Stage Showing Side Mounting Holes and T-Slot Detail

2.4. Attaching the Payload to the Stage

To prevent damage to the stage or parts, test the operation of the stage before any material is held in the collet or gripper. 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 documentation of the motion control system or the wiring drawings in Chapter 3: Operating Specifications.

To operate the collet, clean compressed air or nitrogen must be supplied to the stage. The one-touch air inlet fitting accepts ¼ inch OD plastic airline. Simply push the airline into the fitting and supply air to the stage. Aerotech can provide valves, fittings, and airlines to create a custom collet system. Contact the factory for more details.

Once air is supplied, material of the appropriate size can be placed in the collet. All collets supplied by Aerotech are clearly labeled with their clamping size range and collet style. Be sure to use only the correct size material in the collet. The accuracy of the collet could be compromised if the incorrect material size is clamped. Never clamp material or tools that are larger than the specified range. It is also important to have the material or tool inserted at least 2/3 the length of the collet bore. Any less than this could cause permanent deformation of the collet and reduce accuracy.

2.5. Electrical Installation

Aerotech motion control systems are adjusted at the factory for optimum performance. When the ACS or ACS LP series stage is part of a complete Aerotech motion control system, setup involves connecting the stage to the appropriate drive chassis with the cables provided. Connect the provided cables to the feedback and motor connectors on the stage. Labels on the drive indicate the appropriate connections. Refer to the appropriate 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.

See Section 3.5. for more information on the electrical connections on the ACS and ACS LP stages.

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

If you are using cables other than those provided by Aerotech, you must connect the pin in the motor connector carrying the stage's protective ground (shown in Section 3.5.) to a ground connection.

2.6. Air Requirements

The air pressure supplied to the collet holder or gripper is important in ensuring that the material or tool is released properly, or for the optional normally-open (NO) gripper (ACS only), that the material is held securely. If compressed air is used, it must be filtered to 0.25 microns, dry to 0º F dew point, and oil free. If nitrogen is used, it must be 99.99 percent pure and filtered to 0.25 microns. For stages equipped with a three-jaw gripper, air must be regulated to between 3 and 7 bar (45 and 100 psig). Higher pressures could cause damage to the gripper assembly and should be avoided. For stages equipped with an ER collet chuck, the chuck becomes fully open at approximately 4-7 bar (60-100 psig) depending on the collet size. Higher pressures will not cause damage to the rotary union, but high flow rates will result. Because of the noncontact rotary union design on collet-equipped stages, a small amount of leakage will occur. Approximate leakage rates of between 10 Lpm (0.5 CFM) and 40 Lpm (1.4 CFM), depending on pressure, will be observed when the collet is open.

Chapter 3: Operating Specifications

This chapter contains general technical information about ACS and ACS LP series stages. Included are basic product specifications, load capacities and ratings, and motor wiring diagrams.

3.1. Environmental Specifications

The environmental specifications for the ACS and ACS LP are listed in the following table.

Table 3-1: Environmental Specifications

Ambient Temperature	Operating: 10° to 35° C (50° to 95° F) The optimal operating temperature is 20° C ±2° C (68° F ±4° F). If at any time the operating temperature deviates from 20° C degradation in performance could occur. Contact Aerotech for information regarding your specific application and environment.
	Storage: 0° to 40° C (32° to 104° F) in original shipping packaging
Humidity	Operating: 40 percent to 60 percent RH The optimal operating humidity is 50 percent RH.
	Storage: 30 percent to 60 percent RH, non-condensing in original packaging
Altitude	Operating: 0 to 2,000 m (0 to 6,562 ft) above sea level Contact Aerotech if your specific application involves use above 2,000 m or below sea level.
Vibration	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.
Dust Exposure	The ACS and ACS LP stages are not suited for dusty or wet environments. This equates to an ingress protection rating of IP00.
Use	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. ACS Basic Specifications

ACS series rotary stage specifications are shown in Table 3-2, Table 3-3, and Table 3-4. Encoder resolution information is given in Table 3-5. Motor specifications are given in Table 3-6.

Table 3-2: ACS-100 Series Specifications

ACS Series		ACS-100-85	ACS-100-135
Total Travel		±360° Continuous	
Gripper/Collet Option		ER8	
Three-Jaw Grippler Travel	3J-12	NA	
	3J-25	NA	
Torque Output	Peak	1.8 Nm	7.84 Nm
	Continuous	0.4 Nm	1.96 Nm
Continuous Current, Stall	A_{pk}	2	3.7
	A_{rms}	1.43	2.6
Accuracy		±72.7 µrad (±15 arc sec)	
Repeatability		±29 µrad (±6 arc sec)	
Axial Runout		±15 µrad	
Radial Runout		±15 µrad	
Wobble		±48.5 µrad (±10 arc sec)	
Aperture	ER8	5 mm	
	ER25	ER25, ER40, 3J-12, and 3J-25 are not applicable	
	ER40	NA	
	3J-12	NA	
	3J-25	NA	
Resolution		0.87-87.3 µrad (0.18-18 arc sec)	
Moment Load		30 Nm	
Axial Load		10 kg	
Rated Speed		800 rpm	
Motor Type		S-76-35-A	S-76-85-A

Table 3-3: ACS-150 Series Specifications

ACS Series		ACS-150-115	ACS-150-135	ACS-150-180
Total Travel		±360° Continuous		
Gripper/Collet Option		ER25, ER40, 3J-12		
Three-Jaw Grippler Travel	3J-12	10 mm, 16 mm		
	3J-25	NA		
Torque Output	Peak	14.4 Nm	26 Nm	37.2 Nm
	Continuous	3.6 Nm	6.5 Nm	11.4 Nm
Continuous Current, Stall	A_{pk}	3.8	3.4	3.1
	A_{rms}	2.7	2.4	2.2
Accuracy		±72.7 µrad (±15 arc sec)		
Repeatability		±29 µrad (±6 arc sec)		
Axial Runout		±15 µrad		
Radial Runout		±15 µrad		
Wobble		±48.5 µrad (±10 arc sec)		
Aperture	ER8	NA		
	ER25	16 mm		
	ER40	30 mm		
	3J-12	12 mm		
	3J-25	NA		
Resolution		0.87-87.3 µrad (0.18-18 arc sec)		
Moment Load		188 Nm		
Axial Load		30 kg		
Rated Speed		600 rpm		
Motor Type		S-130-39-A	S-130-60-A	S-130-81-A

Table 3-4: ACS-200 Series Specifications

ACS Series		ACS-200-155	ACS-200-185
Total Travel		±360° Continuous	
Gripper/Collet Option		3J-12, #j-25	
Three-Jaw Grippler Travel	3J-12	10 mm, 16 mm	
	3J-25	13 mm, 20 mm	
Torque Output	Peak	69.2 Nm	99.6 Nm
	Continuous	16.9 Nm	24.9 Nm
Continuous Current, Stall	A_{pk}	5.1	4.9
	A_{rms}	3.6	3.5
Accuracy		±72.7 µrad (±15 arc sec)	
Repeatability		±29 µrad (±6 arc sec)	
Axial Runout		±30 µrad	
Radial Runout		±30 µrad	
Wobble		±72.7 µrad (±26 arc sec)	
Aperture	ER8	NA	
	ER25	NA	
	ER40	NA	
	3J-12	12 mm	
	3J-25	25 mm	
Resolution		0.87-87.3 µrad (0.18-18 arc sec)	
Moment Load		425 Nm	
Axial Load		140 kg	
Rated Speed		500 rpm	
Motor Type		S-180-69-A	S-180-94-A

Table 3-5: ACS Series Resolution Information

Stage	Position Transducer	Counts per Revolution	Interpolation Factor	Resolution	
				Arc Sec	µrad
ACS-100	-AS	3600	1	360.0 (2)	1745.3 (2)
	-X5	3600	5	18.0 (1)	87.3 (1)
	-X10	3600	10	9.0 (1)	43.6 (1)
	-X25	3600	25	3.6 (1)	17.5 (1)
	-X50	3600	50	1.8 (1)	8.7 (1)
ACS-150	-AS	3600	1	360.0 (2)	1745.3 (2)
	-X5	3600	5	18.0 (1)	87.3 (1)
	-X10	3600	10	9.0 (1)	43.6 (1)
	-X25	3600	25	3.6 (1)	17.5 (1)
	-X50	3600	50	1.8 (1)	8.7 (1)
ACS-200	-AS	5400	1	240.0 (2)	1163.6 (2)
	-X5	5400	5	12.0 (1)	58.2 (1)
	-X10	5400	10	6.0 (1)	29.1 (1)
	-X25	5400	25	2.4 (1)	11.6 (1)
	-X50	5400	50	1.2 (1)	5.8 (1)

(1) Assumes quadrature (x4) interpolation by controller.

(2) Amplified Sine resolution depends on controller multiplier used.

NOTE: The encoders used on all ACS series stages come standard with a 16 MHz clock rate. Aerotech can provide slower or faster clock rates to match the controller being used. Consult the factory for more information.

