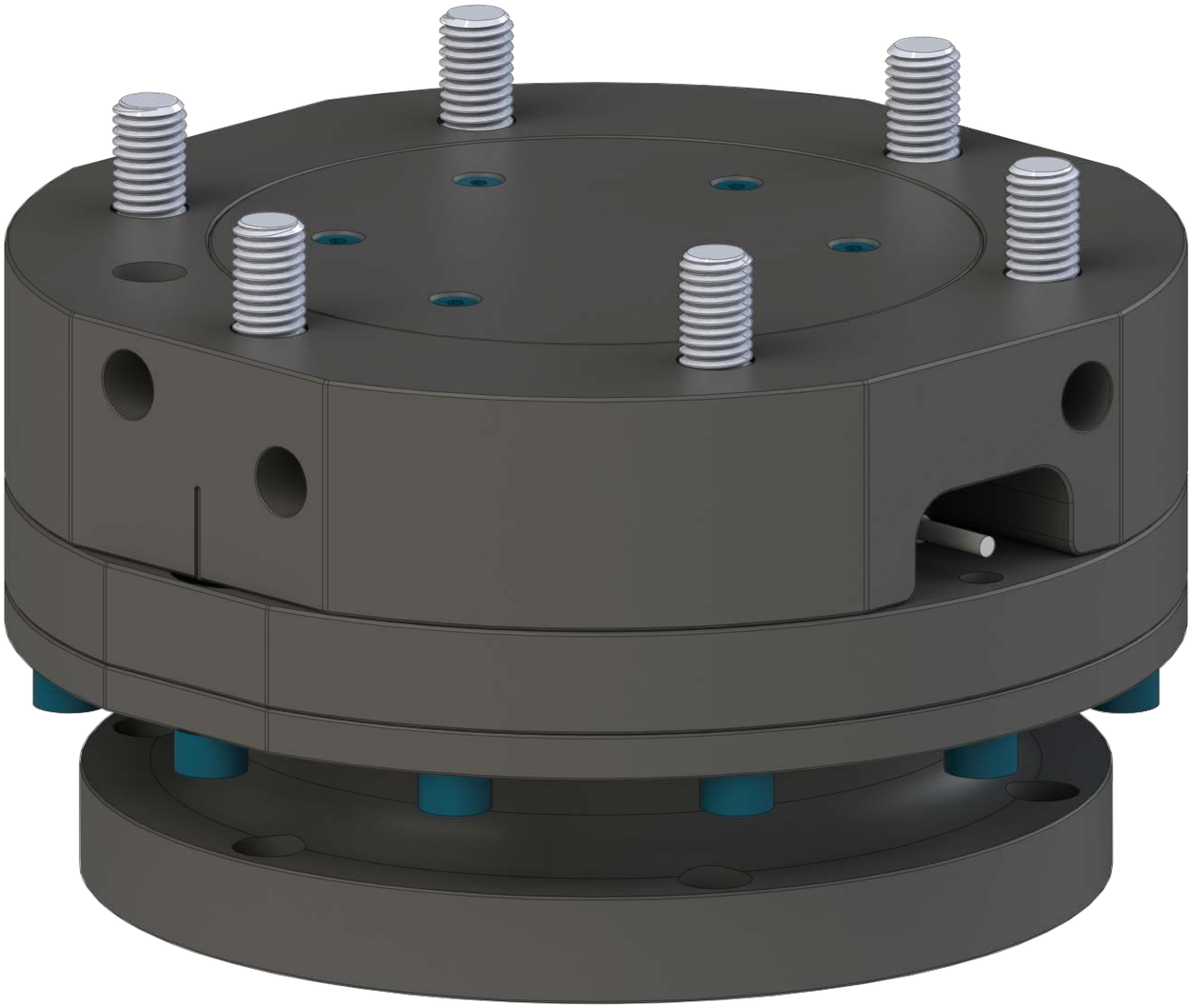
ATI INDUSTRIAL AUTOMATION

Product Manual

Lateral Compliance Compensator L1X-125



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Engineered Products for Robotic Productivity

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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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Glossary

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 Base Ring	A circular plate that transfers force from the (4) position lock pistons to the tool plate, when the Position Hold function is activated.
Compensator Body	The part of the Lateral Compliance Compensator that is mounted to a robot and contains the locking mechanism.
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. Product specific notifications are imbedded within the sections of this manual (where they apply).

1.1 Explanation of Notifications

These notifications are used in all of ATI manuals and are not specific to this product. The user should 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.

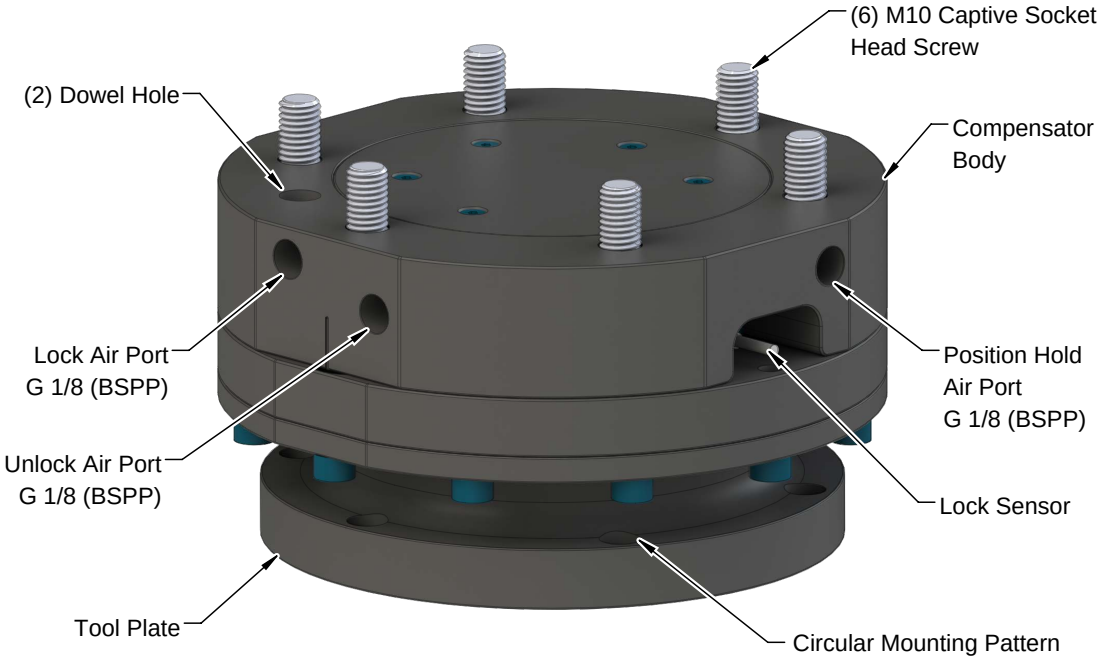
CAUTION: The Compensator is only to be used for intended applications and applications approved by the manufacturer. Using the Compensator in applications other than intended will result in damage to Compensator or end-of-arm tooling and could cause injury to personnel.

