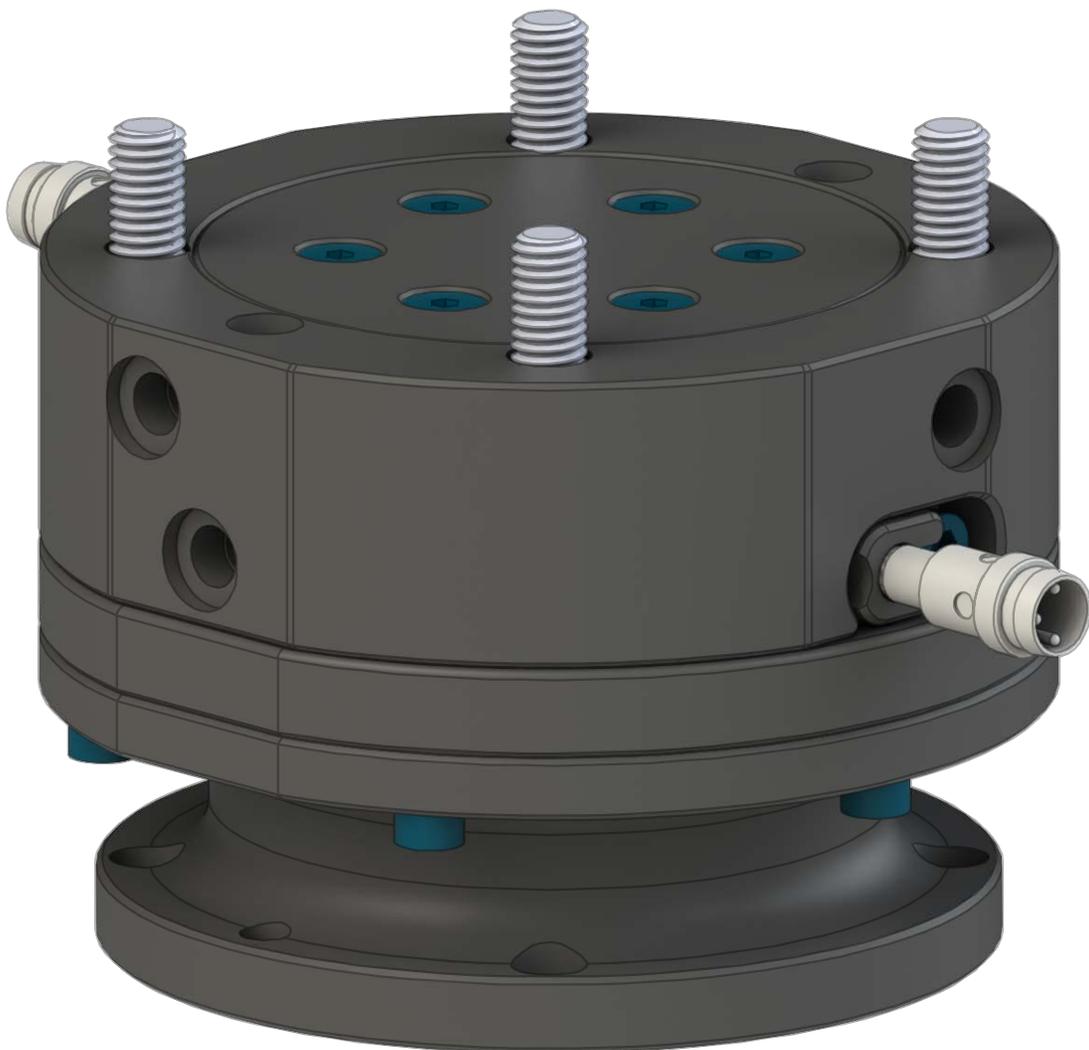




Compensator Manual

Lateral Compliance Compensator L1X-063



Document #: 9610-15-1005

Engineered Products for Robotic Productivity

Pinnacle Park • 1031 Goodworth Drive • Apex, NC 27539 USA • Tel: 919.772.0115 • Fax: 919.772.8259 • www.ati-ia.com • Email: info@ati-ia.com

Foreword

Please contact ATI Industrial Automation with any questions concerning your particular model.



CAUTION: This manual describes the function, application, and safety considerations of this product. This manual must be read and understood before any attempt is made to install or operate the product, otherwise damage to the product or unsafe conditions may occur.

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How to Reach Us

Sale, Service and Information about ATI products:

ATI Industrial Automation

1031 Goodworth Drive
Apex, NC 27539 USA
www.ati-ia.com
Tel: 919.772.0115
Fax: 919.772.8259
E-mail: info@ati-ia.com

Technical support and questions:

Application Engineering

Tel: 919.772.0115, Option 2, Option 2
Fax: 919.772.8259
E-mail: mech_support@ati-ia.com

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Glossary of Terms

Term	Definition
Ball Cage	A hardened steel ring with a thin dense chrome finish contains the chrome steel ball bearings that are engaged by the piston cam, during the locking process. The cage attaches to the Compensator body.
Compensator Body	The part of the Lateral Compliance Compensator that is mounted to a robot and contains the locking mechanism.
Compliance Ring	A circular plate that transfers force from the (4) position lock pistons to the tool plate, when the Position Hold function is activated.
End-effector	A customer's tooling that attaches to the Compensator's tool plate and is used to perform a particular function.
Lock Port	A pneumatic bore in the compensator body to which air is supplied to force the piston cam in the locked position.
Lock Sensing	A proximity sensor that is mounted in the compensator body and detects when the piston cam is in the Locked position.
Piston-Cam	A circular device with a flange that contacts the flange of the ball cage and forces the ball bearings outward during the locking process.
Position Hold Port	A pneumatic bore in the compensator body to which air is supplied the (4) position lock pistons move and force the compliance ring and tool plate in a fixed position. Some models have a plug in this port so that the Position Hold function is not operational.
Tool Plate	The part of the Lateral Compliance Compensator that attaches to the End-effector. During the locking process, the piston cam and ball cage force the ball bearings outward to contact the internal surface of the tool plate and lock the Compensator.
Unlock Port	A pneumatic bore on the compensator body to which air is supplied to force the ball lock cam in the Unlocked position.
Unlock Sensing	A proximity sensor that is mounted in the compensator body and detects when the piston cam is in the Unlocked position.

1. Safety

The safety section describes general safety guidelines to be followed with this product, explanations of the notifications found in this manual, and safety precautions that apply to the product. More specific notifications are imbedded within the sections of the manual where they apply.

1.1 Explanation of Notifications

The following notifications are specific to the product(s) covered by this manual. It is expected that the user heed all notifications from the robot manufacturer and/or the manufacturers of other components used in the installation.



DANGER: Notification of information or instructions that if not followed will result in death or serious injury. The notification provides information about the nature of the hazardous situation, the consequences of not avoiding the hazard, and the method for avoiding the situation.



WARNING: Notification of information or instructions that if not followed could result in death or serious injury. The notification provides information about the nature of the hazardous situation, the consequences of not avoiding the hazard, and the method for avoiding the situation.



CAUTION: Notification of information or instructions that if not followed could result in moderate injury or will cause damage to equipment. The notification provides information about the nature of the hazardous situation, the consequences of not avoiding the hazard, and the method for avoiding the situation.

NOTICE: Notification of specific information or instructions about maintaining, operating, installing, or setting up the product that if not followed could result in damage to equipment. The notification can emphasize, but is not limited to: specific grease types, best operating practices, and maintenance tips.

1.2 General Safety Guidelines

Prior to purchase and installation, the customer should verify that the Lateral Compliance Compensator selected is rated for the maximum loads expected during operation. Refer to [Section 8—Specifications](#) for specific ratings, or contact ATI for assistance. Particular attention should be paid to dynamic loads caused by robot acceleration. These forces can be many times the value of static forces in high acceleration or deceleration situations.

All pneumatic fittings and tubing must be capable of withstanding the repetitive motions of the application without failing. The routing of electrical and pneumatic lines must minimize the possibility of stress/strain, kinking, rupture, etc. Failure of critical electrical or pneumatic lines to function properly may result in injury to personnel and equipment.

All electrical power, pneumatic and fluid circuits should be disconnected prior to servicing.

1.3 Safety Precautions



WARNING: Do not perform maintenance or repair on the Lateral Compliance Compensator with power or pneumatic circuits energized or injury or equipment damage will occur. Turn off and de-energize the power and pneumatic circuits before performing maintenance or repair on Compensator.



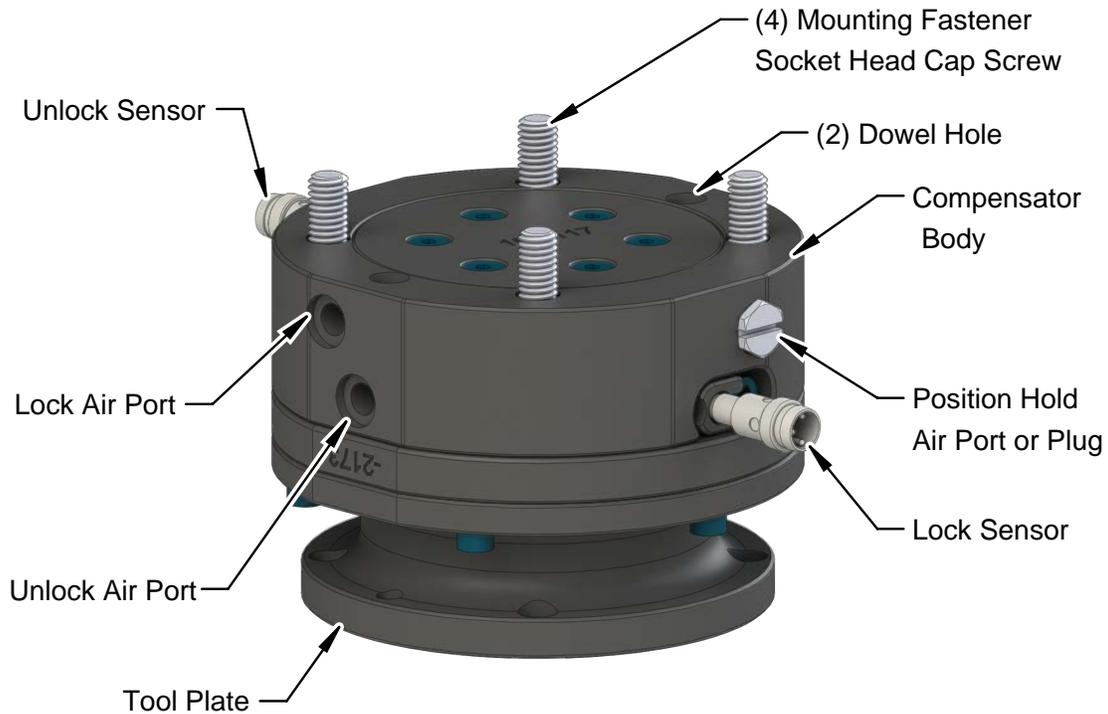
CAUTION: The Compensator is only to be used for intended applications and applications approved by the manufacturer. Using the Compensator in applications other than intended will result in damage to Compensator or end-of-arm tooling and could cause injury to personnel.

2. Product Overview

The Lateral Compliance Compensator is a compliance device that enhances the flexibility and reliability of a robot or assembly machine. Compensators are used in automated assembly applications to provide compliance for misalignment during assembly. When unlocked, the Compensator allows lateral compliance within the XY plane and rotation about the Z axis simultaneously.

The anodized aluminum Compensator body assembly has a locking mechanism that retains or traps the Tool plate to the Compensator body. The locking mechanism contains a piston-cam and ball cage for (3) ball bearings. When air is supplied to the “Lock” air port, the piston-cam moves the ball bearings outward so that the tool plate is centered and in a locked position. Extreme pressure grease is applied to the piston-cam and ball bearings to enhance performance and maximize the life of the locking mechanism.