Table 3-6: ACS Motor Specifications

Model		S-76-35	S-76-85	S-130-39	S-130-60	S-130-81	S-180-69	S-180-94
Winding Designation		-A	-A	-A	-A	-A	-A	-A
Performance Specifications (1,5)								
Stall Torque, Continuous (2)	N-m	0.53	1.60	2.36	4.18	5.89	11.12	15.93
	in-lb	75.0	227.0	20.9	37.0	52.1	98.4	141.0
Peak Torque (3)	N-m	2.12	6.41	9.42	16.73	23.55	44.47	63.70
	in-lb	300.0	908.0	83.4	148.1	208.5	393.7	563.9
Rated Speed	rpm	3,000	3,000	2,000	1,000	750	500	250
Rated Power Output, Continuous	watts	166.3	381.2	493.4	437.9	462.4	582.1	416.9
Electrical Specifications (5)								
BEMF Constant (line to line, max)	Volts pk / krpm	32.1	57.0	75.1	148.9	222.7	263.9	393.4
Continuous Current, Stall (2)	Amp pk	2.0	3.80	3.8	3.4	3.2	5.1	4.9
	Amp rms	1.4	2.7	2.7	2.4	2.3	3.6	3.5
Peak Current, Stall (3)	Amp pk	8.0	15.2	15.2	13.6	12.8	20.4	19.6
	Amp rms	5.7	10.7	10.7	9.6	9.1	14.4	13.9
Torque Constant (4,9)	N-m / Amp pk	0.26	0.42	0.62	1.23	1.84	2.18	3.25
	in-lb / Amp pk	37.5	59.7	5.5	10.9	16.3	19.3	28.8
	N-m / Amp rms	0.37	0.60	0.88	1.74	2.60	3.08	4.60
	in-lb / Amp rms	53.0	84.5	7.8	15.4	23.0	27.3	40.7
Motor Constant (2,4)	N-m / √W	0.083	0.179	0.265	0.446	0.586	1.053	1.391
Resistance, 25 °C (line to line)	ohms	10.5	5.7	5.6	7.8	10.1	4.4	5.6
Inductance (line to line)	mH	1.40	1.10	1.70	1.80	2.80	1.70	2.60
Maximum Bus Voltage	VDC	340	340	340	340	340	340	340
Thermal Resistance	°C / W	1.83	0.93	0.95	0.85	0.74	0.67	0.57
Number of Poles	P	14	14	18	18	18	18	18

(1) Performance is dependent upon heat sink configuration, system cooling conditions, and ambient temperature
(2) Values shown @ 75 °C rise above a 25 °C ambient temperature, with housed motor mounted to a 330 mm x 330 mm x 13 mm aluminum heat sink
(3) Peak torque assumes correct rms current, consult Aerotech
(4) Torque Constant and Motor Constant specified at stall
(5) All performance and electrical specifications +/- 10%
(6) Losses due to bearings and aerodynamics considered negligible
(7) Maximum winding temperature is 100 °C, Thermistor trips at 100 °C
(8) Ambient operating temperature range: 0 °C - 25 °C, consult Aerotech for performance in elevated ambient temperatures
(9) All Aerotech amplifiers are rated Apk; use torque constant in N-m / Apk when sizing

3.3. ACS LP Basic Specifications

ACS LP series rotary stage specifications are shown in 3.3 and ACS LP series stage maximum encoder frequencies are given in Table 3-8. Motor specifications are given in Table 3-9.

Table 3-7: ACS LP Series Specifications

Model		ACS-100LP	ACS-150LP	ACS-200LP
Total Travel		±360° Continuous		
Collet Option(1,2)		ER8	ER25	ER40
Width		100 mm	150 mm	200 mm
Tabletop Diameter		95 mm	140 mm	190 mm
Aperture	ER8	5 mm	NA	NA
	ER25	NA	16 mm	NA
	ER40	NA	NA	25 mm
Motor (-A/-B)		S-76-35-A/S-76-35-B	S-130-39-A/S-130-39-B	S-180-44-A/S-180-44-B
Bus Voltage		Up to 320 VDC		
Continuous Current, Stall	A pk	2.0	3.8	5.1
	A rms	1.43	2.7	3.6
Resolution		0.87-87.3 µrad (0.18-18 arc sec)	0.315-31.5 µrad (0.065-6.5 arc sec)	
Max Speed(3)		1500 rpm	600 rpm	400 rpm
Accuracy	Uncalibrated	388 µrad (80 arc sec)		
	Calibrated(4)	29.1 µrad (6 arc sec)	48.5 µrad (10 arc sec)	48.5 µrad (10 arc sec)
Repeatability		14.6 µrad (3 arc sec)	19.4 µrad (4 arc sec)	19.4 µrad (4 arc sec)
Max Load(5)	Axial	70 N (15.7 lb)	200 N (45 lb)	400 N (89.9 lb)
	Moment	5 N-m		
Axial Error Motion(6)		2 µm	5 µm	5 µm
Radial Error Motion(6)		15 µm	5 µm	5 µm
Tilt Error Motion		48.5 µrad (10 arc sec)	97 µrad (20 arc sec)	97 µrad (20 arc sec)
Inertia	Unloaded	0.00038 kg-m^2	0.00242 kg-m^2	0.00843 kg-m^2
Total Mass		2.0 kg	4.3 kg	7.6 kg
Finish	Tabletop	Hardcoat		
	Stage	Black Anodize		

(1) Requires Rego-Fix electropolished collet for proper operation.
(2) Air supply for collet actuation must be clean and dry to 0° F dewpoint and filtered to 0.25 µm or better. Nitrogen at 99.9% purity may also be used.
(3) Maximum speed is based on stage capability. Actual speed may depend on encoder resolution, load, amplifier bus voltage, and motor. See the S-series rotary motor for more information.
(4) With HALAR.
(5) Maximum loads are mutually exclusive.
(6) Runout measured with a precision collet and precision gage pin at a position 6 mm from the face of the collet.

Table 3-8: ACS LP Maximum Encoder Frequency

Resolution - Speed	ACS-100LP	ACS-150LP	ACS-200LP
AS/X5/X10	1500 rpm	600 rpm	600 rpm
X25	1067 rpm	384 rpm	384 rpm
X50	533 rpm	192 rpm	192 rpm

Table 3-9: ACS LP Motor Specifications

Model		S-76-35		S-130-39		S-180-44	
Winding Designation		-A	-B	-A	-B	-A	-B
Performance Specifications (1,5)							
Stall Torque, Continuous (2)	N-m	0.53		2.36		5.99	
	in-lb	75.0		20.9		53.1	
Peak Torque (3)	N-m	2.12		9.42		23.98	
	in-lb	300.0		83.4		212.2	
Rated Speed	rpm	3,000	5,000	2,000	4,000	500	1,000
Rated Power Output, Continuous	watts	166.3	277.2	493.4	986.9	313.8	627.7
Electrical Specifications (5)							
BEMF Constant (line to line, max)	Volts pk / krpm	32.1	16.0	75.1	37.5	268.7	134.4
Continuous Current, Stall (2)	Amp pk	2.0	4.0	3.8	7.6	2.7	5.4
	Amp rms	1.4	2.8	2.7	5.4	1.9	3.8
Peak Current, Stall (3)	Amp pk	8.0	16.0	15.2	30.4	10.8	21.6
	Amp rms	5.7	11.3	10.7	21.5	7.6	15.3
Torque Constant (4,9)	N-m / Amp pk	0.26	0.13	0.62	0.31	2.22	1.11
	in-lb / Amp pk	37.5	18.8	5.5	2.7	19.7	9.8
	N-m / Amp rms	0.37	0.19	0.88	0.44	3.14	1.57
	in-lb / Amp rms	53.0	26.5	7.8	3.9	27.8	13.9
Motor Constant (2,4)	N-m / √W	0.083		0.265		0.628	
Resistance, 25 °C (line to line)	ohms	10.5	2.6	5.6	1.4	12.8	3.2
Inductance (line to line)	mH	1.40	0.35	1.70	0.43	3.40	0.85
Maximum Bus Voltage	VDC	340	160	340	160	340	340
Thermal Resistance	°C / W	1.83		0.95		0.82	
Number of Poles	P	14		18		18	

(1) Performance is dependent upon heat sink configuration, system cooling conditions, and ambient temperature
(2) Values shown @ 75 °C rise above a 25 °C ambient temperature, with housed motor mounted to a 330 mm x 330 mm x 13 mm aluminum heat sink
(3) Peak torque assumes correct rms current, consult Aerotech
(4) Torque Constant and Motor Constant specified at stall
(5) All performance and electrical specifications +/- 10%
(6) Losses due to bearings and aerodynamics considered negligible
(7) Maximum winding temperature is 100 °C, Thermistor trips at 100 °C
(8) Ambient operating temperature range: 0 °C - 25 °C, consult Aerotech for performance in elevated ambient temperatures
(9) All Aerotech amplifiers are rated Apk; use torque constant in N-m / Apk when sizing

3.4. Limit Switch Wiring

Standard ACS and ACS LP stages do not include end of travel limits. Please consult the factory for custom solutions.