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

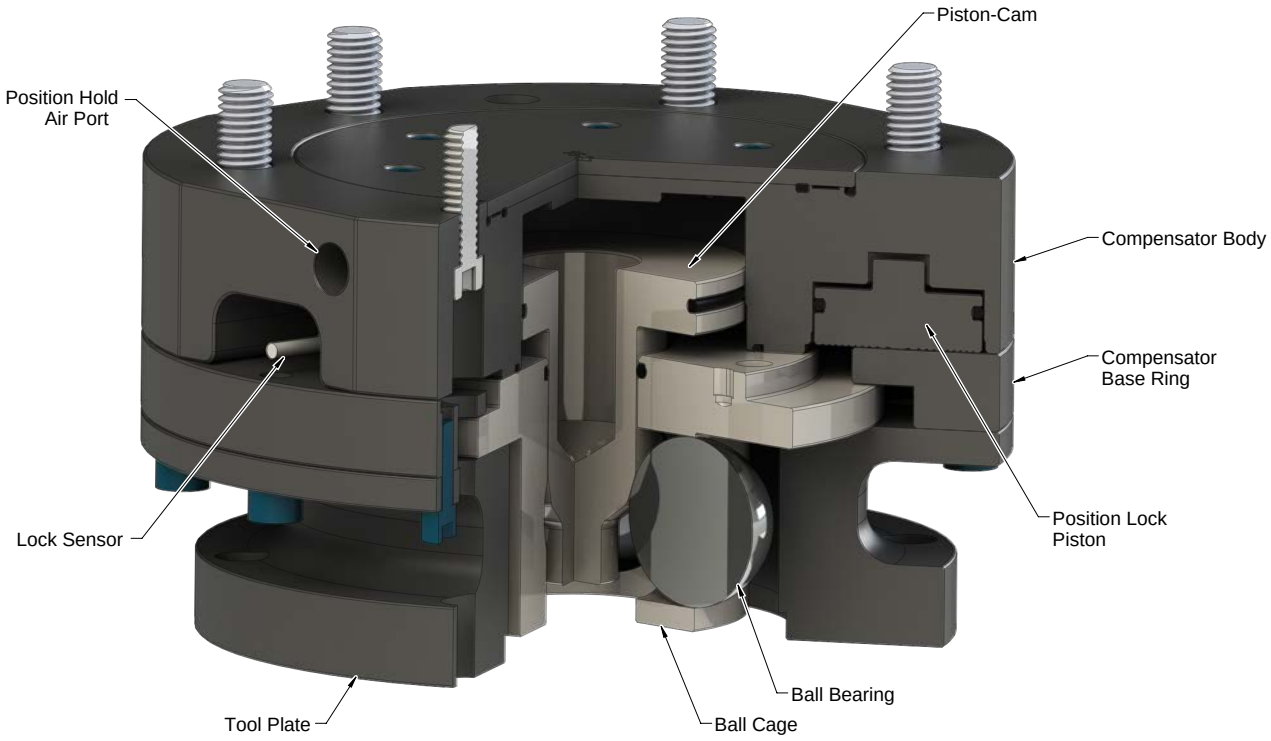


The compensator body is equipped with a circular mounting pattern, consisting of (6) supplied captive socket head cap screws, and (2) locating dowel holes used to mount the Compensator to the robot. The body has (2) air ports for Lock, Unlock, and (2) PNP proximity sensors to detect the Lock and Unlock position of the piston cam (refer to *Section 9—Drawings*).

Some models have an additional air port for a "Position Hold" function. When air is applied, the (4) position lock pistons apply force to the compensator base ring (2) O-rings seal the annular manifold within the Compensator body and cap plate so that air pressure is distributed equally among the (4) lock pistons. Models with the position hold function have "-H" in the ATI part number. Models with out this designator, "-H", in the part number do not have the (4) position lock pistons that are required for the position hold function.

The tool plate has a circular mounting pattern and (2) locating dowel pin holes for mounting the tool (refer to *Section 9—Drawings*).

Figure 2.2—Section View



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* for the compliance values of each device from a centered position).