Figure 2.1—Lateral Compliance Compensator

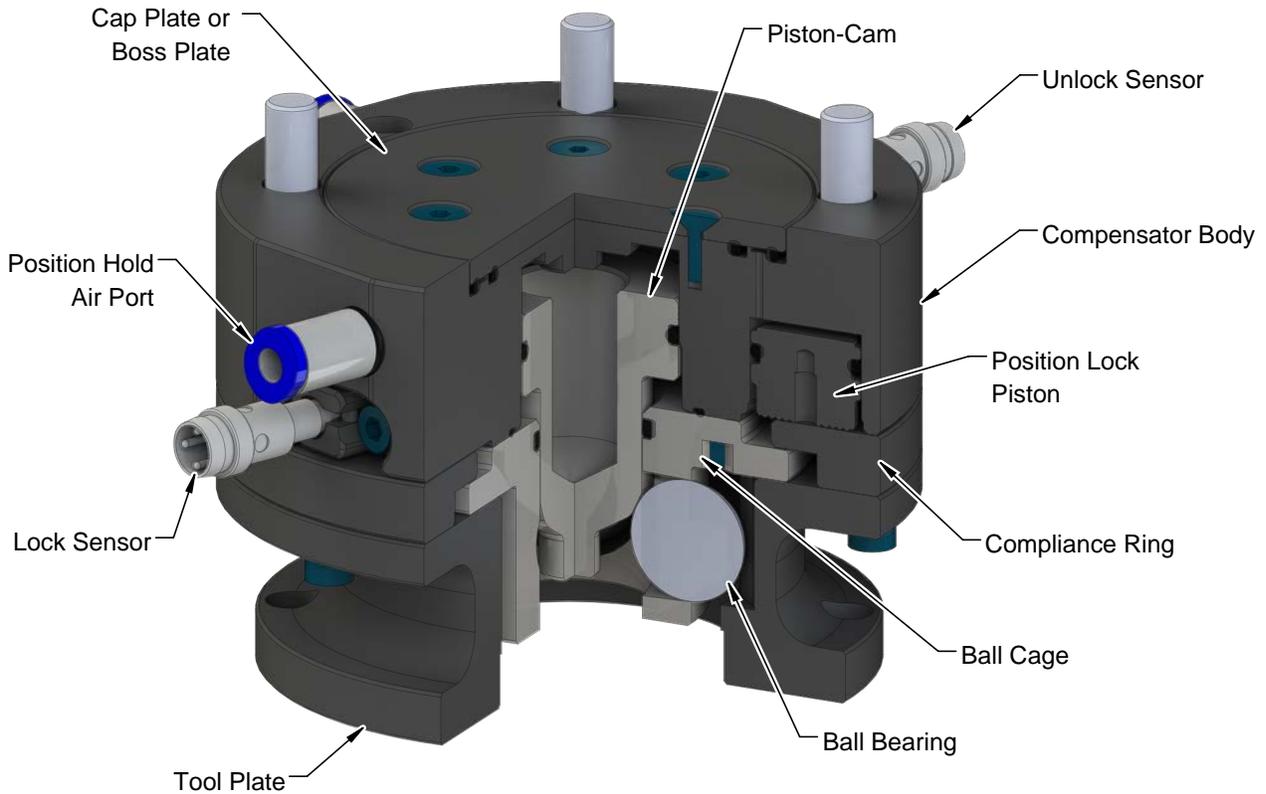


The compensator body is equipped with a circular mounting pattern, consisting of (4) supplied captive socket head cap screws, and two locating dowel holes used to mount the Compensator to the robot. Some models have a cap plate, and other models have a boss plate that can be used for installation (refer to [Section 3—Installation](#)). The body has (2) air ports for Lock, Unlock, and (2) PNP proximity sensors to detect the Lock and Unlock position of the piston cam. Refer to [Section 9—Drawings](#).

Some models have an optional “Position Hold” function. The Compensator body has an additional air port so that when air is applied, the (4) position lock pistons apply force to the compliance ring. For models without this function, there is a plug in the “Position Hold” air port, and the (4) position lock pistons are not installed.

The tool plate has a circular mounting pattern and two locating dowel pin holes for mounting the tool. Refer to [Section 9—Drawings](#).

Figure 2.2—Section View



Part numbers for the optional boss and Position Hold features are outlined in the following table.

Table 2.1—Model Optional Features		
Part Number	Boss or Cap Plate and Type of Fastener	Position Hold Option
9117-L1A-063-SG-M-2070-H	Cap Plate that secures to the Compensator body with (6) M3 Socket Flat Head Cap Screw	Yes
9117-L1J-063-SG-M-2070-H	40 mm Boss that secures to the Compensator body with (6) M3 Socket Head Cap Screw	

2.1 Compliance

The Compensator provides lateral compliance in the X and Y plane and rotational compliance about the Z axis. Refer to [Section 8—Specifications](#) or the model manual for the compliance values of each device from a centered position.

Figure 2.3—Lateral Compliance in the X and Y Axis

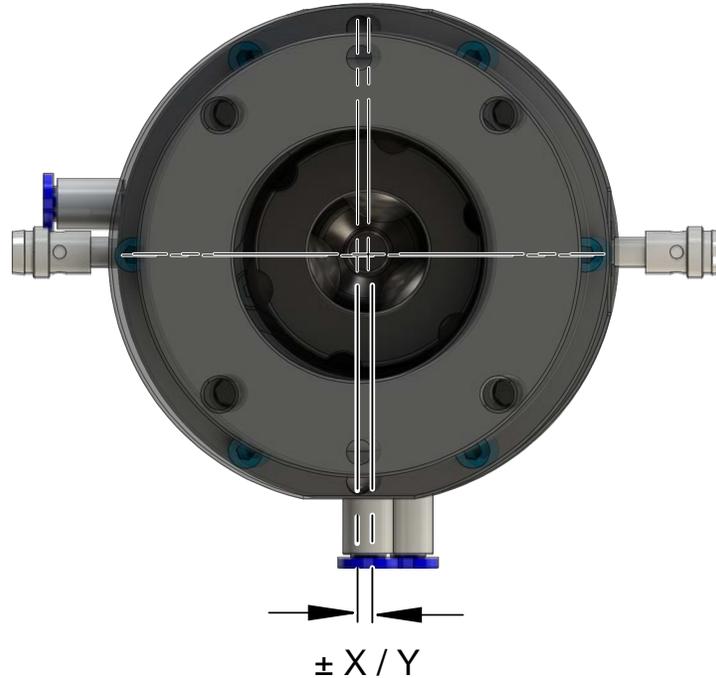
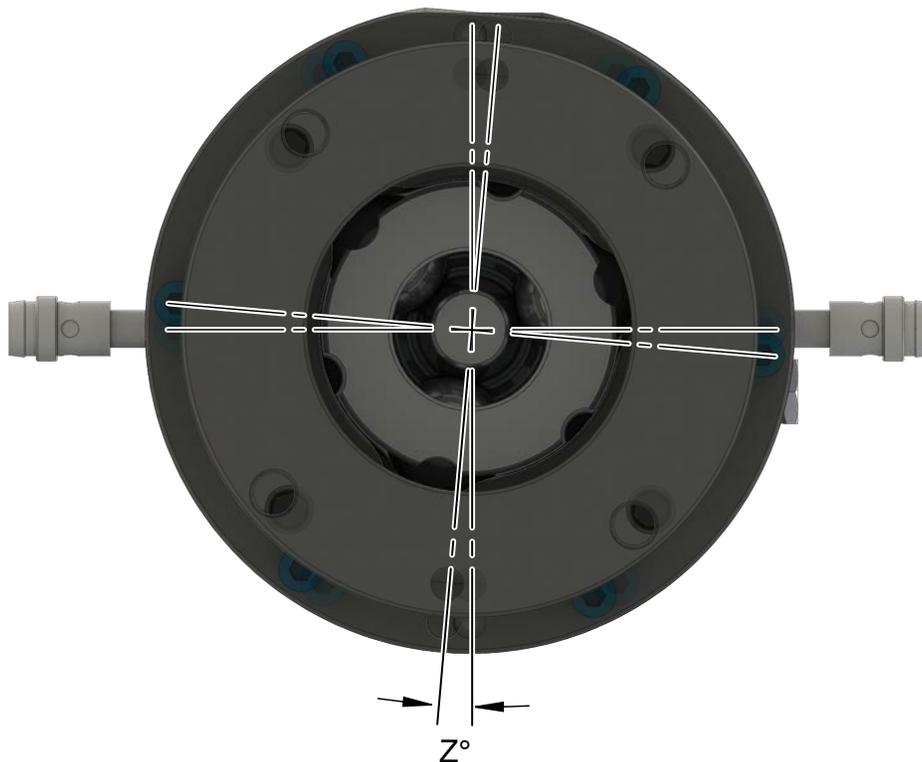


Figure 2.4—Rotational Compliance About the Z-Axis



3. Installation

- 

WARNING: Do not perform maintenance or repair(s) on the Compensator unless all energized circuits (e.g. electrical, air, water, etc.) are turned off, pressurized connections are purged and power is discharged from circuits in accordance with the customer’s safety practices and policies. Injury or equipment damage can occur with energized circuits on. Turn off and discharge all energized circuits, purge all pressurized connections, and verify all circuits are de-energized before performing maintenance or repair(s) on the Compensator.
- 

WARNING: All pneumatic fittings and tubing must be capable of withstanding the repetitive motions of the application without failing. The routing of electrical and pneumatic lines must minimize the possibility of over stressing, pullout, or kinking the lines. Failure to do so can cause critical electrical and/or pneumatic lines to malfunction and might result in injury to personnel or damage to equipment.
- 

CAUTION: Thread locker applied to fasteners must not be used more than once. Fasteners might become loose and cause equipment damage. Always apply new thread locker when reusing fasteners.

The Compensator mounts to the robot wrist using the ATI supplied captive mounting screws. The end-effector is attached to the tool mount plate by using the tapped hole pattern with customer supplied fasteners.

All mounting fasteners should be tightened to a torque value and have thread locker as indicated in [Table 3.1](#), which contains recommended values based on engineering standards.

Pneumatic lines and electrical cables should be attached, bundled, and strain-relieved in a manner that allows for freedom of movement during operation.

Table 3.1—Fastener Size, Class, and Torque Specifications			
Mounting Condition	Fastener Size and Property Class ²	Suggested Torque	Thread Locker
Compensator to the Robot or interface plate, (4) supplied captive M6 fasteners.	M6-1.0 X 20 mm Class 8.8	80 in-lbs (9 Nm)	Pre-applied Adhesive or Loctite® 242
End-effector or tool interface plate to the Compensator tool plate, (4) customer supplied M6 fasteners.	M6-1.0 Class 12.9		
	Socket head cap	90 in-lbs (10.2 Nm)	
	Socket flat head cap	60 in-lbs (6.78 Nm)	
Note: 1. Confirm available thread engagement with the robot manufacturer. 2. Do not exceed maximum available thread depth as shown in Section 9—Drawings .			

3.1 Robot Interface

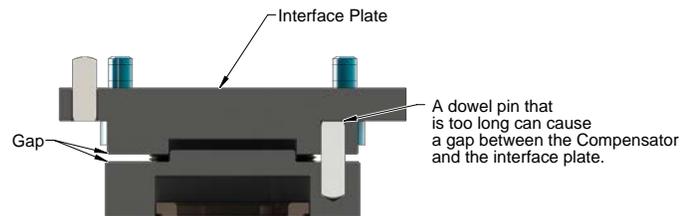
The compensator's body is typically attached to the robot arm. An interface plate can adapt the compensator to a specific robot arm. Alignment features (dowel holes and bosses) accurately position and bolt holes secure the compensator to the robot arm or an interface plate. Custom interface plates are available from ATI upon request. (Refer to [Section 9—Drawings](#).)



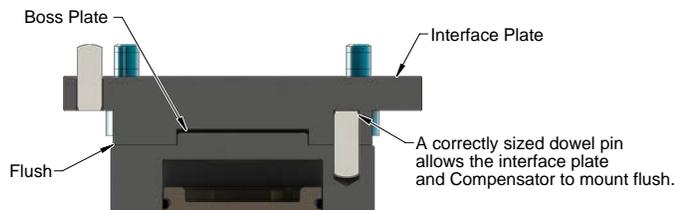
CAUTION: Do not use dowel pins that are too long or do not allow the interface plate and Compensator's body to mate flush. Using dowel pins that are too long will cause a gap between the interface plate and the Compensator's body and damage to the equipment. Use dowel pins that do not extend further than allowed by the Compensator's body.