3.5. Standard Motor Wiring

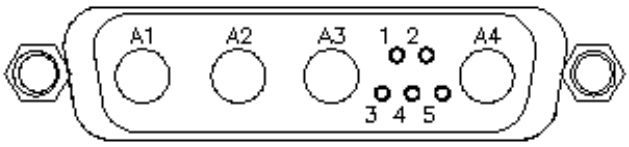
For reference, connector pin outputs and general wiring information are given in the following figures. Pin outputs are defined in Table 3-10.

NOTE: Refer to the other documentation accompanying your Aerotech equipment for more information. Call your Aerotech representative if you have any questions on system configuration.

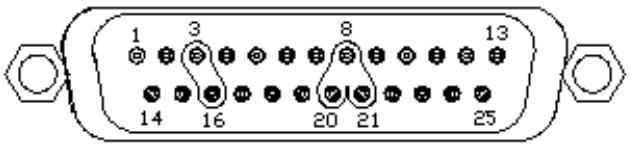
NOTE: If you are using your own cables to connect the stage, ensure that motor and ground wires can handle current higher than the continuous current listed in Table 3-6 and Table 3-9. The voltage rating of the wire insulation must be greater than the maximum bus voltage.

PIN	WIRE	SIGNAL
10	BLU	HA
5	WHT	HB
11	ORN	HC
2	RED	TH+
8	RED	TH-
20	-	-
16	-	-
25	-	-
13	-	-
3	BRN	ENC +5V
21	WHT	ENC COM
18	RED	SIN-N
17	BLU	SIN
7	GRY	MKR
6	PINK	MKR-N
15	YEL	COS-N
14	GRN	COS
23	VIO	ENCFLT

PIN	WIRE	SIGNAL
A1	BLK	MTR øA
A2	RED	MTR øB
A3	WHT	MTR øC
A4	GRN/YEL	FRM GND



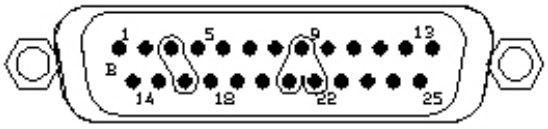
Motor Connector



Feedback Connector
with Commoning Strips

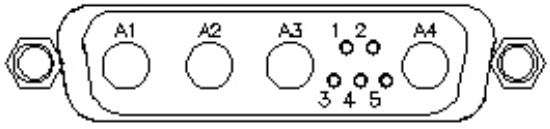
Figure 3-1: Standard Wiring Connectors for ACS-150/200 and ACS-150LP/200LP Stages

PIN	WIRE	SIGNAL
-	-	-
-	-	-
11	WHT	HC
-	-	-
10	BRN	HA
21	BLK	COM
8	WHT/GRN	RESERVED
20	GRY	COM
7	ORN	MKR
18	WHT/BLU	SIN-N
6	WHT/ORN	MKR-N
17	BLU	SIN
5	GRN	HB
16	RED	+5V
3	VIO	+5V
15	WHT/YEL	COS-N
2	WHT/GRY	TH+
14	YEL	COS
1	DRAIN	SHLD
TO BACKSHELL	FOIL	SHLD



Feedback Connector
with Commoning Strips

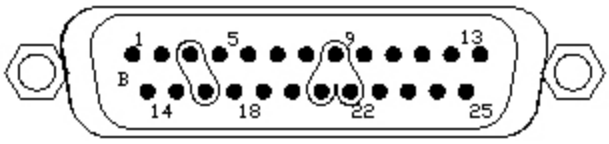
PIN	WIRE	SIGNAL
A1	BLK	MTR øA
A2	RED	MTR øB
A3	WHT	MTR øC
A4	GRN/YEL	FRM GND
1	DRAIN	MTR SHLD
TO BACKSHELL	FOIL	MTR SHLD



Motor Connector

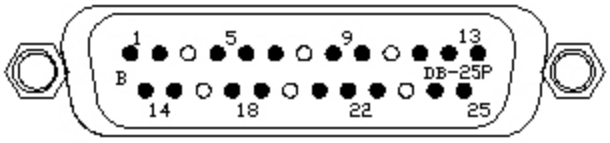
Figure 3-2: Standard Wiring Connectors for ACS-100 and ACS-100LP Stages

PIN	WIRE	SIGNAL
-	-	-
-	-	-
11	WHT	HC
-	-	-
10	BRN	HA
21	BLK	COM
8	WHT/GRN	RESERVED
20	GRY	COM
7	ORN	MKR
18	WHT/BLU	SIN-N
6	WHT/ORN	MKR-N
17	BLU	SIN
5	GRN	HB
16	RED	+5V
3	VIO	+5V
15	WHT/YEL	COS-N
2	WHT/GRY	TH+
14	YEL	COS
1	DRAIN	SHLD
TO BACKSHELL	FOIL	SHLD



Feedback Connector
with Commoning Strips

PIN	WIRE	SIGNAL
TO BACKSHELL	FOIL	SHEILD
1	-	-
14	-	-
2	G/YEL	FRM GND
15	-	-
3	REMOVED PIN	KEY
16	REMOVED PIN	-
4	-	-
17	-	-
5	WHT	MTR øC
18	-	-
6	-	-
19	REMOVED PIN	-
7	REMOVED PIN	-
20	-	-
7	-	-
18	RED	MTR ØB
6	-	-
17	-	-
10	REMOVED PIN	-
23	REMOVED PIN	-
11	-	-
24	-	-
12	BLK	MTR øA
25	-	-
13	-	-



Motor Connector
with Gold Jumpers

Figure 3-3: Optional Wiring Connectors for ACS-100 Stages

Table 3-10: Motor Wiring Pinout Descriptions

Pin Output	Description
COS	Cosine. Incremental encoder output; either TTL line driven or amplified sine wave type signal.
COS-N	Incremental encoder output. Complement of cos.
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.
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 sign wave type signal.
SIN-N	Incremental encoder output. Complement of sin.
TH+	Positive lead for motor thermistor (to motion controller).
TH-	Negative lead for motor thermistor (tied to ground via feedback connector).
ENCFLT	Encoder Fault. Active low TTL output.
MTR ØA	Motor Phase A.
MTR ØB	Motor Phase B.
MTR ØC	Motor Phase C.
COM	Common ground.

3.6. Vacuum Operation

Contact the factory for information regarding operation in a vacuum environment.

Chapter 4: Maintenance

Although the ACS and ACS LP series stages are designed to be low in maintenance, there are a few items that may require preventative maintenance during the lifetime of the stage. This chapter will detail the lubrication, inspection, and replacement process of various components.

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

Seal inspection and replacement in ACS and ACS LP series stages depends on conditions such as duty cycle, speed, and the environment. A frequent inspection interval is recommended until a trend develops for the application. As part of this inspection interval, the seals should be examined for excessive air or water leakage. The application will determine the required replacement interval for the seals. The bearings, motor, and encoder for the ACS and ACS LP series require no lubrication or maintenance.

4.2. Cleaning and Lubrication

O-rings and collet piston seals should be lubricated with Dow Corning Molykote 55 O-ring Lubricant or an equivalent O-ring lubricant.

Any metal parts can be cleaned with either acetone or isopropyl alcohol. Seals and O-rings can be wiped with a small amount of isopropyl alcohol if necessary.

Never use acetone on O-rings

4.2.1. Collet and Collet Chuck Lubrication and Cleaning

For the collet chuck and collet to operate properly, preventative maintenance and regular cleaning is required.

Failure to lubricate and clean the collet interface surfaces will cause premature failure and wear that may void the warranty.

Before inserting any collet into the chuck, clean the chuck taper and the collet with acetone or isopropyl alcohol with a lint-free cloth or rag. If required, compressed air can be used to clean out the collet grooves. Inspect the collet and the chuck interface surfaces to be sure no wear marks are present. If wear or fret marks (copper-colored oxide marks) are present, the taper can be lightly polished with a fine-grit crocus cloth. The goal is to clean the surface of the taper and not to remove an excessive amount of material. If the wear marks are large, or excessive polishing is required to remove these marks, the taper and the collet may need to be replaced. Contact Aerotech Customer Service for more information. Finally grease the chuck taper and collet taper with a small amount of lubricant and insert the collet.

Aerotech recommends the following lubricants (or equivalent):

Vender	Product	Item #	Description
Henkel Technologies	Loctite	80209	Silver Grade Anti-Seize
Henkel Technologies	Loctite	51168	Food Grade Anti-Seize
Jet Lube	White Knight	16404	Food Grade Anti-Seize

Lubricant inspection and replenishment depends on conditions such as collet chuck duty cycle and the machining environment. An inspection interval of once every 8-hours is recommended until a trend develops for the application. Longer or shorter intervals may be required to maintain a film of lubricant on the collet taper. It is also recommended that every time a collet is removed, the collet and the chuck interface surfaces are cleaned, inspected, and greased.