Figure 2.3—Lateral Compliance in the X and Y Axis

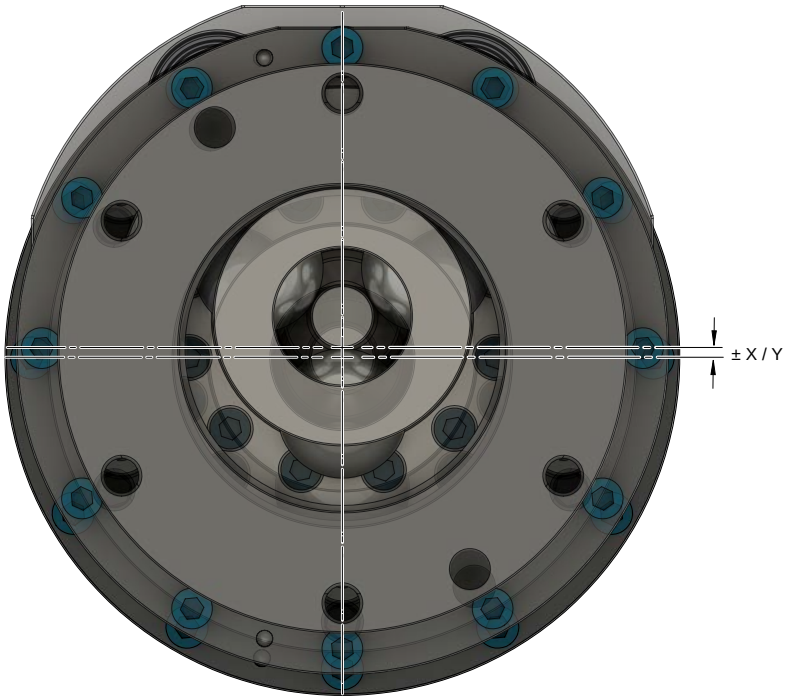
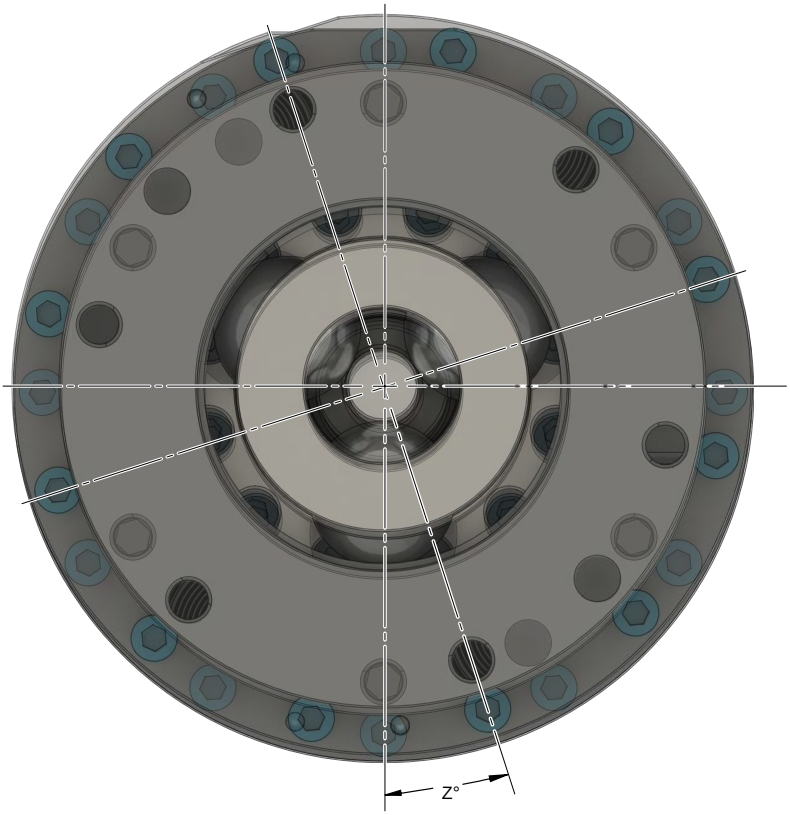


Figure 2.4—Rotational Compliance About the Z-Axis



3. Installation

WARNING: Do not perform maintenance or repair(s) on the Compensator unless all energized circuits (for example: 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, (6) supplied captive M10 fasteners.	M10-1.5 X 25 mm Class 8.8	40 ft-lbs (54.2 Nm)	Pre-applied Adhesive or Loctite® 242
End-effector or tool interface plate to the Compensator tool plate, (6) customer supplied M6 fasteners.	M10-1.5 Class 12.9 Socket head cap	40 ft-lbs (54.2 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*.

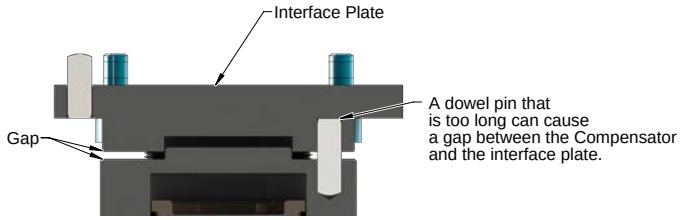
3.1 Robot Interface

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*).

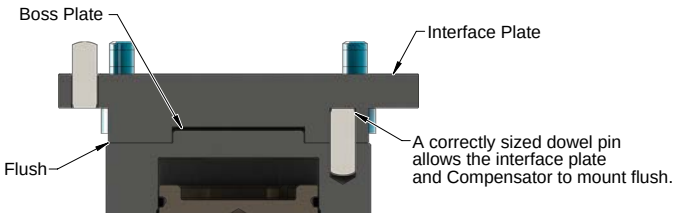
CAUTION: Do not use dowel pins that are too long or do not allow the interface plate and Compensator's body to mate flush. Using dowel pins that are too long will cause a gap between the interface plate and the Compensator's body and damage to the equipment. Use dowel pins that do not extend further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

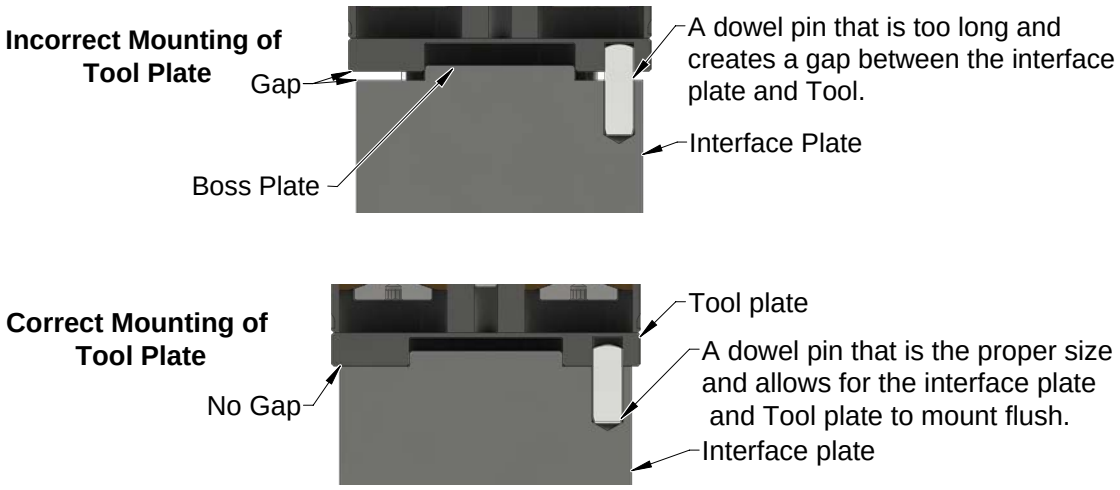
- The interface plate should include bolt holes for mounting and either two dowel pins or a dowel pin and a boss for accurate positioning on the robot and Compensator. The dowel pins prevent rotation (refer to the robot manual for robot mounting features).
- The thickness of the interface plate must 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.

3.2 Tool Interface

The tool plate is attached to the customer's tooling. An interface plate can adapt the tool plate to the customer's tooling. Alignment features (dowel holes) accurately position and bolt holes secure the Tool plate to the customer's tooling. Custom tool interface plates can be supplied by ATI to meet customer's requirements (refer to *Section 9—Drawings*).

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

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.



If the customer chooses to design and build a tool 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 customer tooling and the tool plate. The dowel and boss features prevent unwanted rotation.
- The interface plate should include bolt holes for mounting and dowel pin holes for accurate positioning on the customer tooling and tool plate. The dowel pins prevent rotation.
- 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 tool plate.