CAUTION: Do not use more than two alignment features when securing the Compensator to an interface plate. Using more than two alignment features can cause damage to the equipment. Use either two dowel pins or a single dowel pin along with a boss/recess feature to align the Compensator with the interface plate.

Incorrect Mounting of the Compensator's Body



Correct Mounting of the Compensator's Body



If the customer chooses to design and build a robot interface plate, consider the following points:

- The interface plate should include bolt holes for mounting and either two dowel pins or a dowel pin and a boss for accurate positioning on the robot and Compensator. The dowel pins prevent rotation. Refer to the robot manual for robot mounting features.
- The thickness of the interface plate must be sufficient to provide the necessary thread engagement for the mounting bolts.
- Dowel pins must not extend out from the surface of the interface plate farther than the depth of the dowel holes in the Compensator's body.
- If a boss is used on the Compensator, a recess of proper depth and diameter must be machined into the interface plate to correspond with the boss on the Compensator.
- Mounting bolts that are too long can create a gap between the interface plate and the Compensator.
- The interface plate must provide rigid mounting to the Compensator.

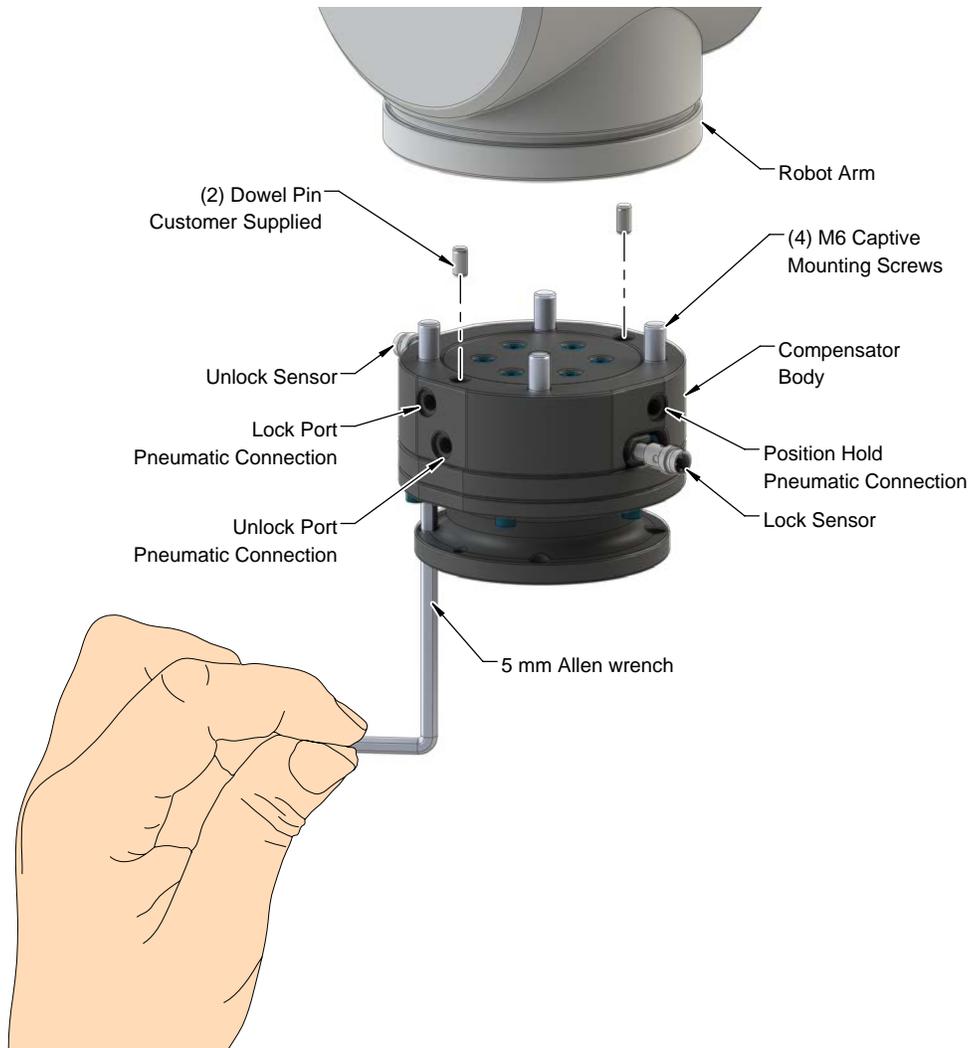
3.3 Installing the Compensator to the Robot

Tools required: 4 mm Allen wrench or hex key (for the M6 captive fasteners or the customer supplied M6 flat head socket cap screws), 5 mm Allen wrench (for the customer supplied M6 socket head cap screws) and a torque wrench

Supplies required: Loctite 242 and a clean rag

1. Turn off and de-energize all energized circuits, for example, electrical, air, and water.
2. Clean the mounting surfaces.
3. With the Compensator in the unlocked position, secure the Compensator to the robot.
 - a. Apply Loctite 242 to the exposed threads of the (4) M6 captive socket head cap screw.
 - b. Insert a 4 mm Allen wrench through the tapped M6 holes of the tool plate.
 - c. Using the Allen wrench, secure the Compensator to the robot with the (4) captive socket head cap screws. Tighten to 80 in-lbs (9 Nm).

Figure 3.1—Installing the Compensator to the Robot



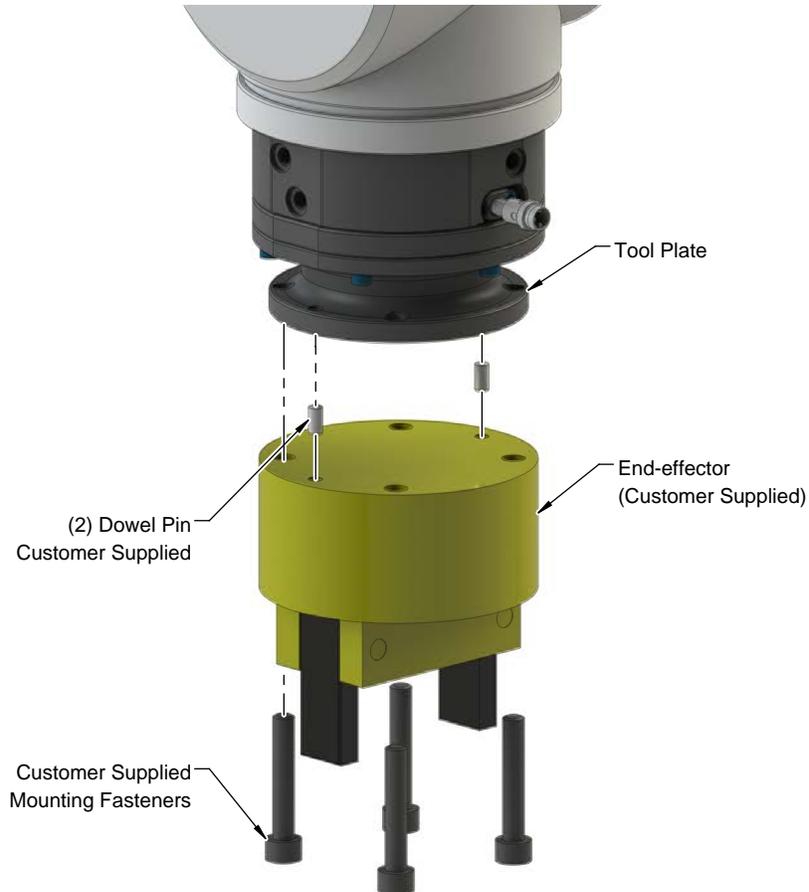
4. Attach pneumatic hosing to the Compensator's Lock,Unlock, and, if equipped, position hold connections.



CAUTION: All pneumatic fittings and tubing must be capable of withstanding the repetitive motions of the application without failing. The routing of electrical and pneumatic lines must minimize the possibility of over stressing, pullout, or kinking the lines. Failure to do so can cause some critical electrical and/or pneumatic lines malfunction and may result in injury to personnel or damage to equipment.

5. If equipped, attach the (2) sensor cable connection.
6. Using an Allen wrench, secure the end-effector or customer supplied interface plate to the Compensator's tool plate with customer supplied fasteners. Refer to [Table 3.1](#) for torque and thread locker specifications and [Section 9—Drawings](#) for mounting details.

Figure 3.2—Installing the End-effector to the Compensator



7. After the procedure is complete, the Compensator is ready for normal operation.

3.4 Removing the Compensator from the Robot

Tools required: 4 mm Allen wrench or hex key

1. Place the Compensator in the unlocked position.
2. Turn off and de-energize all energized circuits, for example electrical, air, and water.
3. If equipped, disconnect the cable connections to the sensors and pneumatic hosing to the air fittings.
4. Using an Allen wrench, remove the mounting fasteners that secure the end-effector or customer supplied interface plate to the Compensator's tool mount plate.
5. Using a 4 mm Allen wrench, loosen the captive fasteners that secure the Compensator to the robot.
6. Remove the Compensator.

3.5 Lock/Unlock Pneumatic Connections and Valve



CAUTION: The locking mechanism cannot function properly when connected to a 3-way valve as this type of valve is incapable of venting trapped air or a vacuum from within the Compensator. This could result in damage to the product, attached tooling, or injury to personnel. Connect the Lock and Unlock supply air to a 2-position 4-way or 5-way valve.

To lock the Compensator, supply air to the "Lock" air port on the Compensator body so that the piston-cam moves downward and forces the ball bearings to move outward. When the ball bearings move outward and contact the internal surface of the tool plate, the Compensator and tool plate become rigid and reach a central, locked position.

To unlock the Compensator, air must be vented from the "Lock" air port and air must be supplied to the "Unlock" air port.

3.5.1 Air Requirements

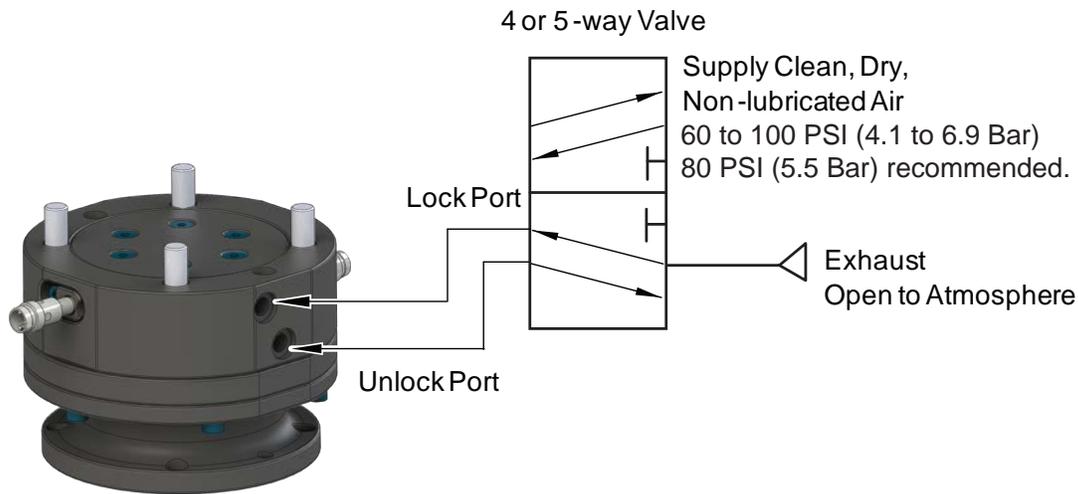
Proper operation of the Compensator's locking mechanism requires a constant supply of clean, dry, non-lubricated air, with the following conditions:

- A pressure between 60 and 100 PSI (4.1 to 6.9 Bar). 80 PSI (5.5 Bar) is recommended.
- Filtered to 50 micron or better.

3.5.2 Valve Requirements and Connections

A customer supplied 2-position 4-way or 5-way valve must be used to actuate the locking mechanism in the Compensator. It is imperative that when air is supplied to the “Lock” or “Unlock” port on the compensator body, that the opposite port be vented to the atmosphere (i.e., when air is supplied to the “Lock” port, the “Unlock” port must be open to the atmosphere). Failure to vent trapped air or a vacuum on the inactive port may inhibit operation of the valve and prevent the Compensator from locking and unlocking. The “Lock” and “Unlock” air ports are threaded for M5 x 0.8 connections.