4.3. Seal Replacement

4.3.1. Piston Seal Change Procedure

The seals on the collet piston may be replaced if a leak or excess wear becomes apparent. Figure 4-1 shows an exploded view of the assembly and includes all parts involved in the process. Figure 4-1 shows an ACS stage; ACS LP stages have an equivalent layout. The procedure to change the seals is as follows.

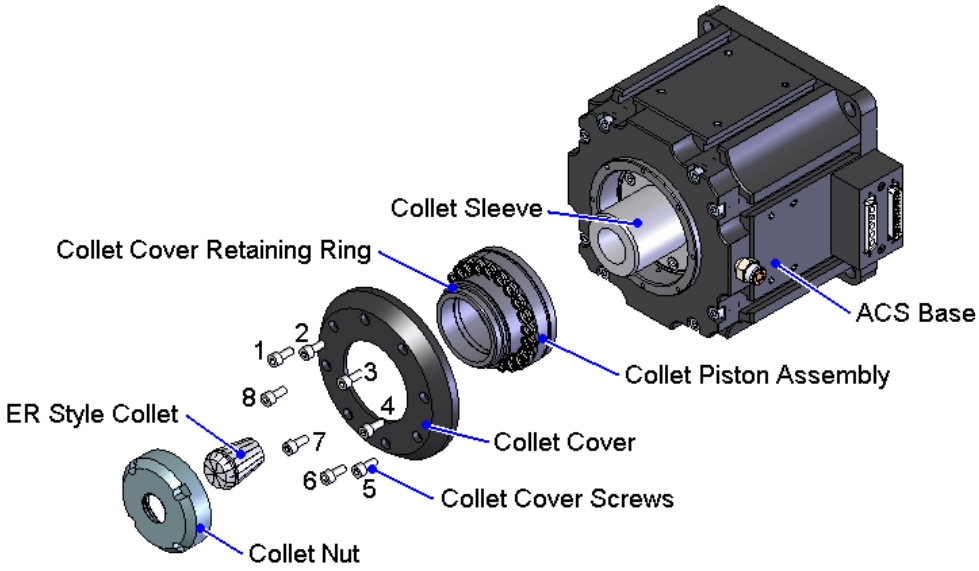


Figure 4-1: Exploded View of Collet Assembly

1. Remove power to the stage.
2. Supply air to the stage in order to release the collet.
3. Remove the collet nut by turning it counterclockwise. Spanner wrenches may be necessary for removal and are available from Aerotech.
4. Remove air pressure from the stage. This will allow the internal springs to relax slightly and ease further disassembly.

The collet cover is under tension from internal springs. Removing the collet cover screws incorrectly can result in personal harm and damage to the equipment.

5. Refer to Figure 4-1. Remove every other collet cover screw (i.e., screws 1, 3, 5, and 7). All screws cannot be removed at once as the cap is under tension from several springs and will be damaged or cause bodily harm if removed without caution.
6. Obtain four M4 x 0.7 x 12 mm long socket head cap screws and thread them into the holes where the previous screws were removed. Tighten each one until it bottoms out in its hole.

7. Loosen the four remaining collet cover screws, 1/4 turn at a time. Loosen the screws in a cross pattern (i.e., loosen screw number 2, then screw number 6, then screw number 8, then screw number 4, then return to screw number 2). Repeat this process until the longer screws are supporting the tension of the springs entirely. It is then safe to remove the remaining collet cover screws completely.
8. Using the same method as in step 7, remove the longer screws until the spring tension is completely relieved.
9. Carefully slide the collet piston assembly out from its housing. Use caution not to tilt the piston assembly in its housing as this could cause damage to the housing, seals, or piston.
10. It is now safe to remove the collet cover retaining ring. This can be done with a flat-head screwdriver or a pair of needle nosed pliers.
11. Remove the collet cover and the springs from the collet piston.
12. There are two seals on the piston itself. One is an external seal that seals the piston against its housing, the other is an internal seal that seals the piston against the collet sleeve. To remove the seals, carefully pry them out of their housings with a small screwdriver or pick. Use caution not to scratch the surface of the piston.
13. Thoroughly clean seal mounting surfaces, the chamfers, and all surfaces that the new seals may come in contact with. Even small particles or debris can damage the seals during installation.
14. Lubricate the new seals with o-ring lubricant as specified in Section 4.2. Press the new seals over the chamfer and into their respective grooves. See Figure 4-2 for installation procedure. Be sure to align the seals such that the open end (when looking at a cross section) is facing away from the collet, as shown in Figure 4-3. The direction of the seal is extremely important in sealing the piston. Make sure that the seals seat into their mounting grooves by running a fingernail around the edge. If the seal is tilted or twisted slightly its function will be severely compromised.
15. Reinstall the springs.
16. Place the collet cover over the piston and reinstall the collet cover retaining ring.
17. Reinstall the collet piston assembly into its housing. There are chamfers to help guide the piston into place, but use caution not to twist or damage the seals. It is recommended that a small amount of o-ring lubricant is used.
18. Installation of the collet cover is the reverse of removal. Begin by inserting the four 12 mm long screws in every other hole and tightening until they bottom out in their respective holes. Then install the shorter original screws into the remaining holes and tighten in a cross pattern until the collet cover is seated against the shaft. Install the remaining four original screws. Torque all screws to a final torque of 1.8 to 2.0 Nm (16 to 18 in-lbs).
19. Apply air pressure to the stage in order to install the collet.
20. Install the new collet as described in Section 4.4.2. .
21. Restore the air supply to the original settings and restore power to the stage.

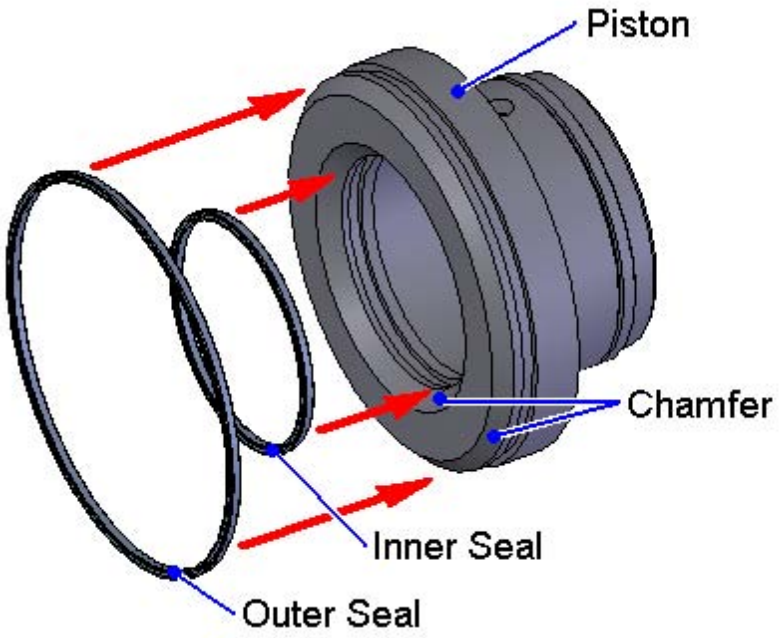


Figure 4-2: Piston Seal Installation Procedure

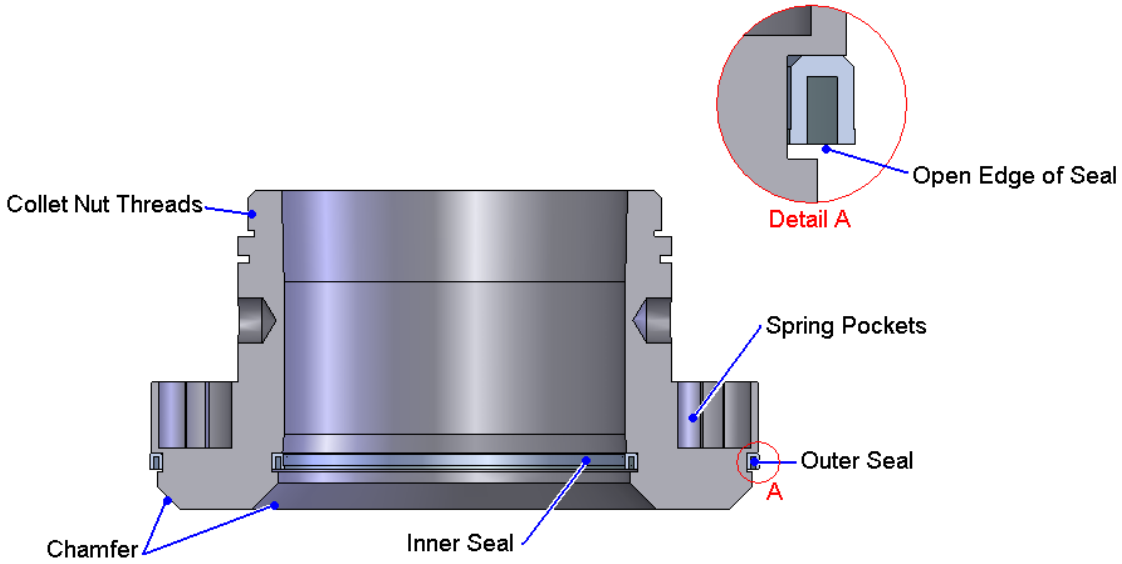


Figure 4-3: Cross-section View of Piston Showing Seal Orientation

4.3.2. Ringseal O-ring Replacement (ACS Only)

On ACS stages equipped with a water jacket, it may be necessary to change the ringseal o-rings. A typical ringseal insert is shown in Figure 4-4. Depending on the size, the ringseal may be one or two pieces. The ringseal screws into the center of the collet sleeve, and is replaced by the following steps:

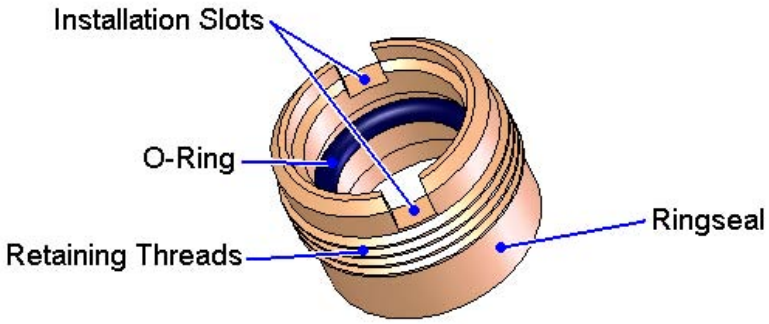


Figure 4-4: Typical Ringseal with O-ring Installed

1. Remove power to the stage.
2. Release the collet. Since the collet holder is in the normally closed position, this will require air pressure supplied to the air inlet.
3. Once the collet has been released, unscrew the collet nut. If necessary, use a spanner wrench available from Aerotech.
4. With the collet and collet nut removed, the ringseal will now be exposed. Using a tool dimensioned in Figure 4-5, unscrew the ringseal from the collet sleeve.
5. Remove the o-ring on the ringseal itself, and replace it with a properly lubricated new item. The second o-ring is within the collet sleeve, as shown in Figure 4-6. A long pick or thin screwdriver will be necessary to remove the o-ring and replace it.
6. Re-insert the ringseal into the inner collet housing, and tighten it into position.
7. Replace collet and collet nut.

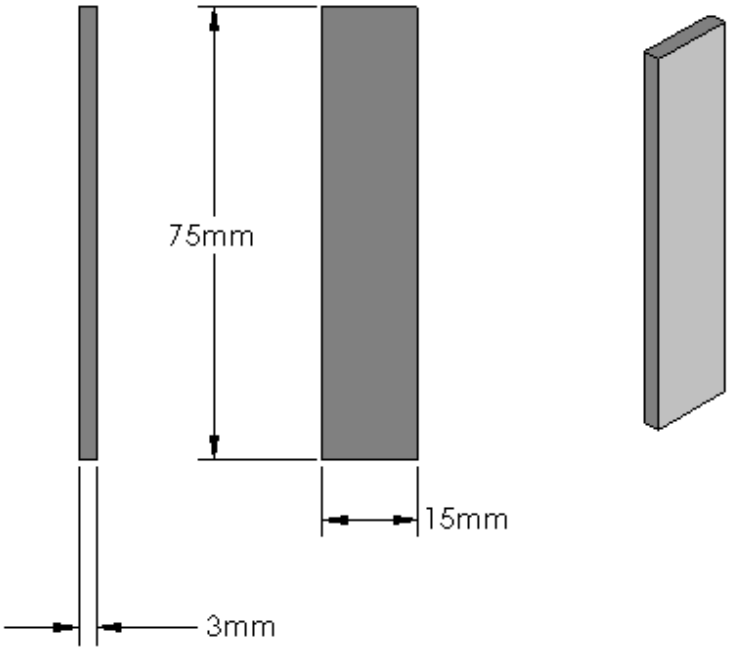


Figure 4-5: Ringseal Removal Tool Dimensions

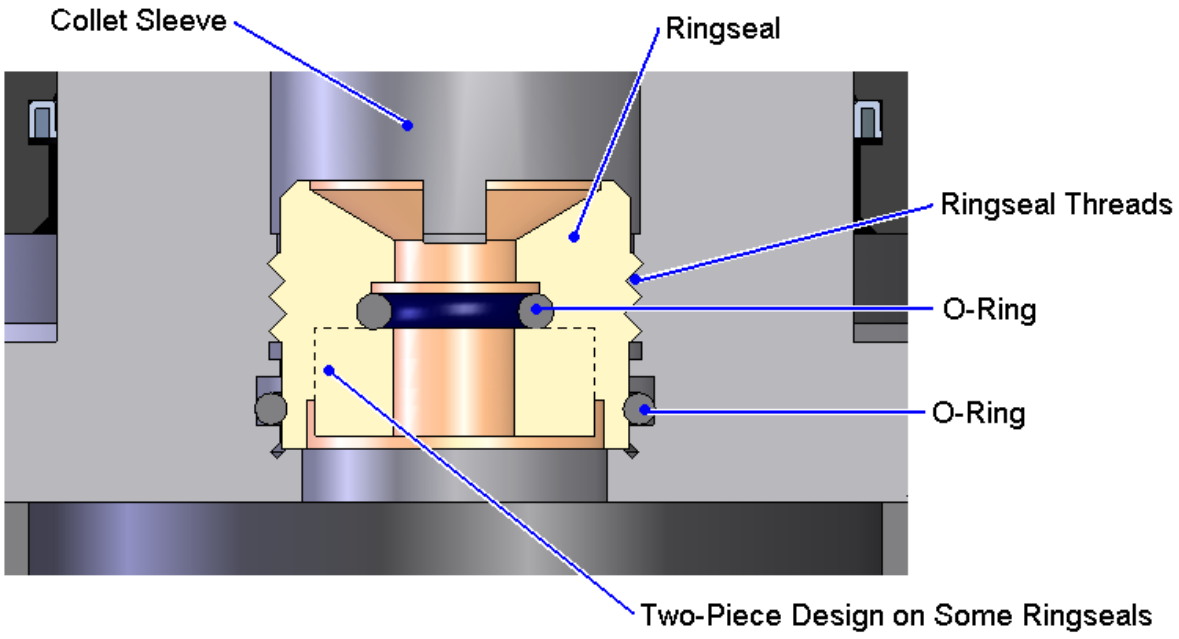


Figure 4-6: Cross-section View of Ringseal Showing Both O-rings

4.3.3. Rotary Union Seals for Three-Jaw Gripper Stages (ACS Only)

This section applies only to the ACS-200 and ACS-150 stages equipped with the three-jaw gripper chuck option.

Unlike ACS stages with ER collet holders, stages equipped with three-jaw grippers include a sealed rotary union. Due to friction of the seals on the shaft, wear can occur over a period of time and the seals may require replacement. Figure 4-7. shows an exploded view of the rotary union assembly. The following is the procedure for replacing the rotary union seals.

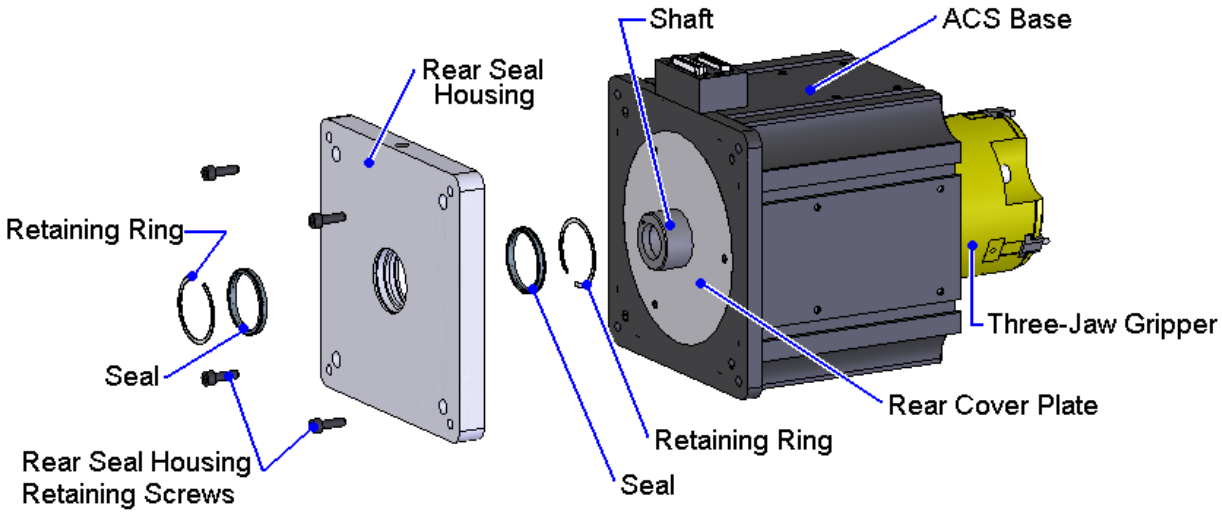


Figure 4-7: Exploded Drawing of Rear Seal Components

1. Disconnect Power and air pressure to the stage.
2. Remove the air line from the air input.
3. Remove the four rear seal housing retaining screws and carefully pull the rear seal housing straight off of the main shaft of the stage.
4. Remove the two retaining rings using a small screwdriver or needle-nosed pliers. Be careful not to damage the rear seal housing.
5. Pry the air seals from their housings. This may require a small screwdriver or pick. Use caution not to damage the seal housings.
6. Clean all surfaces before reassembly. See Section 4.2. for recommended cleaning solvents.
7. Lubricate the new seals with o-ring lubricant (see Section 4.2.) and press them into the rear seal housing. Note the orientation of the seals in Figure 4-8. Check to make sure that the seals are seated completely by running a fingernail along the edge. If the seal is seated improperly a leak may result.
8. Replace the retaining rings.
9. Lubricate the sealing surfaces and carefully press the rear seal housing back onto the stage base. Use care when replacing the rear seal housing as the seals can be easily damaged.
10. Replace the rear seal housing retaining screws to a torque of 1.8 to 2.0 Nm (16 to 18 in-lbs).
11. Replace the airline and reconnect power.