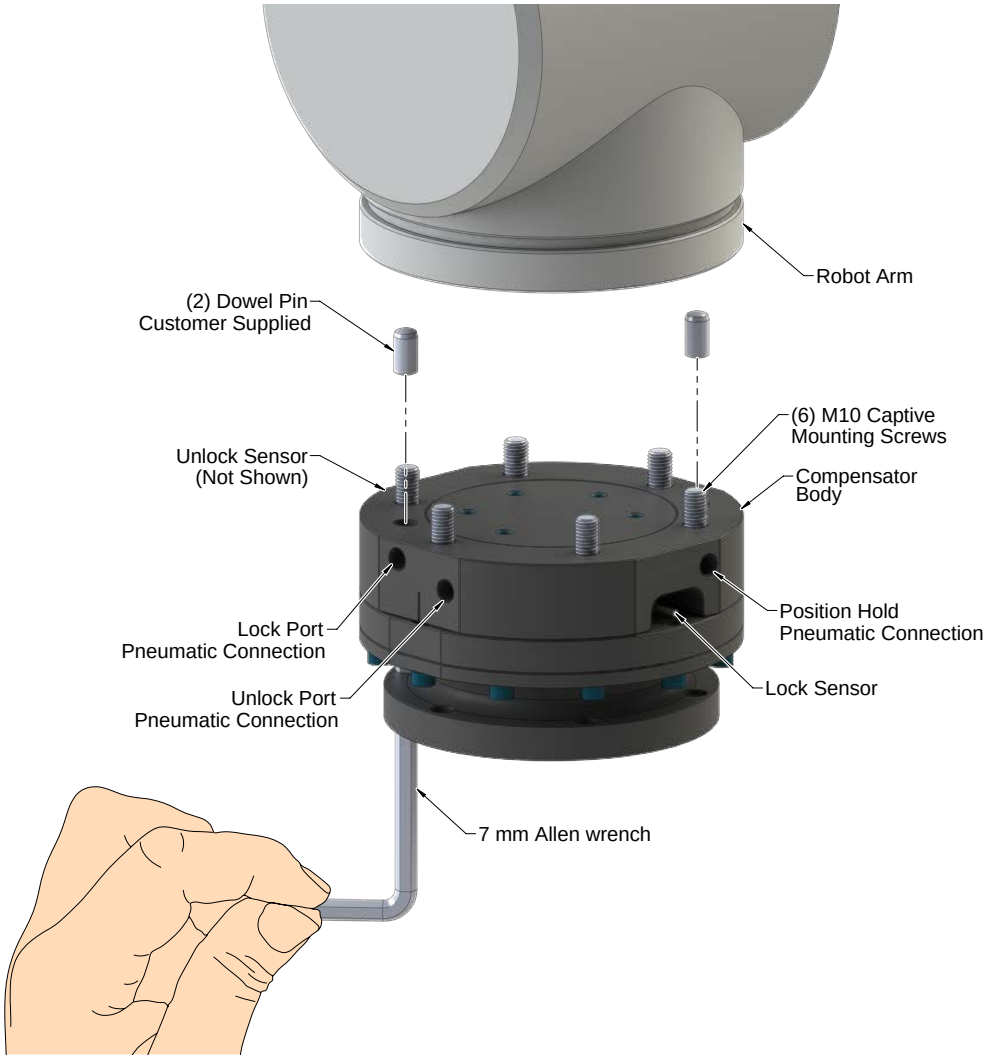
3.3 Installing the Compensator to the Robot

Tools required: *7 mm hex key and a torque wrench*

Supplies required: *Loctite 242 and a clean rag*

1. Turn off and de-energize all energized circuits (for example: electrical, pneumatic, and hydraulic).
2. Wipe down the mounting surfaces with a clean rag.
3. With the Compensator in the unlocked position, secure the Compensator to the robot.
   a. Apply Loctite 242 to the exposed threads of the (6) M10 captive socket head cap screw.
   b. Insert a 7 mm hex key through the M10 tapped holes of the tool plate.
   c. Using the hex key, secure the Compensator to the robot with the (6) captive socket head cap screws. Tighten to 40 ft-lbs (54.2 Nm).

Figure 3.1—Installing the Compensator to the Robot

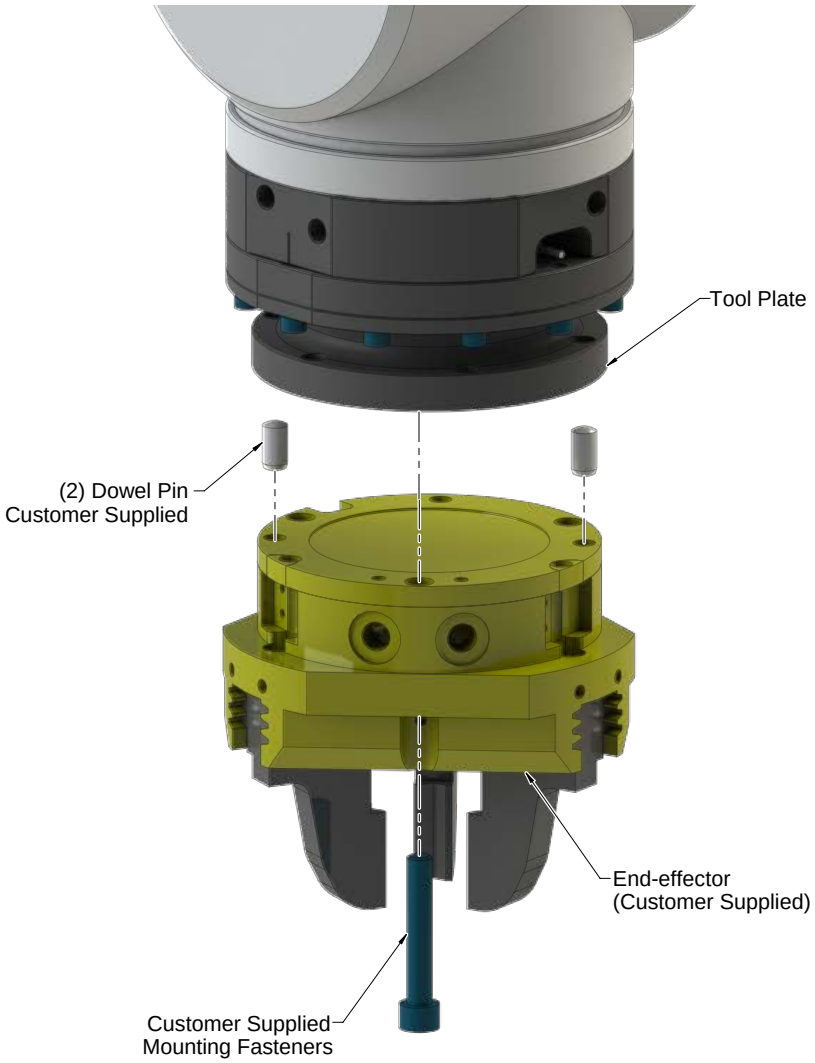


4. Attach pneumatic hosing to the Compensator's lock,unlock, and, if equipped, position hold connections.

> **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 to malfunction and may result in injury to personnel or damage to equipment.