Figure 3.3—Lock and Unlock Pneumatic Connections



3.6 Position Hold Pneumatic Connection (Optional)

To activate the Position Hold function, supply air to the “Position Hold” air port to move the (4) internal lock pistons and apply force on the compliance ring and by extension, the tool plate. The Compensator maintains a Position Hold until the air pressure is removed from the “Position Hold” air port.

3.6.1 Air Requirements

Proper operation of the Compensator’s Position Hold operation requires a constant supply of clean, dry, non-lubricated air, with the following conditions:

- A pressure between 60 to 100 PSI (4.1 to 6.9 Bar). 80 PSI (5.5 Bar) is recommended.
- Filtered to 50 micron or better.

3.7 Electrical Connections

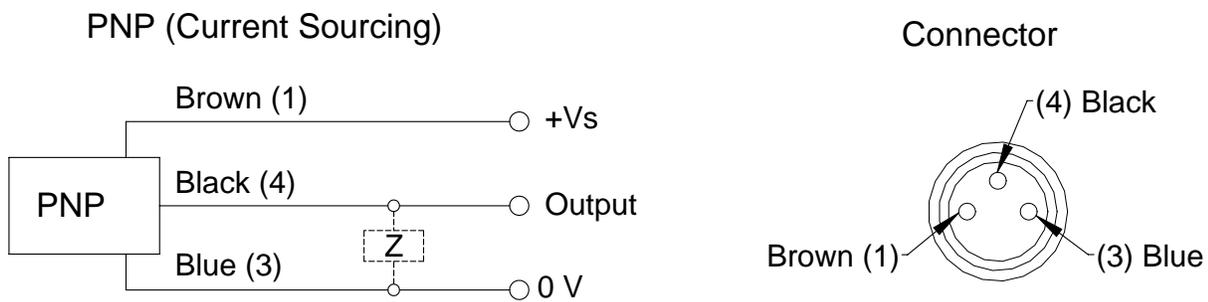
The Compensator body has lock and unlock PNP proximity sensors with M8 quick disconnect connections.

3.7.1 PNP Type Lock Sensors

The PNP sensors are 4 mm cylindrical inductive proximity sensors.

Table 3.2—PNP (Current Sourcing)	
Description	Value
Voltage Supply Range	10-30 VDC
Output Current	< 100 mA
Nominal Sensing Distance	1.0 mm
Output Circuit	PNP sensor (NO)

Figure 3.4—PNP Type Lock Sensors



4. Operation

The Compensator locking mechanism is pneumatically driven and requires a continuous supply of clean, dry non-lubricated air from 60 to 100 PSI (4.1 to 6.9 Bar), 80 PSI (5.5 bar) recommended, and filtered to 50 microns or better. The Position Hold function requires dry non-lubricated air 60 to 100 PSI (4.1 to 6.9 Bar), 80 PSI (5.5 bar) recommended, and filtered to 50 microns or better only when the Position Hold function is applied.



CAUTION: Safe, reliable operation of the Compensators locking mechanism depends on a continuous supply of compressed air at a pressure of 60 to 100 PSI (4.1 to 6.9 Bar), 80 PSI (5.5 bar) recommended. Robot motion should be halted, if the air supply pressure drops below 60 psi (4.1 Bar) for any reason.

4.1 Lock Position

To lock the Compensator in the centered position, air must be supplied to the “Lock” air port on the Compensator body to move the piston-cam and force the ball bearings outward. When the ball bearings move outward and contact the internal surface of the tool plate, the Compensator and tool plate become rigid and reach a central position. The Compensator is locked. Air from the “Unlock” port must be exhausted to the atmosphere. The Compensator is not compliant in the locked position.



CAUTION: Do not lock the Compensator if the Position Hold function is active or components in the locking mechanism will be damaged. Release air from the “Position Hold” port before supplying air to the “Lock” port.

4.2 Unlocked Position

To unlock the Compensator, air must be supplied to the “Unlock” air port on the Compensator body to move the piston-cam upward and release the locking balls. The locking balls move inward and release the tool plate. Air from the “Lock” port must be exhausted to the atmosphere. In the unlock position, the Compensator is fully compliant.

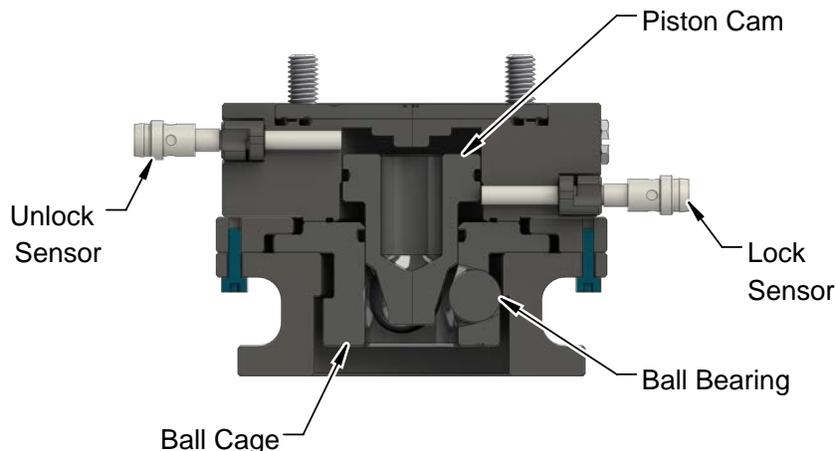
4.3 Position Hold (Optional)

To activate the Position Hold function, air must be supplied to the “Position Hold” port on the Compensator body. Activate Position Hold when the Compensator is in the Unlocked position. Before locking the Compensator, remove Position Hold. When the Position Hold function is activated, the Compensator is not compliant.

4.4 Locked and Unlocked Position Sensing

The proximity sensors verify the Compensator is in the locked or unlocked position. When the piston-cam moves within the Compensator body, the lock and unlock proximity sensors detect when the piston-cam enters the sensing range and sends a lock or unlock signal.

Figure 4.1—Lock Position Sensor

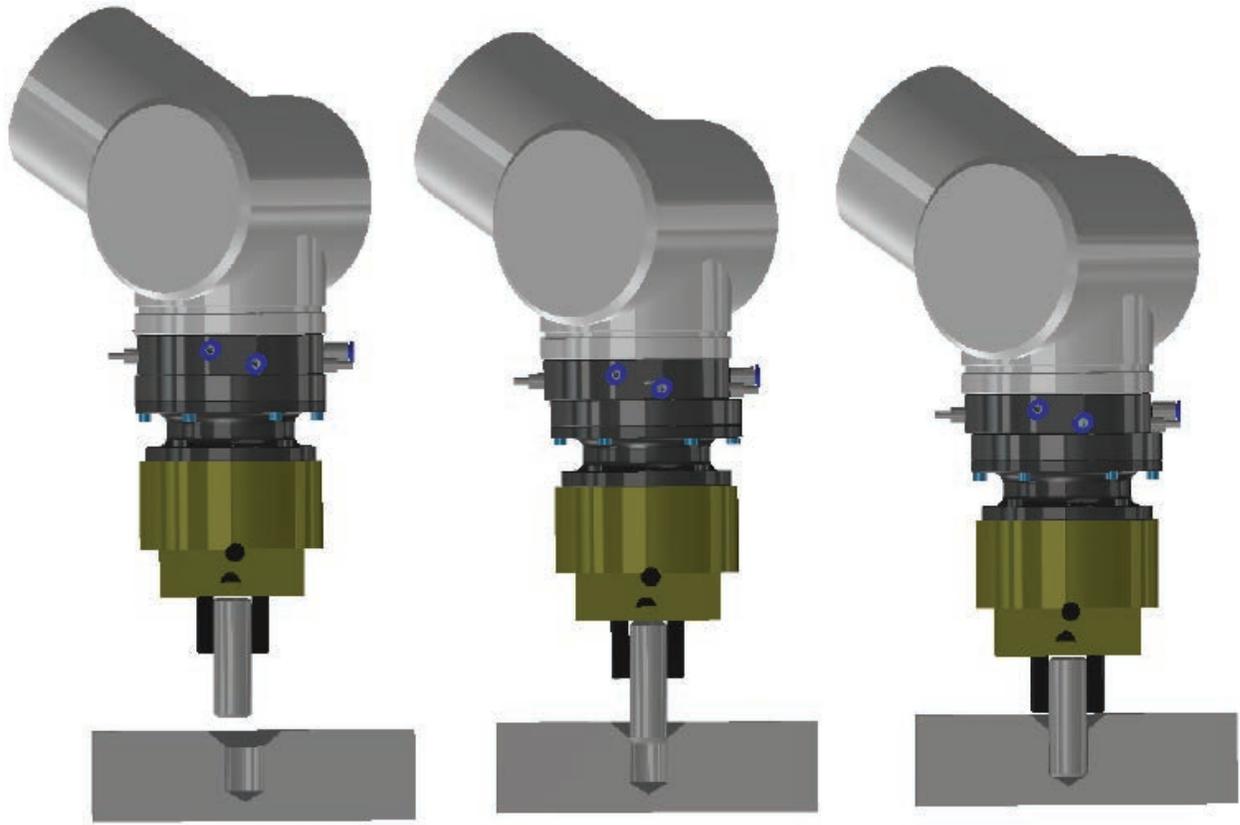


4.5 Operation of Inserting a Part

The Compensator can be used in a part insertion operation. The LCC is intended for use in the vertical orientation for the following functions: Unlock, Lock, and Position Hold. However, the LCC can be used for horizontal applications with decreased ratings. Refer to [Section 8—Specifications](#). When the Compensator is locked and centered, its stiffness supports motion in all orientations. Contact ATI for consultation about using the Compensator in various orientations.

The Compensator allows for misalignment of the robot and work piece in the X-Y and rotational directions.

Figure 4.2—Part Insertion



The robot moves to the insertion position above the work piece.

The Compensator is unlocked and fully compliant.

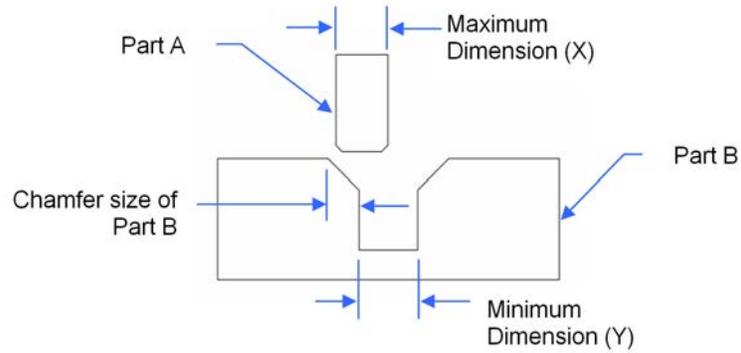
The robot moves to insert the pin. The Compensator adjusts to the chamfer to center the pin in the hole.

The Compensator is unlocked with position hold on.

The robot inserts the pin into the hole.

The Compensator is intended to be used in applications where one part is inserted into another part in the vertical orientation. Example applications include the following: dowel pin insertion, mold alignment, washer insertion, bearings into housings, and shafts into bearings.