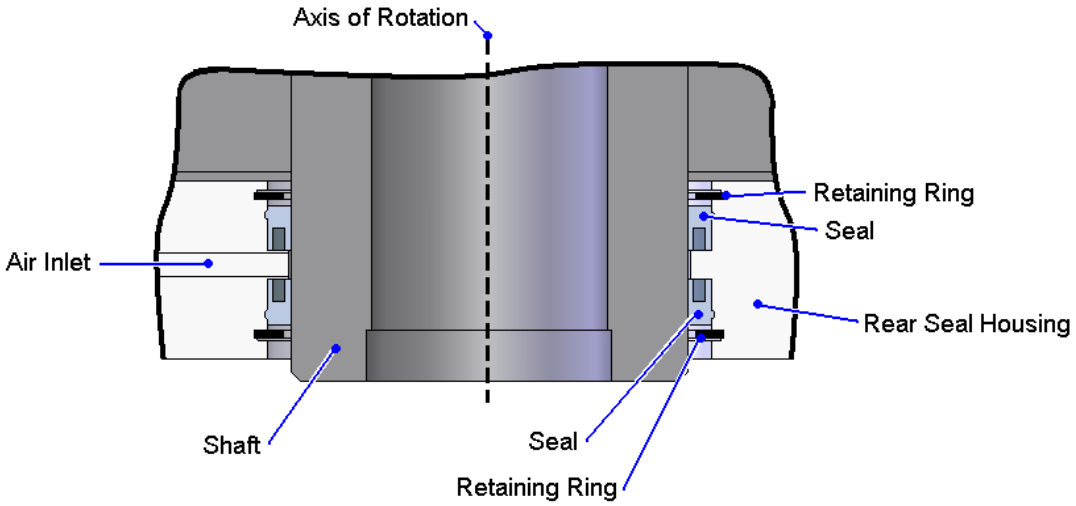


Figure 4-8: Cross-section View of Rear Seal Showing Seal Orientations

4.3.4. Water Jacket Seal Replacement (ACS Only)

On ACS stages with a water jacket, there is a seal in the rear of the stage that requires periodic replacement. Figure 4-9 shows an exploded view of all components involved, and the procedure for replacement follows.

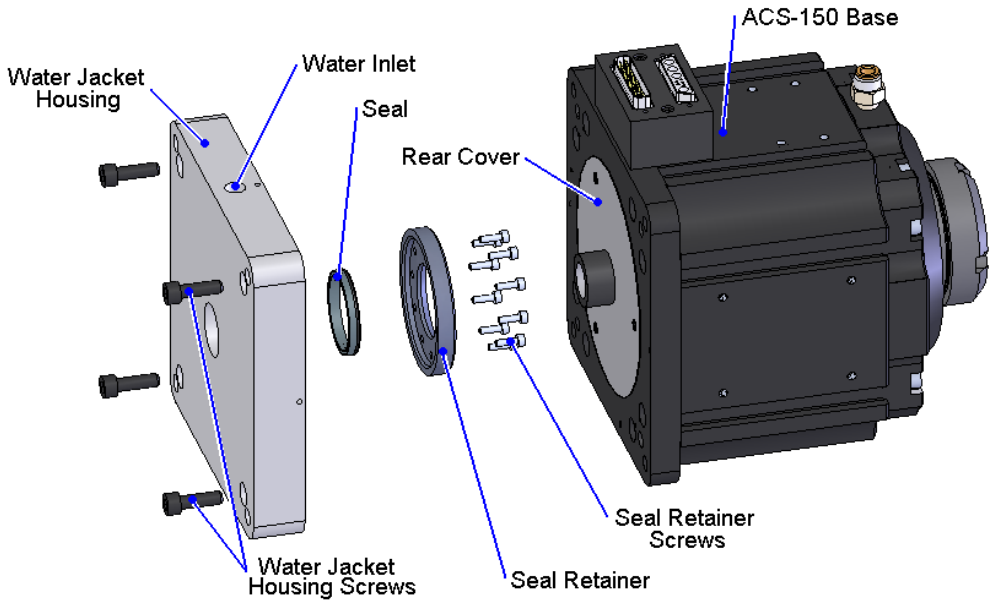


Figure 4-9: Exploded View of Water Jacket Housing Assembly

1. Remove power to the stage.
2. Remove the four water jacket housing screws from the rear end of the stage.
3. Carefully pull the water jacket housing off of the stage. The seal and seal retainer will now be exposed.
4. Remove the ten seal retainer screws and remove the seal retainer.
5. Pry the seal from its housing using care not to damage the sealing surfaces.
6. Lubricate the new seal with o-ring lubricant and press it into its housing. Be sure to note the seal orientation in Figure 4-10.
7. Replace the seal retainer and tighten all screws to 1.8 to 2.0 Nm (16 to 18 in-lbs) in a cross pattern.
8. Make sure the seal is lubricated and press the water jacket housing back over the shaft of the stage.
9. Tighten the water jacket housing screws to 1.8 to 2.0 Nm (16 to 18 in-lbs).
10. Restore power to the stage.

NOTE: After installing new water jacket seals, some initial leakage is typical until the new seal surface is worn in. Aerotech recommends that the stage is run dry for approximately one hour to help seat the seal against the sealing surface.

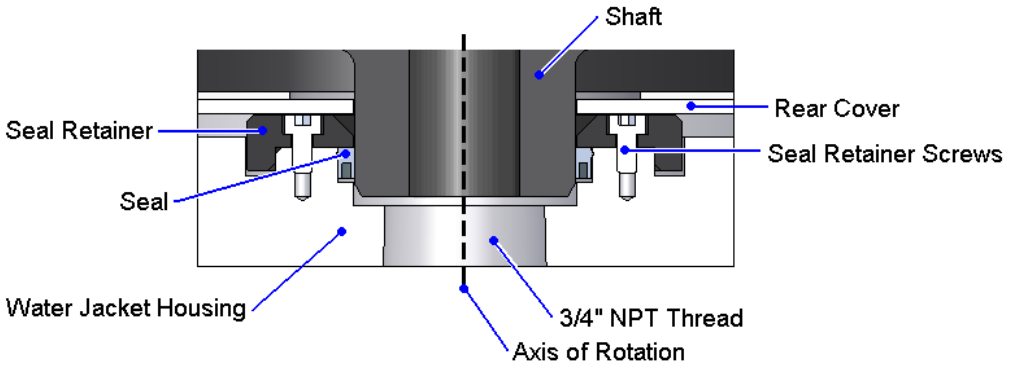


Figure 4-10: Cross-section View of Water Jacket Seal Showing Seal Orientation

4.4. Changing ACS and ACS LP Workholding Devices

ACS and ACS LP series stages are equipped with either an ER style collet or a three-jaw gripper chuck. It may be necessary to change the style of collet or gripper. This chapter will detail the process of changing collets, show how to change the style of collet, and cover removal and installation methods for the available three-jaw grippers

4.4.1. Availible Workholding Devices

The ACS-100 and ACS-100LP series rotary stages are all equipped with an ER8 style collet holder. Various grip diameters are commonly available and can be interchanged following the collet removal and installation procedure detailed in Section 4.4.2. ACS-150 stages can be equipped with an ER25 collet, ER40 collet, or 3J-12 three-jaw gripper. It is important that only those collets designed for a particular collet holder are used. If necessary, check the part number on the stage to determine if the collet holder is designed for ER25 or ER40 collets. ACS-150LP stages are equipped with a ER25 collet, ACS-200 series stages only come equipped with 3-jaw chucks, and ACS-200LP stages are equipped with a ER40 collet.