5. If equipped, attach the (2) sensor cable connections.
6. Using a hex key, 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: *7 mm 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 a hex key, remove the mounting fasteners that secure the end-effector or customer supplied interface plate to the Compensator's tool mount plate.
5. Using a 7 mm hex key, 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

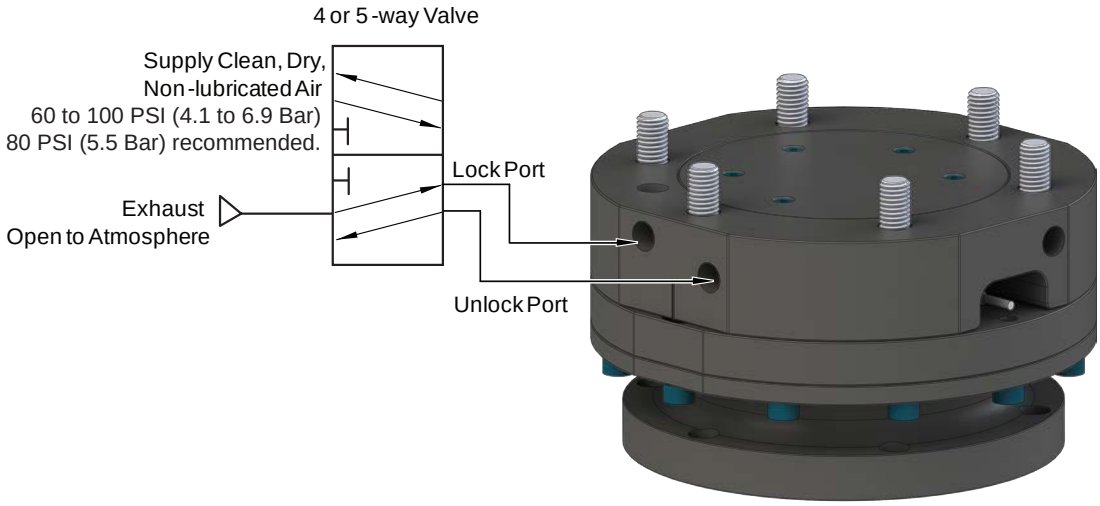
Proper operation of the Compensator's locking mechanism requires a constant supply of clean, dry, non-lubricated air, with the following conditions:

- 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 (for example: 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 for G 1/8 (BSPP) connections.

Figure 3.3—Lock and Unlock Pneumatic Connections



3.6 Position Hold Pneumatic Connection (Optional, for “-H” models)

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

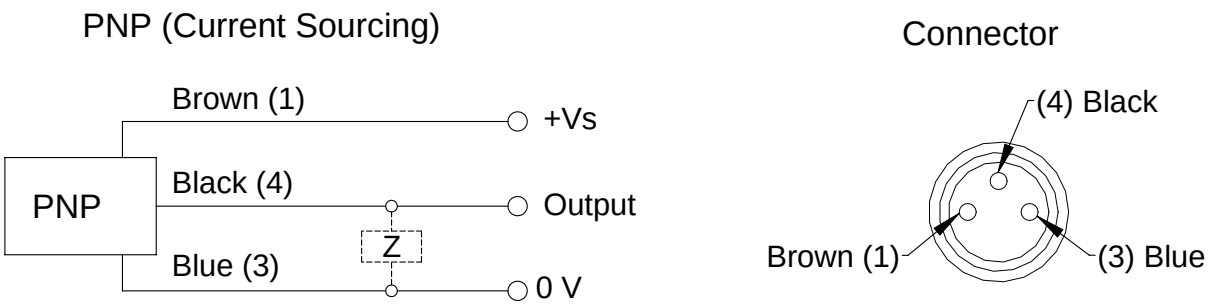
The Compensator body has lock and unlock PNP proximity sensors.

3.7.1 PNP Type Lock and Unlock Sensors

The PNP sensors are 4 mm stainless steel barrel wired proximity sensors.

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

Figure 3.4—PNP Type Lock Sensors

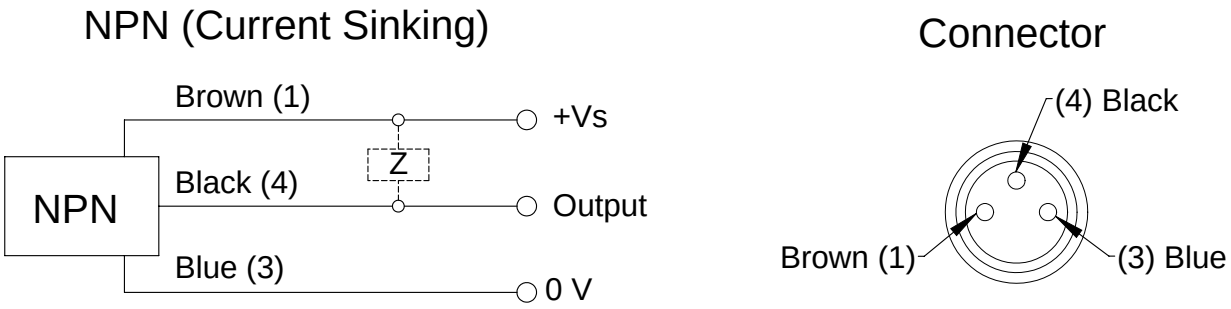


3.7.2 NPN Type Lock and Unlock Sensors

NPN sensors are 4 mm stainless steel barrel wired proximity sensors.

Table 3.3—NPN (Current Sourcing)	
Description	**Value**
Voltage Supply Range	10-30VDC
Output Current	< 200 mA
Nominal Sensing Distance	2.0 mm
Output Circuit	NPN make function, Normally Open (NO)

Figure 3.5—NPN Type Lock and Unlock 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.