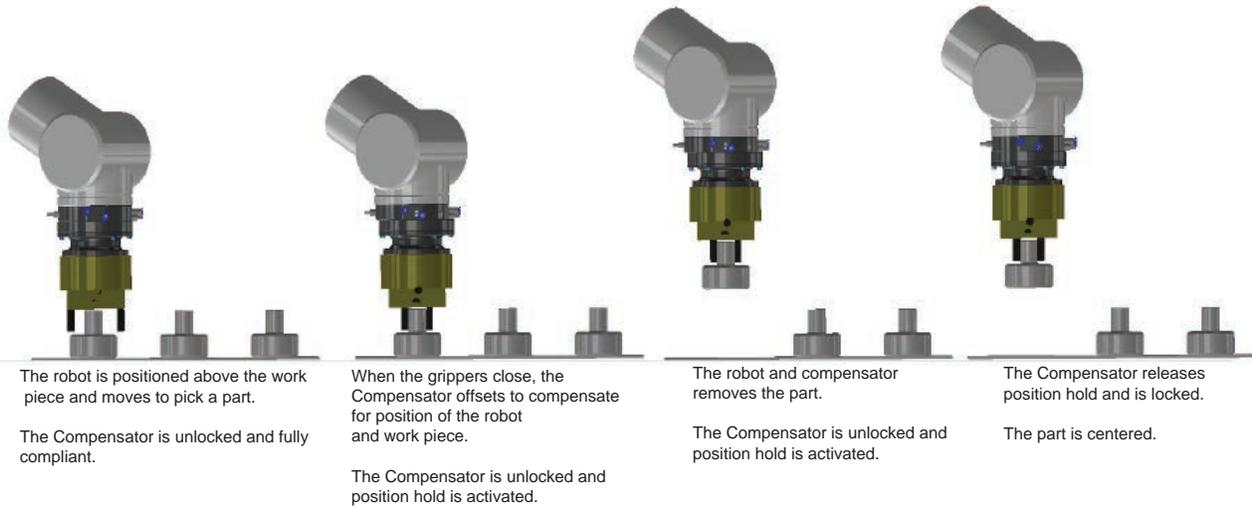
Figure 4.3—Assembly Inaccuracy



4.6 Operation of Picking a Part

The Compensator can be used in a part picking operation in a vertical orientation. The Compensator allows for misalignment of the robot and work piece in the X-Y and rotational directions.

Figure 4.4—Part Selection



5. Maintenance

Under normal conditions, no special maintenance is necessary; however, it is recommended that periodic inspections be performed to assure long-lasting performance and that unexpected damage has not occurred. Refer to [Section 5.1—Preventive Maintenance](#) for a schedule and items that should be visually inspected at regular intervals. Spare parts are available from ATI. Call for recommendations.



WARNING: Do not perform maintenance or repair(s) on the Compensator unless all energized circuits (e.g. electrical, air, water, etc.) are turned off, pressurized connections are purged and power is discharged from circuits in accordance with the customer's safety practices and policies. Injury or equipment damage can occur with energized circuits on. Turn off and discharge all energized circuits, purge all pressurized connections, and verify all circuits are de-energized before performing maintenance or repair(s) on the Compensator.



CAUTION: Thread locker applied to fasteners must not be used more than once. Fasteners might become loose and cause equipment damage. Always apply new thread locker when reusing fasteners.

5.1 Preventive Maintenance

A visual inspection and preventive maintenance schedule is provided in the [Table 5.1](#). Assembly details are provided in [Section 9—Drawings](#) of this manual.

Table 5.1—Preventive Maintenance Checklist		
Application(s)	Cycle Frequency	Inspection Schedule
General Usage, Material Handling, Docking Station	More than 1 per minute	Weekly
	Less than 1 per minute	Monthly
Wet or Humid Environments	All	Weekly
Welding/Servo/Deburring, Foundry Operations (Dirty Environments)	All	Weekly
Mounting Fasteners		
<input type="checkbox"/> Inspect mounting fasteners, verify they are tight and have the proper torque. Refer to Section 3—Installation .		
Interface Connections		
<input type="checkbox"/> Inspect pneumatic connections for cuts in hoses, abrasions, or wear. If signs of wear are apparent, replace and secure the lines so that they allow freedom of movement during operation and do not rub or obstruct other components.		
<input type="checkbox"/> Inspect electrical cables for cuts, abrasions, or wear. If signs of wear are apparent, replace and secure cables so that they allow freedom of movement during operation and do not rub or obstruct other components.		
Rubber O-ring seals		
<input type="checkbox"/> Inspect for wear, abrasion, and cuts. If worn or damaged, replace. Refer to Section 6.2.1—O-ring Seal Replacement, Cleaning, & Lubrication of the Locking Mechanism .		
Locking Mechanism - cleaned and lubricated every 250,000 cycles.		
<input type="checkbox"/> Inspect and lubricate the locking mechanism. Over time lubricants become contaminated with process debris. Clean the mechanism of existing grease and relubricate. Refer to Section 6.2.1—O-ring Seal Replacement, Cleaning, & Lubrication of the Locking Mechanism .		
<p>Note: The locking mechanism components are subject to corrosion from water. If these components become wet, dry and grease immediately to prevent damage.</p>		

6. Troubleshooting and Service Procedures

The following section provides troubleshooting information to help diagnose conditions with the Compensator and service procedures to help resolve these conditions.



WARNING: Do not perform maintenance or repair(s) on the Compensator unless all energized circuits (e.g. electrical, air, water, etc.) are turned off, pressurized connections are purged and power is discharged from circuits in accordance with the customer's safety practices and policies. Injury or equipment damage can occur with energized circuits on. Turn off and discharge all energized circuits, purge all pressurized connections, and verify all circuits are de-energized before performing maintenance or repair(s) on the Compensator.



CAUTION: Thread locker applied to fasteners must not be used more than once. Fasteners might become loose and cause equipment damage. Always apply new thread locker when reusing fasteners.

6.1 Troubleshooting

The following table is provided to assist with troubleshooting the system.

Table 6.1—Troubleshooting		
Symptom	Possible Cause	Correction
The locking mechanism does not actuate.	The pneumatic connections are incorrect, or the supplied air is insufficient.	Ensure that the Compensator has proper pneumatic connections and that air is supplied at a minimum of 60 psi (4.1 bar). Refer to Section 3.5—Lock/Unlock Pneumatic Connections and Valve .
	Air or a vacuum is trapped in a de-energized Lock or Unlock port, or the valve type is incorrect.	Ensure that no air or a vacuum can be trapped in a de-energized Lock or Unlock port, and verify a 4 way type valve is used (pressure must be vented to the atmosphere). Refer to Section 3.5—Lock/Unlock Pneumatic Connections and Valve .
	O-ring seals are worn and leaking air.	Replace O-ring seals. Refer to Section 6.2.1—O-ring Seal Replacement, Cleaning, & Lubrication of the Locking Mechanism .
The Position Hold is not operating properly.	The pneumatic connections are incorrect, or the supplied air is insufficient.	Ensure that the Compensator has proper pneumatic connections and that air is supplied at a minimum of 60 psi (4.1 bar). Refer to Section 3.5—Lock/Unlock Pneumatic Connections and Valve .
	O-ring seals are worn and leaking air.	Replace O-ring seals. Refer to Section 6.2.1—O-ring Seal Replacement, Cleaning, & Lubrication of the Locking Mechanism .
The sensors do not report a locked or unlocked position or are sending intermittent signals.	The sensor cable is damaged, or there is a loose connection.	Inspect sensor cable for damage or a loose connection. If a connection is loose, re-connect. If the sensor cable is damaged, replace. Refer to Section 6.2.2—Sensor Replacement .
	Sensor not functioning.	Replace sensor. Refer to Section 6.2.2—Sensor Replacement .

6.2 Serviceable Procedures

The following service procedures provide instructions for inspection, adjustment, test or replacement of components.

6.2.1 O-ring Seal Replacement, Cleaning, & Lubrication of the Locking Mechanism

Refer to [Figure 6.1](#) through [Figure 6.3](#), while completing the following procedure.

Parts required: Refer to [Section 7—Serviceable Parts](#).

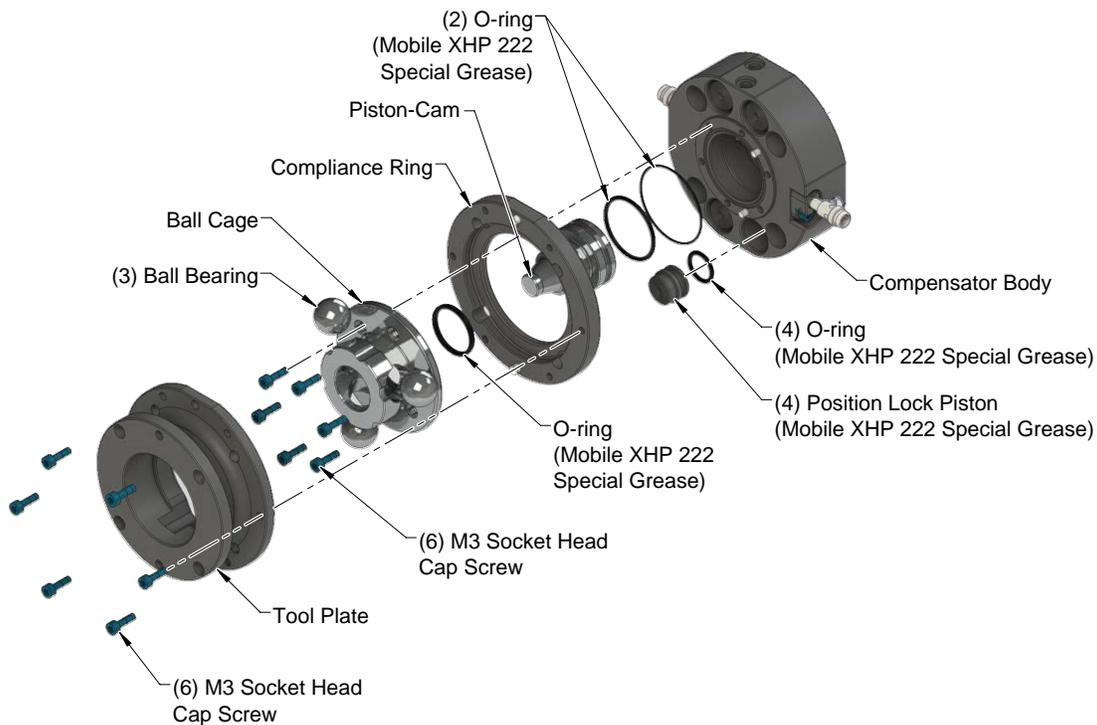
Tools required: 2 mm and 2.5 mm Allen wrench or hex key, torque wrench.

Supplies required: Clean rag, MobilGrease® XHP222 Special grease, Loctite 222.

1. Turn off and de-energize all energized circuits, for example, electrical, air, and water.
2. Remove the end-effector from the Compensator and remove the Compensator from the robot. Refer to [Section 3.4—Removing the Compensator from the Robot](#).
3. Remove and clean the tool plate.
 - a. Using a 2.5 Allen wrench, remove the (6) M3 socket head cap screws that secure the tool plate to the compliance ring.
 - b. Carefully pull the tool plate straight up and off the compliance ring. This may be difficult due to the close fit of the dowel pins. Set aside.
 - c. Clean the lubrication from the inner surfaces of the tool plate.

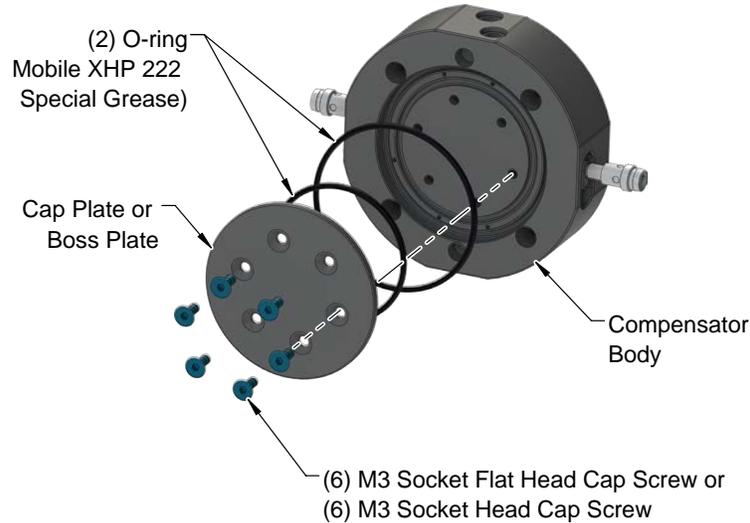
4. Remove and clean the locking mechanism.
 - a. Using a 2.5 Allen wrench, remove the (6) M3 socket head cap screws that secure the ball cage flange to the Compensator body.
 - b. Remove the ball cage and (3) ball bearings.
 - c. Remove the O-ring from the inner bore of the ball cage and discard.
 - d. Clean the lubrication from the ball cage and (3) ball bearings.
 - e. Remove the compliance ring.
 - f. Clean the lubrication from the inner surfaces of the compliance ring.
 - g. Remove the piston-cam from the base of the Compensator body.
 - h. Remove the O-ring from the groove in the piston-cam and discard.
 - i. Clean the outer surfaces of the cam.
 - j. Remove the (4) position lock pistons from the bores in the Compensator body.
 - k. Remove and discard the (4) O-rings from each of the position lock pistons.
 - l. Remove the O-ring from the top of the Compensator body and discard.
 - m. Clean lubrication from the bore in the Compensator body.