4.4.2. Collet Change Procedure

1. Remove power to the stage.
2. Apply air pressure to release the collet.
3. Once the collet has been released, unscrew the collet nut. If necessary, use a spanner wrench available from Aerotech. Use caution when removing the collet nut as the collet may fall from its housing and be damaged.
4. Once the collet nut has been removed, remove the collet from the nut. Figure 4-11 shows the proper installation and removal pcedures.
5. Clean the collet housing, collet nut threads, collet nut, and new collet, and then insert the collet into the nut (acetone or isopropyl alcohol may be used to clean the metal components). The insertion method is shown in Figure 4-11 and is the reverse of removal. A small amount of grease can be applied to the taper to reduce wear.
6. Guide the collet and nut into the stage, making sure that the collet seats properly in its taper. See Figure 4-12. Be sure that air pressure is still being supplied to the stage so the collet chuck is in the open position.
7. Tighten the collet nut (tightening by hand is sufficient because the clamping force is not determined by the torque of the nut, but by the force of internal springs). Spanner wrenches may be used if desired.
8. Restore power to the stage.

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

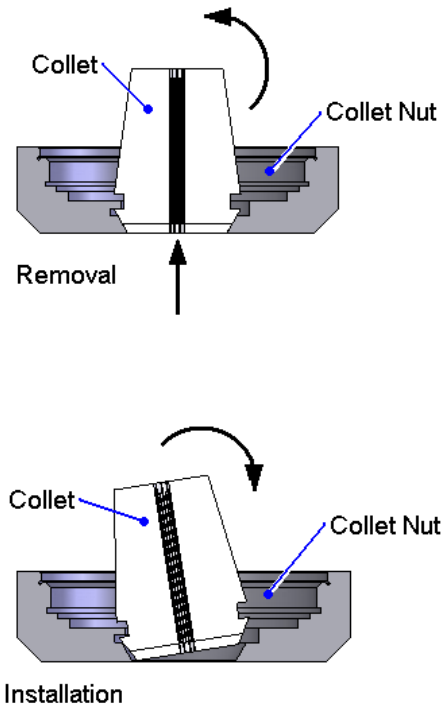


Figure 4-11: Schematic of Collet Insertion Into and Removal from Collet Nut

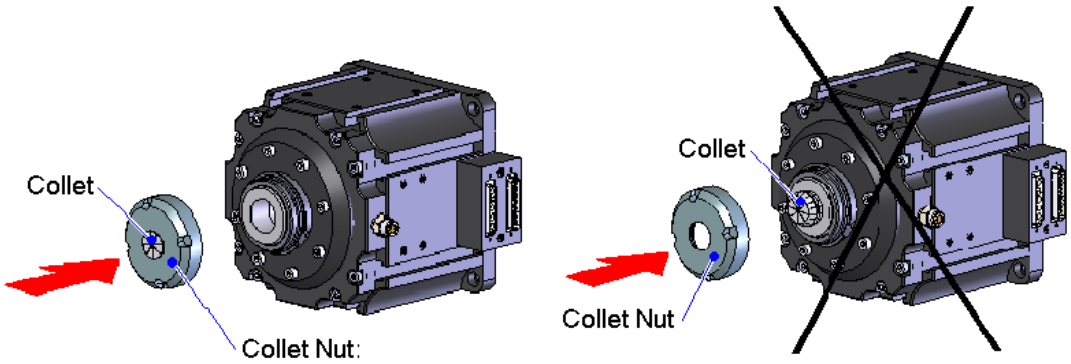


Figure 4-12: Installation Procedure for Collet

Figure 4-12 shows an ACS stage. The same procedure applies to ACS LP stages.

4.4.3. Changing Collet Chucks (ACS Only)

ACS-150 series stages are configurable with ER collet chucks for both ER-25 and ER-40 collets. In order to switch from the ER-25 to the ER-40 (or vice versa), some disassembly is required. This section outlines the procedure.

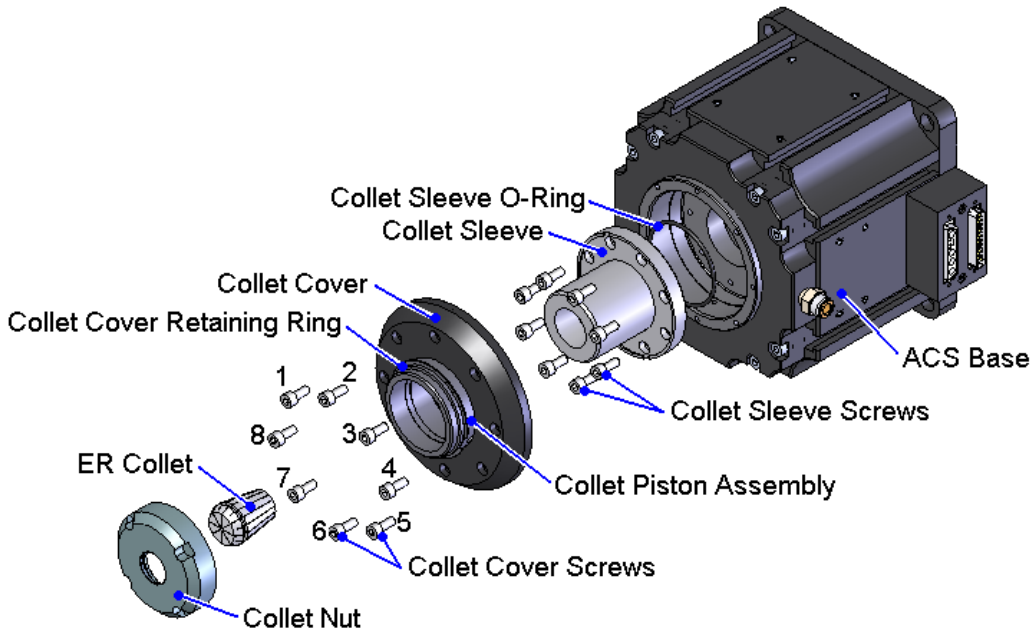


Figure 4-13: Exploded View of Collet Assembly

1. Remove power to the stage.
2. Supply air to the stage in order to release the collet.
3. Remove the collet nut by turning it counterclockwise. Spanner wrenches may be necessary for removal and are available from Aerotech.
4. Remove air pressure from the stage. This will allow the internal springs to relax slightly and ease further disassembly.

The collet cover is under tension from internal springs. Removing the collet cover screws incorrectly can result in personal harm and damage to the equipment.

5. Refer to Figure 4-13. Remove every other collet cover screw (i.e., screws 1, 3, 5, and 7). All screws cannot be removed at once as the cap is under tension from several springs and will be damaged or cause bodily harm if removed without caution.
6. Obtain four M4 x 0.7 x 12 mm long socket head cap screws and thread them into the holes where the collet cover screws were removed. Tighten each one until it bottoms out in its hole.

7. Loosen the four remaining collet cover screws, 1/4 turn at a time. Loosen the screws in a cross pattern. For example, loosen screw number 2, then screw number 6, then screw number 8, then screw number 4, then return to screw number 2. Repeat this process until the longer screws are supporting the tension of the springs entirely. It is then safe to remove the shorter screws completely.
8. Using the same method as in step 7, remove the longer screws until the spring tension is completely relieved.
9. Carefully slide the collet piston assembly out from its housing. Use caution not to tilt the piston assembly in its housing as this could cause damage to the housing, seals, or piston itself.
10. It is now safe to remove the collet cover retaining ring. This can be done with a flat-head screwdriver or a pair of needle nosed pliers.
11. Remove the collet cover and the springs from the collet piston.
12. Remove the collet sleeve and collet sleeve O-ring.
13. Thoroughly clean the new collet sleeve and nut as well as all old components. Inspect the seals and O-ring for damage or excessive wear and replace if necessary.
14. Insert the collet sleeve O-ring into its groove. Place the new collet sleeve into the shaft. The collet sleeve is piloted to ease assembly. Finger tighten all eight screws, then tighten in a cross pattern to a torque of 1.8 to 2.0 Nm (16 to 18 in-lbs).
15. Reinstall the collet piston assembly into its housing. It is recommended that O-ring lubricant is used during reassembly (see Section 4.2. for recommended lubricants). There are chamfers to help guide the piston into place, but use caution not to twist or damage the seals.
16. Replace the collet piston assembly.
17. Installation of the collet cover is the reverse of removal. Begin with the four 12mm long screws in every other hole and tighten until they bottom out in their respective holes. Then install the shorter original screws into the remaining holes and tighten in a cross pattern until the collet cover is seated against the shaft. Install the remaining four original screws. Torque all screws to a final torque of 1.8 to 2.0 Nm (16 to 18 in-lbs).
18. Apply air pressure to the stage in order to install the collet.
19. Install the new collet and collet nut as described in Section 4.4.2.
20. Restore the air supply to the original settings and restore power to the stage.

4.4.4. Gripper Configurations (ACS Only)

This section gives information on three-jaw grippers available on ACS-150 and ACS-200 stages.