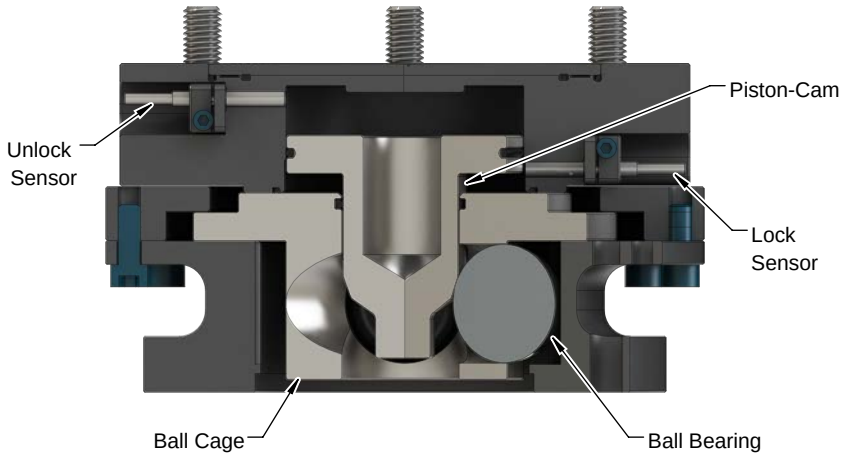
4.3 Position Hold (Optional)

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

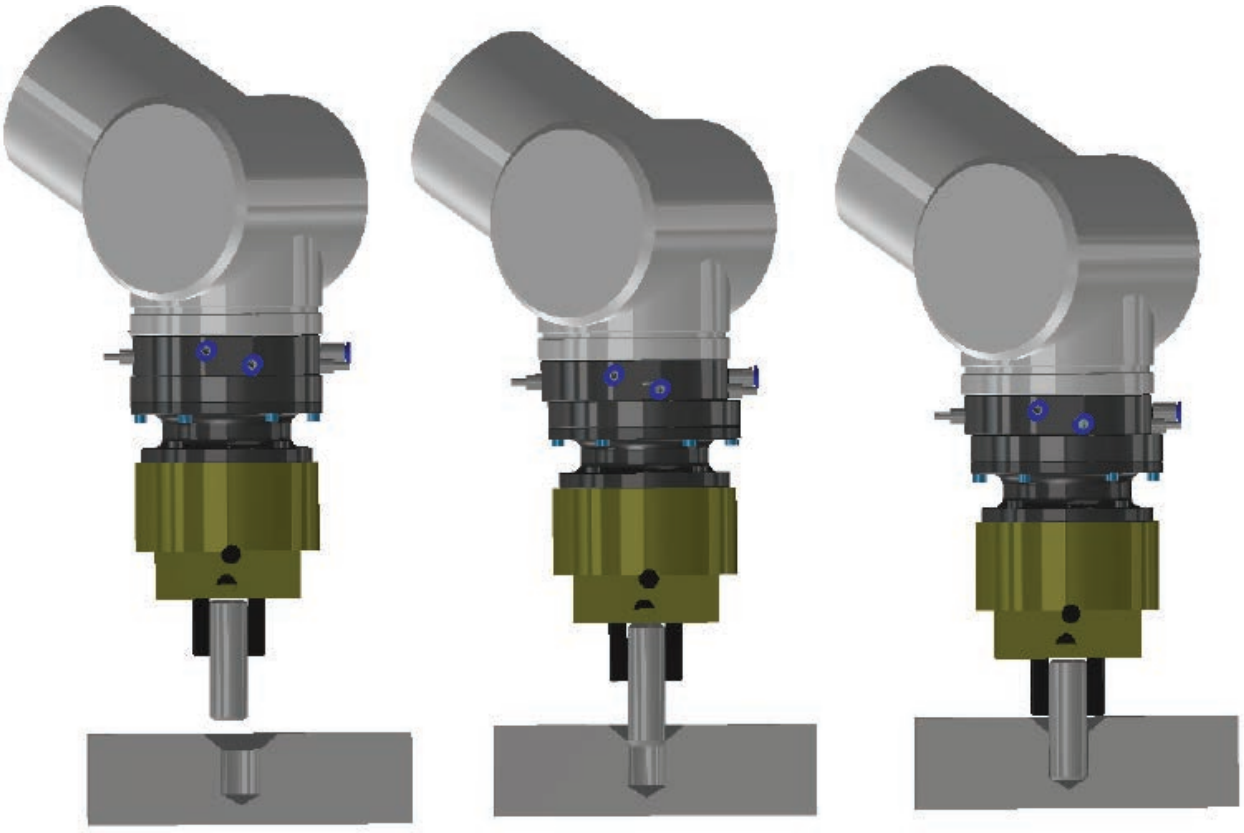


4.5 Operation of Inserting a Part

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.

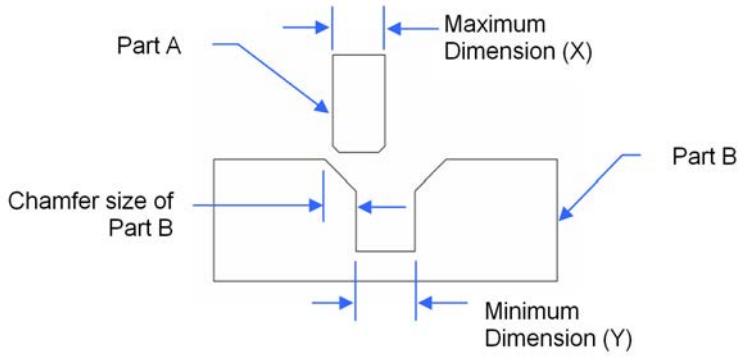
The robot moves to insert the pin. The Compensator adjusts to the chamfer to center the pin in the hole.

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.

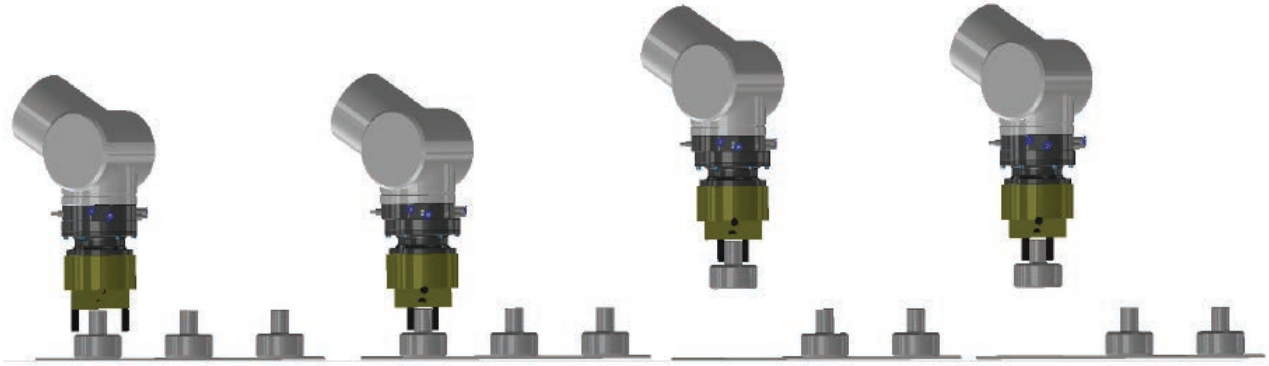
Figure 4.3—Assembly Inaccuracy



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



The robot is positioned above the work piece and moves to pick a part.