Figure 6.1—Disassemble the Tool Plate and Locking Mechanism for O-ring Replacement and Cleaning



5. Remove and clean the cap plate and seals in the robot side of the Compensator body.
 - a. Using a 2.5 mm Allen wrench for (6) socket head cap screws, or a 2 mm Allen wrench for socket flat head cap screws, remove the fasteners from the cap plate.
 - b. Remove the cap or boss plate.
 - c. Remove and discard the (2) O-rings in the Compensator body.
 - d. Clean the bore in the Compensator body.

Figure 6.2—Disassemble the Cap or Boss Plate for O-ring Replacement and Cleaning

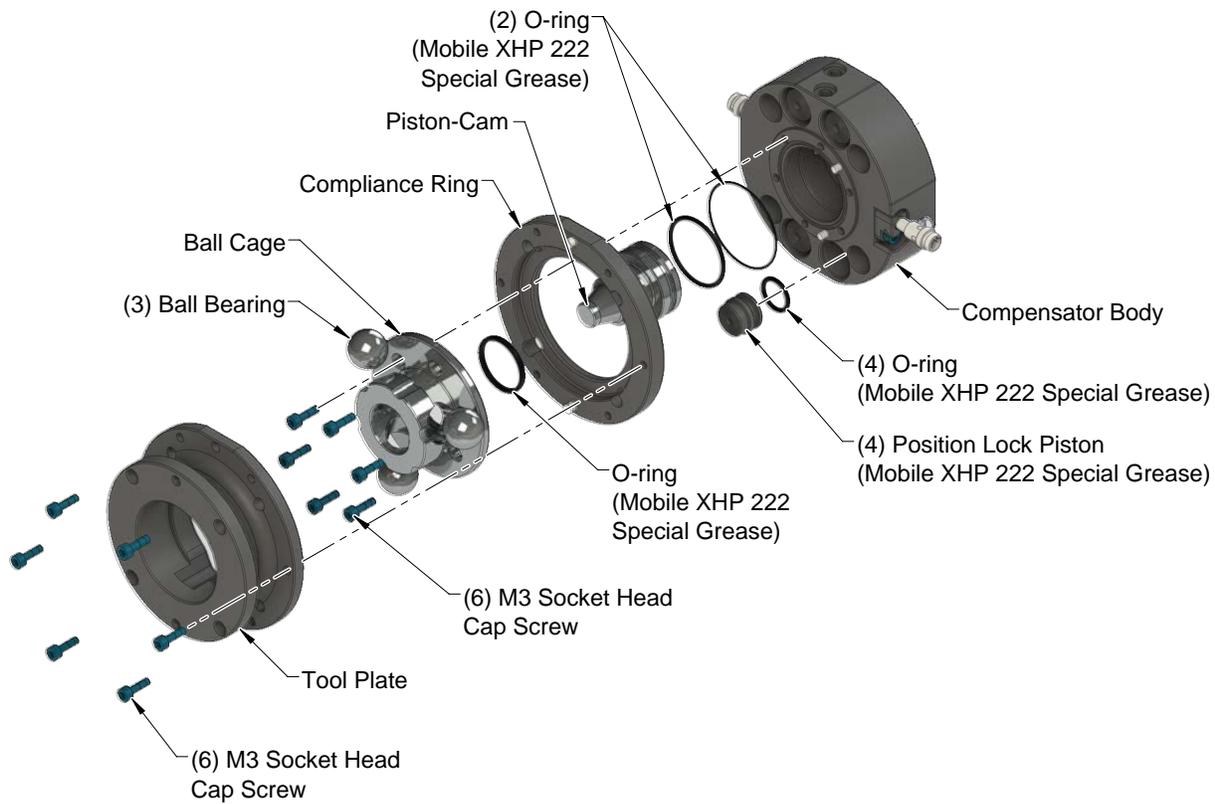


NOTICE: Use MobilGrease XHP222 Special grease to lubricate the locking mechanism and O-rings. Note: MobilGrease XHP222 Special is a NLGI #2 lithium complex grease with molybdenum disulfide.

6. Assemble the cap or boss plate and seals in the robot side of the Compensator body.
 - a. Apply a coating of lubricant to the (2) new O-ring seals and insert in the Compensator body.
 - b. Apply Loctite 222 to the threads of the (6) M3 socket flat head cap screws.
 - c. Using a 2.5 mm Allen wrench for the (6) socket head cap screws, or a 2 mm Allen wrench for (6) socket flat head cap screws, secure the plate to the Compensator body. Tighten to 6 in-lbs (0.68 Nm).

7. Assemble the locking mechanism in the Compensator body.
 - a. Lubricate the new O-ring seal and insert in the top groove of the Compensator body.
 - b. Assemble the (4) new O-rings in the grooves of the (4) position lock pistons.
 - c. Apply lubrication to the outer surfaces of the (4) O-rings and (4) position lock pistons.
 - d. Insert the (4) position lock pistons in the bores of the Compensator body.
 - e. Install a new O-ring in the groove of the piston-cam.
 - f. Lubricate the O-ring and piston-cam surface.
 - g. Insert the piston-cam into the Compensator.
 - h. Lubricate the inner surface of the Compliance ring.
 - i. Place the Compensator ring on the Compensatory body.
 - j. Install a new O-ring in the bore of the ball cage.
 - k. Install the (3) ball bearings in the ball cage.
 - l. Lubricate the O-ring and (3) ball bearings.
 - m. Insert the ball cage and (3) ball bearings onto the piston-cam.
 - n. Apply Loctite 222 to the threads of the (6) M3 socket head cap screws.
 - o. Using a 2.5 mm Allen wrench secure the ball cage to the Compensator body with the (6) M3 socket head cap screws. Tighten to 12 in-lbs (1.4 Nm).

Figure 6.3—Assemble the Locking Mechanism and Tool Plate



8. Assemble the tool plate to the Compensator body.
 - a. Lubricate the inner surfaces of the tool plate.
 - b. Apply Loctite 222 to the threads of the (6) M3 socket head cap screws.
 - c. Using a 2.5 mm Allen wrench for (6) socket head cap screws, or a 2 mm Allen wrench for (6) socket flat head cap screws, secure the tool plate to the Compensator ring. Tighten to 12 in-lbs (1.4 Nm).
9. Install the Compensator to the robot and the end-effector to the Compensator, refer to [*Section 3.3—Installing the Compensator to the Robot.*](#)
10. After the procedure is complete, resume normal operation.

6.2.2 Sensor Replacement

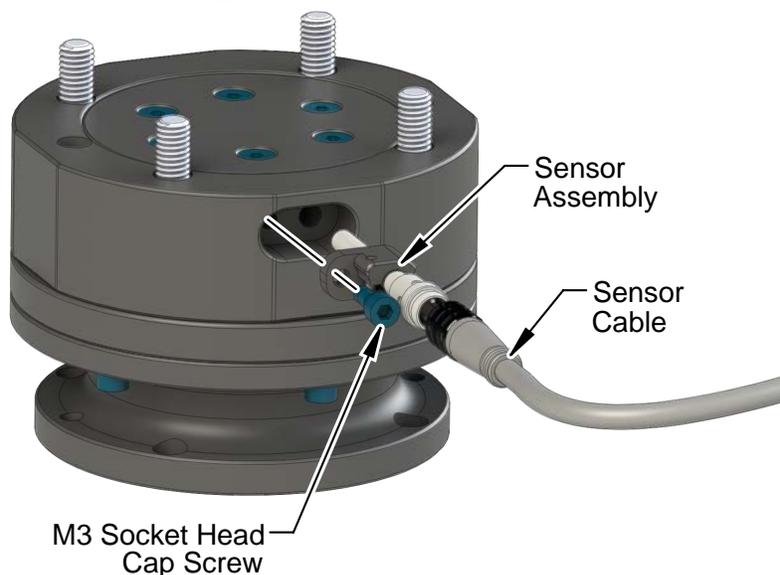
Parts required: Refer to [Section 7—Serviceable Parts](#).

Tools required: 2.5 mm Allen wrench (hex key)

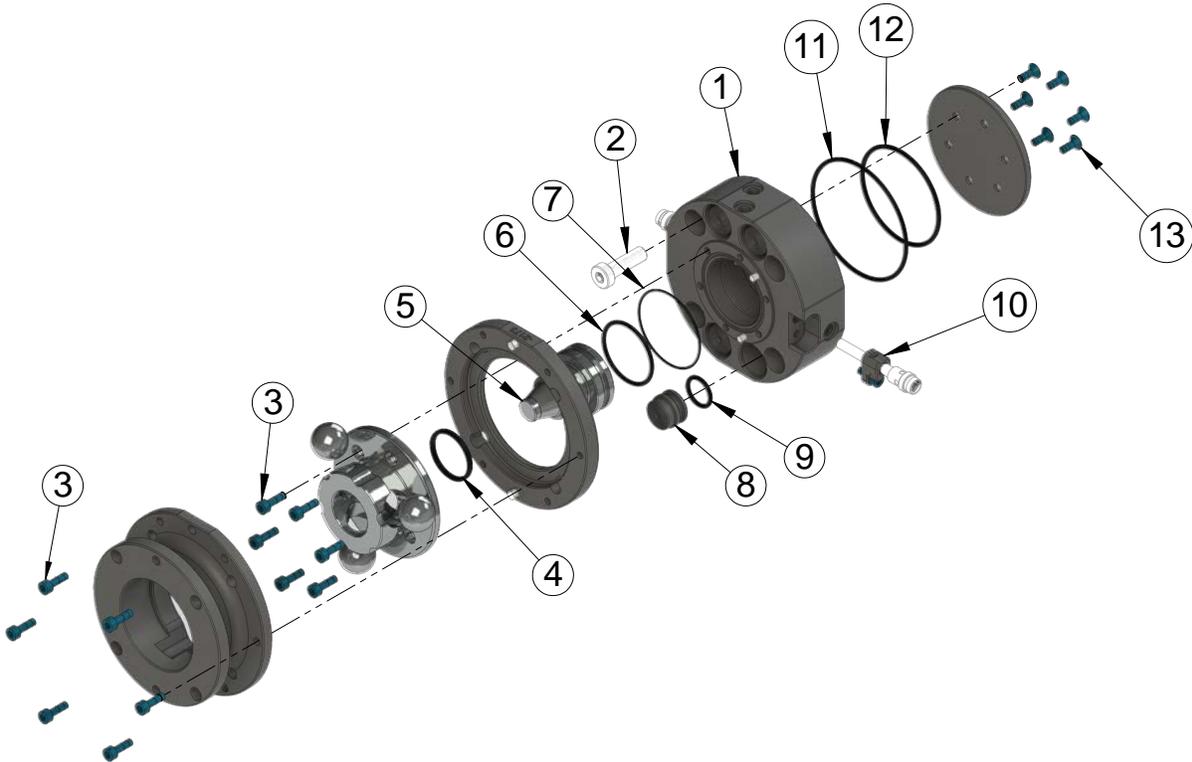
Supplies required: Loctite 222

1. Turn off and de-energize all energized circuits, for example: electrical, air, and water.
2. Clean the sensor hole with compressed air.
3. Remove the sensor assembly:
 - a. Using a 2.5 mm Allen wrench, remove the M3 socket head cap screw.
 - b. Pull the sensor assembly straight out from the Compensator body.
4. Test the sensor:
 - a. Place a ferrous target in front of the proximity sensor to confirm that the sensor is functional. The sensor signal should read “on” (true), and the sensor should illuminate.
 - i. If the sensor is not functioning properly, replace the sensor assembly.
 - ii. If the sensor is functioning properly, reinstall.
5. Install the sensor assembly:
 - a. Verify that the O-ring is seated on the back side of the sensor assembly.
 - b. Apply Loctite 222 to the threads of the M3 socket head cap screw.
 - c. Using a 2.5 mm Allen wrench, secure the sensor assembly to the Compensator body with the M3 socket head cap screw. Tighten to 12 in-lbs (1.4 Nm).
6. Confirm the operation of the sensor:
 - a. Apply supply air pressure to the air fitting. Refer to [Section 3.5.2—Valve Requirements and Connections](#).
 - b. Verify that the LED illuminates on the sensor.
7. After the procedure is complete, resume normal operation.