The grippers are configurable in both normally-closed and normally-open modes. The center shaft of the ACS stages has two sets of mounting holes for the three-jaw grippers, one for a normally-open configuration and one for a normally-closed configuration. See Figure 4-14 for locations of these holes. Figure 4-15 shows the mounting screw locations on the gripper itself. The following is the procedure to change configurations:

1. Remove power to the stage and disconnect air supply.
2. Remove the three gripper mounting screws.
3. Figure 4-16 shows the locations of the set screws in the gripper based on which configuration is desired. Move the set screws as necessary.
4. It will be necessary to move an O-Ring on the shaft. Figure 4-14 shows two O-Rings and the three O-Ring grooves. One O-Ring should always be around the air inlet hole, and the other must be moved to help seal the gripper. Move the O-Ring as necessary so that the set screw in the gripper will be surrounded by an O-Ring when it is bolted to the stage.
5. Bolt the gripper to the stage shaft using the holes labeled either “NC” (normally-closed), or “NO” (normally-open).
6. Restore power and air supply to the stage.

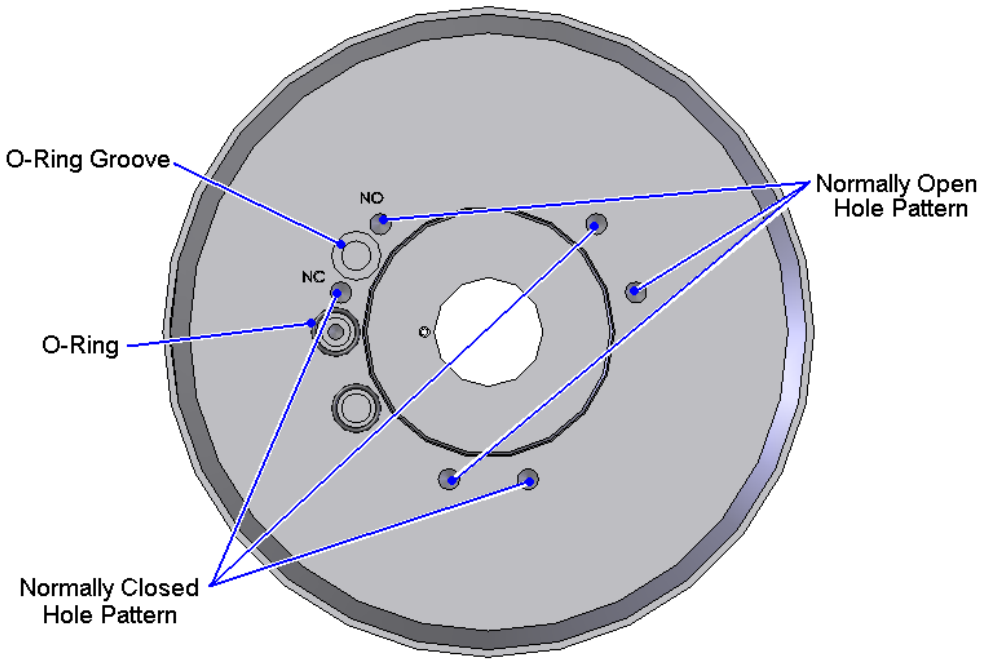


Figure 4-14: Gripper Mounting Hole Locations in ACS and ACS LP Shaft

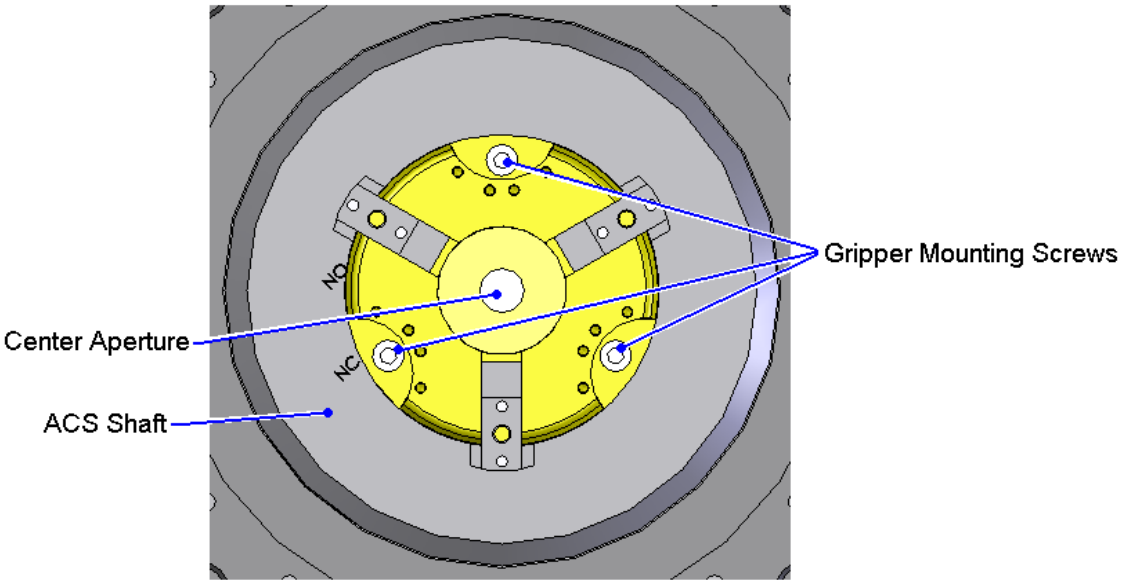


Figure 4-15: Mounting Holes for Three-Jaw Gripper

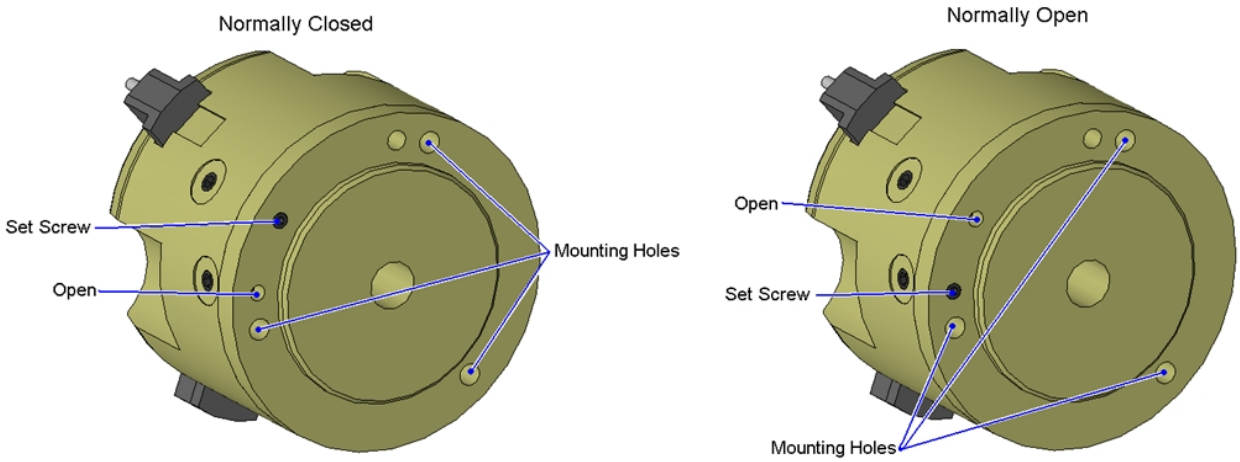


Figure 4-16: Air Inlets in Three-Jaw Grippers

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.

Laser Products

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.

Return Procedure

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.

Returned Product Warranty Determination

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

Returned Product Non-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.

Rush Service

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

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

Aerotech will provide an on-site field service representative in a reasonable amount of time, provided that the customer issues a valid purchase order to Aerotech covering all transportation and subsistence costs. For warranty field repairs, the customer will not be charged for the cost of labor and material. If service is rendered at times other than normal work periods, then special 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 (1.03.00)

Section(s) Affected	General Information
Section 3.5.	Changed pin 8 to reserved

Table B-2: Archived Changes

Revision	Section(s) Affected	General Information
1.02.00	Entire Manual	Added information on ACS-LP stages
1.02.00	Section 1.2.	Added stage dimensions
1.02.00	Section 1.4.	Added section
1.02.00	Section 3.1.	Added section
1.02.00	Chapter 2: Installation, Section 2.1. , Section 2.3. , Section 2.5. , and Section 1.3.	Added safety information and warnings
1.02.00	Section 3.2. and Section 3.3.	Added motor specifications
1.02.00	Section 3.5.	Added note about current and voltage requirements of wires
1.01.00	Section 4.2.1.	Section added
1.00.00	--	New manual

Index

Reader's Comments

ACS and ACS LP Series Stage Manual **P/N: EDS103, April 5, 2011** **Revision 1.03.00** Please answer the questions below and add any suggestions for improving this document.	

Is the manual:	Yes	No
Adequate to the subject		
Well organized		
Clearly presented		
Well illustrated		

How do you use this document in your job? Does it meet your needs? What improvements, if any, would you like to see? Please be specific or cite examples.

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Model #			Title	
Serial #			Company Name	
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