The Compensator is unlocked and fully compliant.

When the grippers close, the Compensator offsets to compensate for position of the robot and work piece.

The Compensator is unlocked and position hold is activated.

The robot and compensator removes the part.

The Compensator is unlocked and position hold is activated.

The Compensator releases position hold and is locked.

The part is centered.

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 (for example: 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 *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		
☐ Inspect mounting fasteners, verify they are tight and have the proper torque (refer to *Section 3—Installation*).		
Interface Connections		
☐ 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. ☐ 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		
☐ 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.		
☐ 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*). Note: The locking mechanism components are subject to corrosion from water. If these components become wet, dry and grease immediately to prevent damage.		

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 (for example: 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
Locking mechanism does not actuate	Pneumatic connections are incorrect, or supplied air is insufficient.	Ensure Compensator has proper pneumatic connections and 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 valve type is incorrect.	Ensure 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*).
	End of arm tooling payload exceeds LCC ratings.	Verify end of arm tooling is within payload rating in *Table 8.1*.
Position hold function is not operating properly	Pneumatic connections are incorrect, or supplied air is insufficient.	Ensure Compensator has proper pneumatic connections and 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*).
	End of arm tooling payload exceeds LCC ratings.	Verify end of arm tooling is within payload rating in *Table 8.1*.
Sensors do not report a locked or unlocked position or are sending intermittent signals.	Sensor cable is damaged, or loose connection.	Inspect sensor cable for damage or a loose connection. If a connection is loose, re-connect. If sensor cable is damaged, replace (refer to *Section 6.2.2—Sensor Replacement*).
	Sensor(s) is 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.*

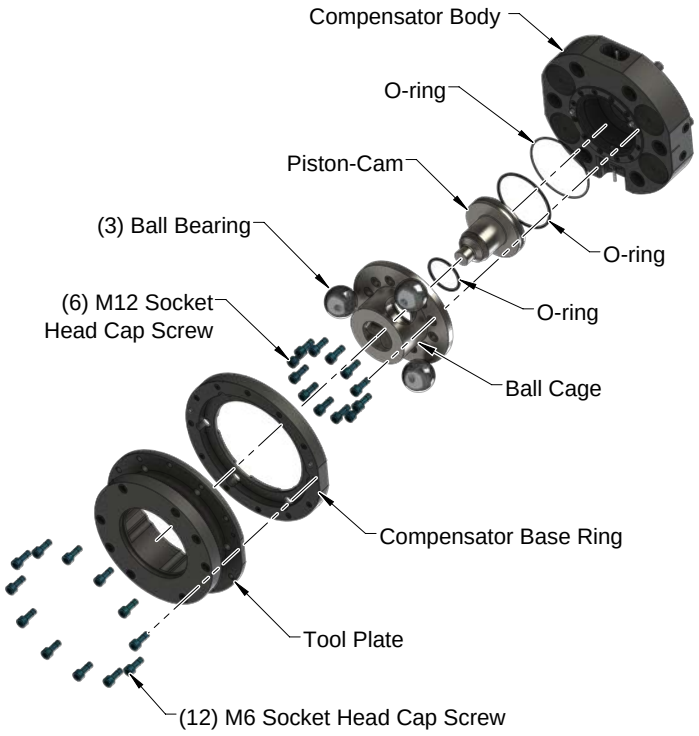
Tools required: *2 mm and 5 mm hex key , torque wrench.*

Supplies required: *Clean rag, MobilGrease® XHP222 Special grease, Loctite 222 and 242.*

1. Turn off and de-energize all energized circuits (for example: electrical, pneumatic, and hydraulic).
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 5 mm hex key, remove the (12) M6 socket head cap screws that secure the tool plate to the compensator base ring.
   b. Carefully pull the tool plate straight up and off the compensator base 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.

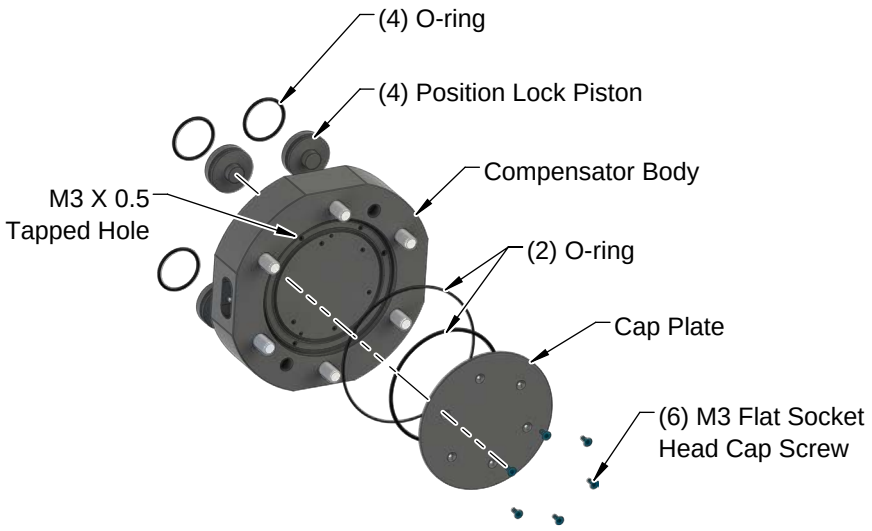
4. Remove and clean the locking mechanism.
   a. Using a 5 mm hex key, remove the (12) M6 socket head cap screws that secure the ball cage flange to the Compensator body.
   b. Remove the ball cage and (3) ball bearings.
   c. Remove the O-ring from the inner bore of the ball cage and discard.
   d. Clean the lubrication from the ball cage and (3) ball bearings.
   e. Remove the compensator base ring.
   f. Clean the lubrication from the inner surfaces of the compensator base 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 piston-cam.
   j. Remove the O-ring from the top of the Compensator body and discard.
   k. 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 mm hex key for (6) M3 socket flat head cap screws, remove the fasteners from the cap plate.
   b. Remove the cap plate.
   c. Remove and discard the (2) O-rings in the Compensator body.
   d. For models with the position hold ("-H") option, remove the (4) position lock pistons from the bores in the Compensator body, using one of the following methods:
      - Insert a M3 Socket Head Cap Screw through the tapped hole and pull the position lock piston out from the bore in the Compensator body.
      - While following the site's safety policy for personal eye protection, cover the piston with a rag and apply low air pressure at 5 psi (0.34 bar) so that the piston releases from the bore in the Compensator body.
   e. Remove and discard the (4) O-rings from each of the position lock pistons.
   f. Clean the bore in the Compensator body.