Figure 6.4—Sensor Replacement



7. Serviceable Parts



Item No.	Qty	Part Number	Description
1	1	9117-L1J-063-SG-M-2070-H	Lateral Compliance Compensator, 63mm BC, 40 mm boss, L, UL PNP Sensor, Position Hold, M5 Ports
		9117-L1A-063-SG-M-2070-H	Lateral Compliance Compensator, 63mm BC, No Boss, L, UL PNP Quick Conn. Sensor, M5 Ports
2	4	3500-1066020-13	SHCS Low Head M6 x 1.0 x 20mm Long, Steel Grade 8.8
3	12	3500-1058010-15A	M3X10 SHCS, 12.9, ISO4762/DIN912, ES-ATI-007, YL M-Spheres/IFI 525
4	1	3410-0001008-01	O-Ring AS568A-018 Buna-N D70
5	1	3700-15-2112	Piston cam
6	1	3410-0001152-01	O-Ring, 1 x 1/16" (AS568-022)
7	10	3410-0001087-01	O-ring ID 32mm x 1mm, Buna-N 70
8	4	3700-15-2069	Position Lock Piston
9	4	3410-0001351-01	O-Ring, AS568-013, Buna N
10	2	9005-20-2345	Sensor Carrier Assembly, Single Screw, 4mm PNP, 0 Degree Orientation
11	1	3410-0001259-01	AS-568-033 O-Ring Buna-N 70 Durometer
12	1	3410-0001020-01	O-Ring AS568-030 Buna-N D70
Components for the 9117-L1J-063-xx Model			
13	6	3500-1058008-15A	M3X8 SHCS, 12.9, ISO4762/DIN912, ES-ATI-007, YL M-spheres/IFI 525
Components for the 9117-L1A-063-xx Model			

Item No.	Qty	Part Number	Description
13	6	3500-1258008-15A	M3-0.5X8 FHSCS, 10.9, ISO10642/DIN7991, ES-ATI-007, YL M-Spheres/IFI 525

8. Specifications

Specifications such as payload, moment capacity, repeatability, and weight for each model may be found in the product catalog and on our website. Drawings may also be found in the product catalog and on our website. 2-D and 3-D models are also available on our website.

Contact ATI for specific information and drawings regarding your installation. We encourage you to use our applications department to review your designs and answer your questions.

Use the following figures as a reference for the vertical and horizontal ratings in [Table 8.1](#).

Figure 8.1—Vertical Orientation

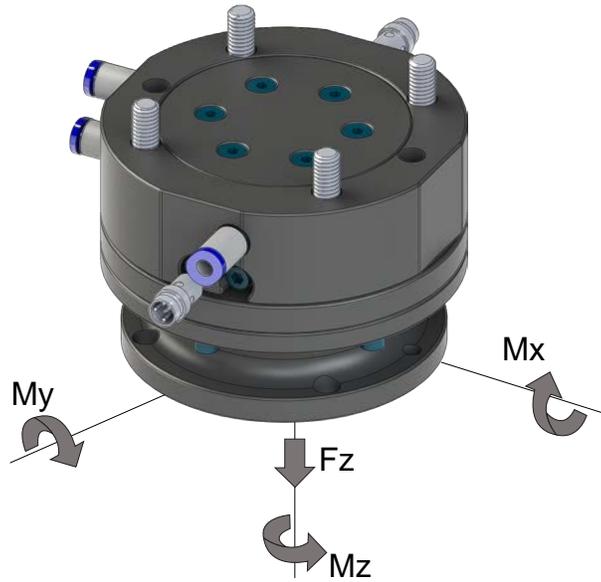


Figure 8.2—Horizontal Orientation

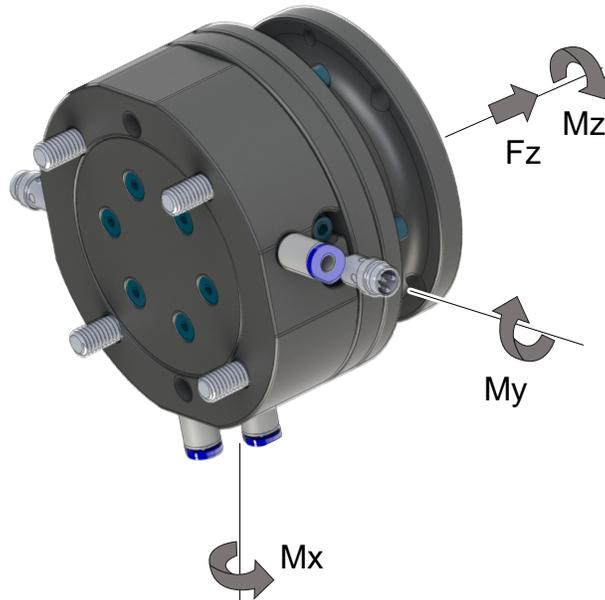


Table 8.1—Specifications for 9117-L1X-063

Specification	Value	Description
Lateral Compliance in the X-Y plane	± 0.060 in (1.5 mm)	The unit complies laterally about the X-Y plane and rotationally about the Z axis simultaneously.
Rotational Compliance about the Z axis	± 10 degrees	
Re-center, Max Vertical Payload	66 lbf (30 kg) ^{1, 2}	The maximum weight the unit can re-center vertically.
Re-center, Max Horizontal Payload	20 lbf (9 kg) ^{1, 2} Offset 4 in (100 mm)	The maximum weight the unit can re-center horizontally.
Re-center, Max Moment (X-Y)	54 lbf-in (6.1 Nm) ^{1, 2}	The maximum torque the unit can re-center.
Re-center, Max Moment (Z)	9 lbf-in (1 Nm) ^{1, 2}	The maximum torque the unit can re-center..
Locked Stiffness at the Max Moment (X-Y)	± 0.1 degrees at $\pm 1,000$ lbf-in (110 Nm)	The stiffness accounts for the freeplay and additional linear (elastic) deflection under the max rating.
Locked Stiffness at the Max Moment (Z)	± 0.1 degrees at ± 75 lbf-in (8.5 Nm)	
Positional Hold, Max Lateral Force ⁴	10 lbf (44 N)	The maximum force the unit can withstand in a Position Hold state.
Notes:		
1. The rating assumes un-locking and re-centering are performed while the robot is static or slowly moving.		
2. The unit may fail to re-center loads that exceed this value.		
3. The nominal operating pressure was used to determine all ratings in the table above.		
4. The specification is applicable to units with the "Position Hold" option, which is designated by "-H" in the part number.		

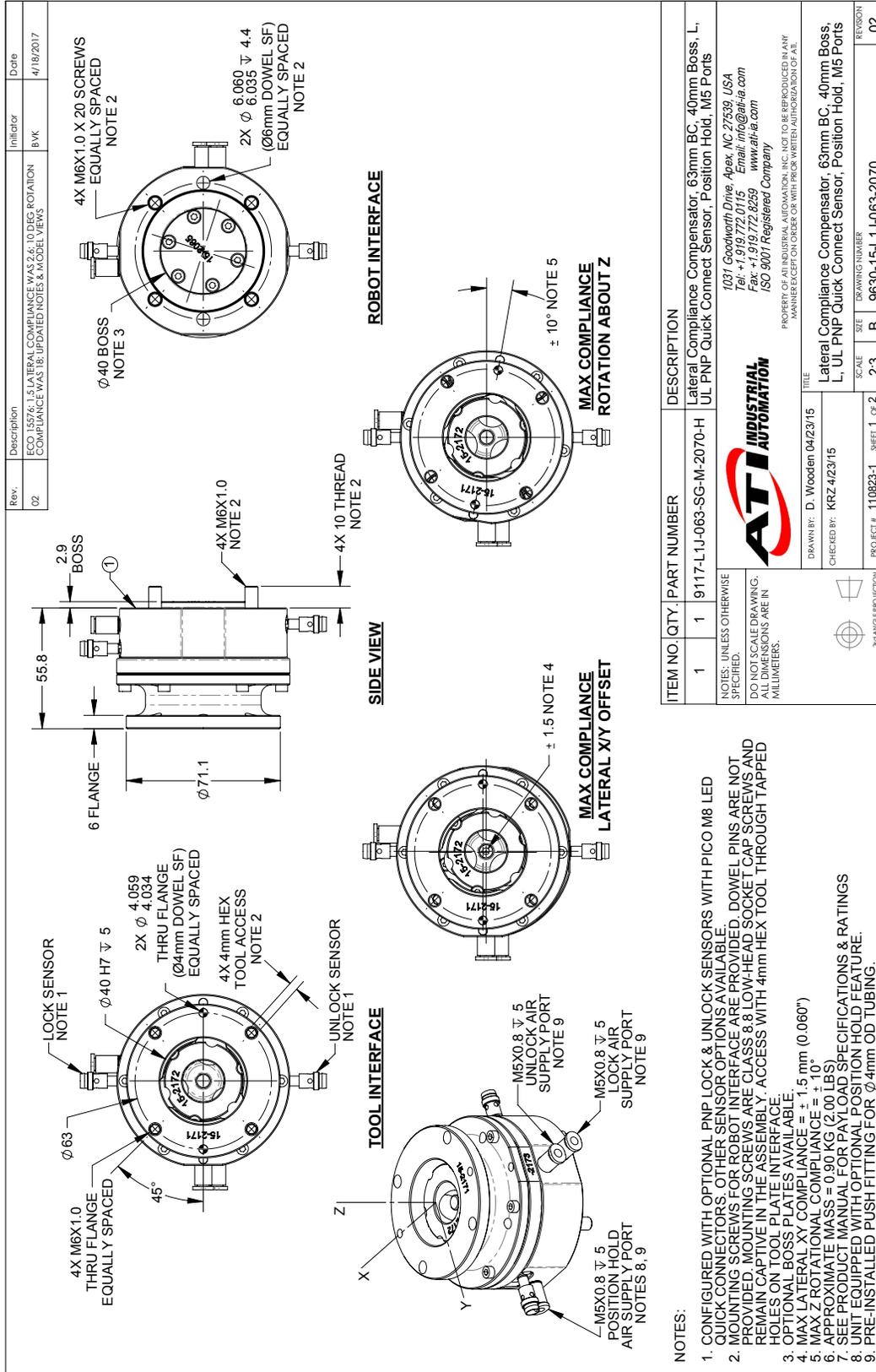
Table 8.1—Specifications for 9117-L1X-063

Specification	Value	Description
Positional Hold, Max Moment Z ⁴	10 lbf-in (1.1 Nm)	The maximum Z axis torque the unit can withstand in a Position Hold state.
Positional Hold, Max Recommended Payload ⁴	5 lbf (2.3 kg)	The advised weight for the unit to withstand in a Position Hold state.
Weight	2 lb (0.9 kg)	The mass of the unit without the sensors.
Nominal Operating Pressure	80 psi (5.5 bar) ³	The recommended supply pressure.
Operating Pressure Range	60-100 psi (4.1-6.9 bar)	The minimum and maximum air supply pressure for proper function. The air supply must be clean, dry, and filtered to 50 micron or better.
Positional Repeatability at the Tool interface	±0.001 in. (0.025 mm)	Measured in the unloaded condition after 1 million cycles at the rated load.
Notes: <ol style="list-style-type: none"> 1. The rating assumes un-locking and re-centering are performed while the robot is static or slowly moving. 2. The unit may fail to re-center loads that exceed this value. 3. The nominal operating pressure was used to determine all ratings in the table above. 4. The specification is applicable to units with the “Position Hold” option, which is designated by “-H” in the part number. 		

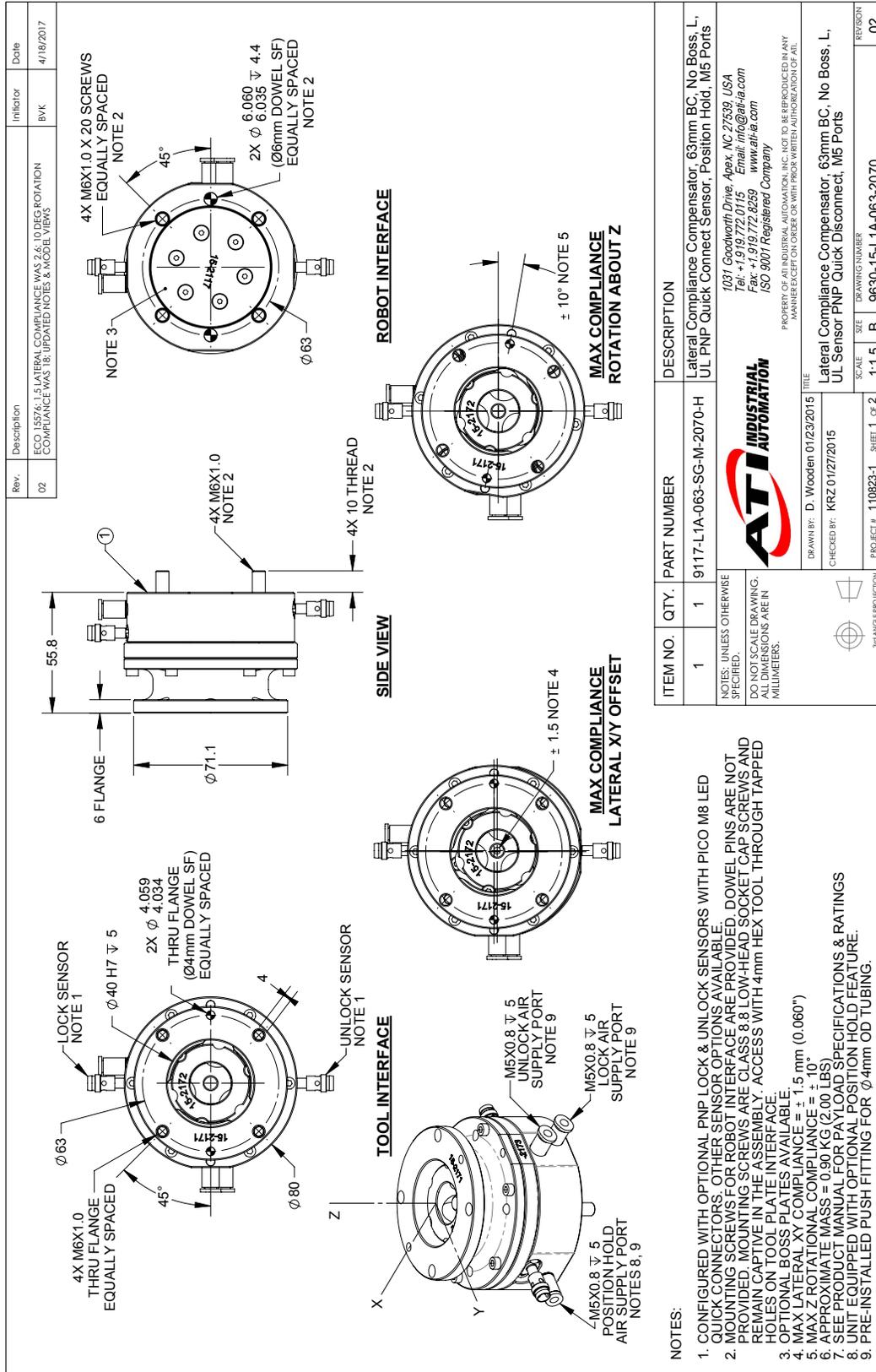
Table 8.1—Specifications for 9117-L1X-063		
Specification	Value	Description
Ambient Temperature Range	-20 to 150°F (-30 to 66°C)	The air temperature surrounding the unit.
Rated Life	1 million cycles	The life value assigned to a serviceable part.
Air Supply Port Size	M5	For Lock, Unlock, and Position Hold.
Mounting Pattern	63 mm BC, (4) M6 SHCS, (2) M6 Dowel	Robot mounting.
	63 mm BC, (4) M6 SHCS, (2) M6 Dowel	Tool mounting. (Custom tooling plates available upon request)
Sensing	Locked (Center) & Unlocked (Floating)	Sensor options: “SG-” M8, male, 3 wire, DC, PNP, quick disconnect sensor.
Construction	Anodized aluminum	Housing and compliance ring.
	Alloy steel	Tool plate and internal compliance components.
	Seals	Nitrile (Buna-N).
Notes: 1. The rating assumes un-locking and re-centering are performed while the robot is static or slowly moving. 2. The unit may fail to re-center loads that exceed this value. 3. The nominal operating pressure was used to determine all ratings in the table above. 4. The specification is applicable to units with the “Position Hold” option, which is designated by “-H” in the part number.		

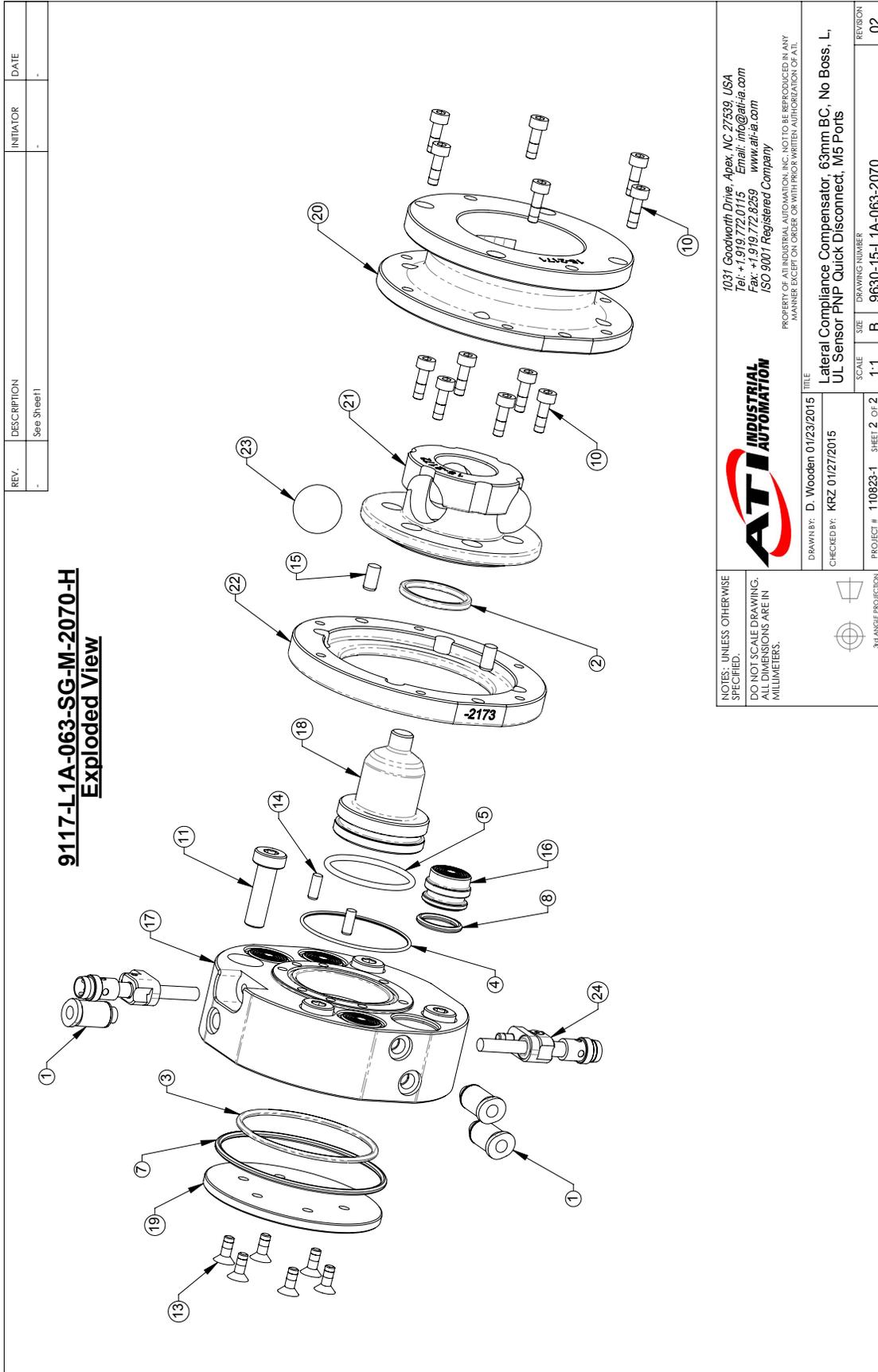
9. Drawings

9.1 9630-15-L1J-063-2070



9.2 9630-15-L1A-063-2070





10. Terms and Conditions of Sale

The following Terms and Conditions are a supplement to and include a portion of ATI's Standard Terms and Conditions, which are on file at ATI and available upon request.

ATI warrants to Purchaser that robotic Compensator products purchased hereunder will be free from defects in material and workmanship under normal use for a period of one (1) year from the date of shipment. The warranty period for repairs made under a RMA shall be for the duration of the original warranty, or ninety (90) days from the date of repaired product shipment, whichever is longer. ATI will have no liability under this warranty unless: (a) ATI is given written notice of the claimed defect and a description thereof within thirty (30) days after Purchaser discovers the defect and in any event not later than the last day of the warranty period; and (b) the defective item is received by ATI not later ten (10) days after the last day of the warranty period. ATI's entire liability and Purchaser's sole remedy under this warranty is limited to repair or replacement, at ATI's election, of the defective part or item or, at ATI's election, refund of the price paid for the item. The foregoing warranty does not apply to any defect or failure resulting from improper installation, operation, maintenance or repair by anyone other than ATI.

ATI will in no event be liable for incidental, consequential or special damages of any kind, even if ATI has been advised of the possibility of such damages. ATI's aggregate liability will in no event exceed the amount paid by purchaser for the item which is the subject of claim or dispute. ATI will have no liability of any kind for failure of any equipment or other items not supplied by ATI.

No action against ATI, regardless of form, arising out of or in any way connected with products or services supplied hereunder may be brought more than one (1) year after the cause of action accrued.

No representation or agreement varying or extending the warranty and limitation of remedy provisions contained herein is authorized by ATI, and may not be relied upon as having been authorized by ATI, unless in writing and signed by an executive officer of ATI.

Unless otherwise agreed in writing by ATI, all designs, drawings, data, inventions, software and other technology made or developed by ATI in the course of providing products and services hereunder, and all rights therein under any patent, copyright or other law protecting intellectual property, shall be and remain ATI's property. The sale of products or services hereunder does not convey any express or implied license under any patent, copyright or other intellectual property right owned or controlled by ATI, whether relating to the products sold or any other matter, except for the license expressly granted below.

In the course of supplying products and services hereunder, ATI may provide or disclose to Purchaser confidential and proprietary information of ATI relating to the design, operation or other aspects of ATI's products. As between ATI and Purchaser, ownership of such information, including without limitation any computer software provided to Purchaser by ATI, shall remain in ATI and such information is licensed to Purchaser only for Purchaser's use in operating the products supplied by ATI hereunder in Purchaser's internal business operations.

Without ATI's prior written permission, Purchaser will not use such information for any other purpose or provide or otherwise make such information available to any third party. Purchaser agrees to take all reasonable precautions to prevent any unauthorized use or disclosure of such information.

Purchaser will not be liable hereunder with respect to disclosure or use of information which: (a) is in the public domain when received from ATI; (b) is thereafter published or otherwise enters the public domain through no fault of Purchaser; (c) is in Purchaser's possession prior to receipt from ATI; (d) is lawfully obtained by Purchaser from a third party entitled to disclose it; or (f) is required to be disclosed by judicial order or other governmental authority, provided that, with respect to such required disclosures, Purchaser gives ATI prior notice thereof and uses all legally available means to maintain the confidentiality of such information.