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

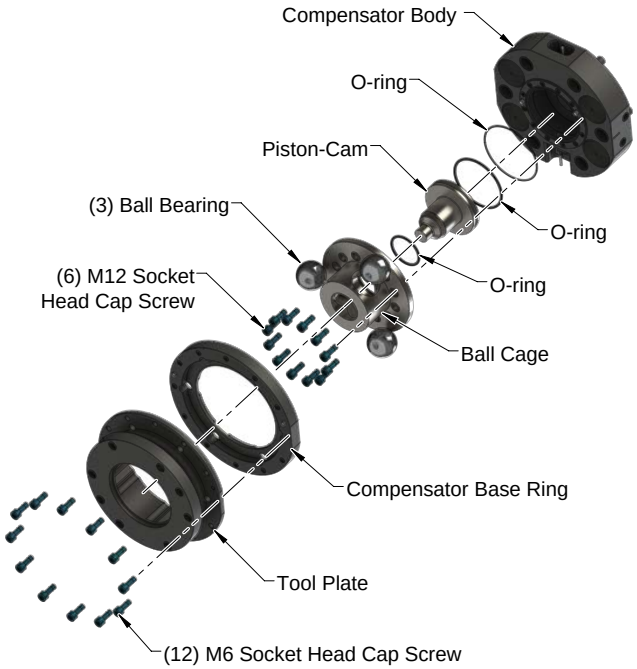


NOTICE: Use MobilGrease XHP222 Special grease to lubricate the locking mechanism and O-rings. Note: MobilGrease XHP222 Special is a NLGI #2 lithium complex grease with molybdenum disulfide.

6. Assemble the cap 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 mm hex key for (6) M3 socket flat head cap screws, secure the plate to the Compensator body. Tighten to 6 in-lbs (0.68 Nm).
   d. For models, with the position hold ("-H") option, apply the following procedure:
      i. Assemble the (4) new O-rings in the grooves of the (4) position lock pistons.
      ii. Apply lubrication to the outer surfaces of the (4) O-rings and (4) position lock pistons.
      iii. Insert the (4) position lock pistons in the bores of the Compensator body.

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. Install a new O-ring in the groove of the piston-cam.
   c. Lubricate the O-ring and piston-cam surface and bore.
   d. Insert the piston-cam into the Compensator.
   e. Lubricate the inner surface of the compliance base ring.
   f. Place the Compensator ring on the Compensatory body.
   g. Install a new O-ring in the bore of the ball cage.
   h. Install the (3) ball bearings in the ball cage.
   i. Lubricate the O-ring and (3) ball bearings.
   j. Insert the ball cage and (3) ball bearings onto the piston-cam.
   k. Apply Loctite 242 to the threads of the (12) M6 socket head cap screws.
   l. Using a 5 mm hex key secure the ball cage to the Compensator body with the (12) M6 socket head cap screws. Tighten to 90 in-lbs (10.2 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 242 to the threads of the (12) M6 socket head cap screws.
   c. Using a 5 mm hex key for the (12) M6 socket head cap screws, secure the tool plate to the compensator base ring. Tighten to 90 in-lbs (10.2 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. Safely resume normal operation.

6.2.2 Sensor Replacement

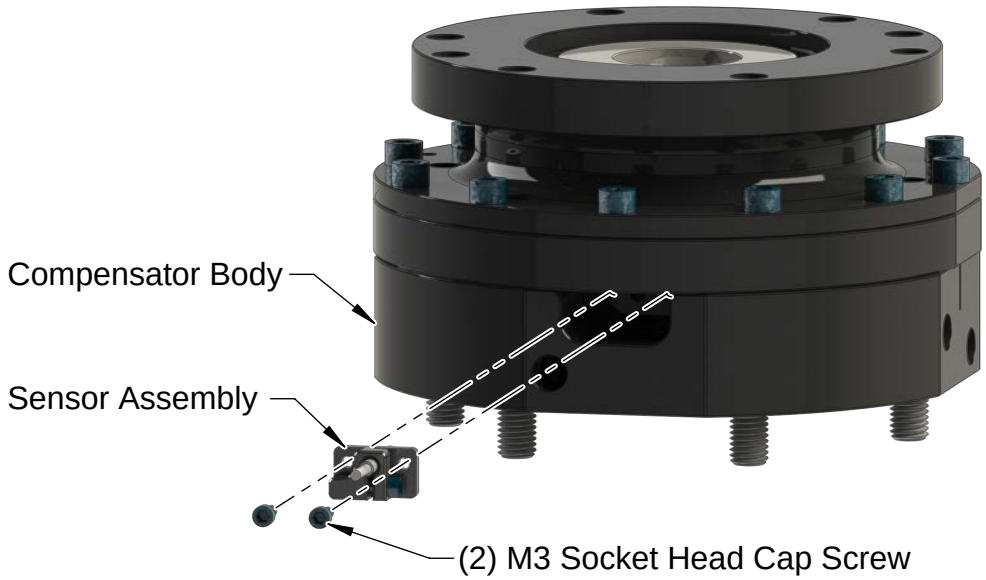
Parts required: *Refer to Section 7—Serviceable Parts.*

Tools required: *2.5 mm hex key*

Supplies required: *Loctite 222*

1. Turn off and de-energize all energized circuits (for example: electrical, pneumatic, and hydraulic).
2. Clean the sensor hole with compressed air.
3. Remove the sensor assembly:
   a. Using a 2.5 mm hex key, remove the (2) M3 socket head cap screws. 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 (2) M3 socket head cap screws.
   c. Using a 2.5 mm hex key, secure the sensor assembly to the Compensator body with the (2) M3 socket head cap screws. 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. Safely resume normal operation.

Figure 6.4—Sensor Replacement



7. Serviceable Parts

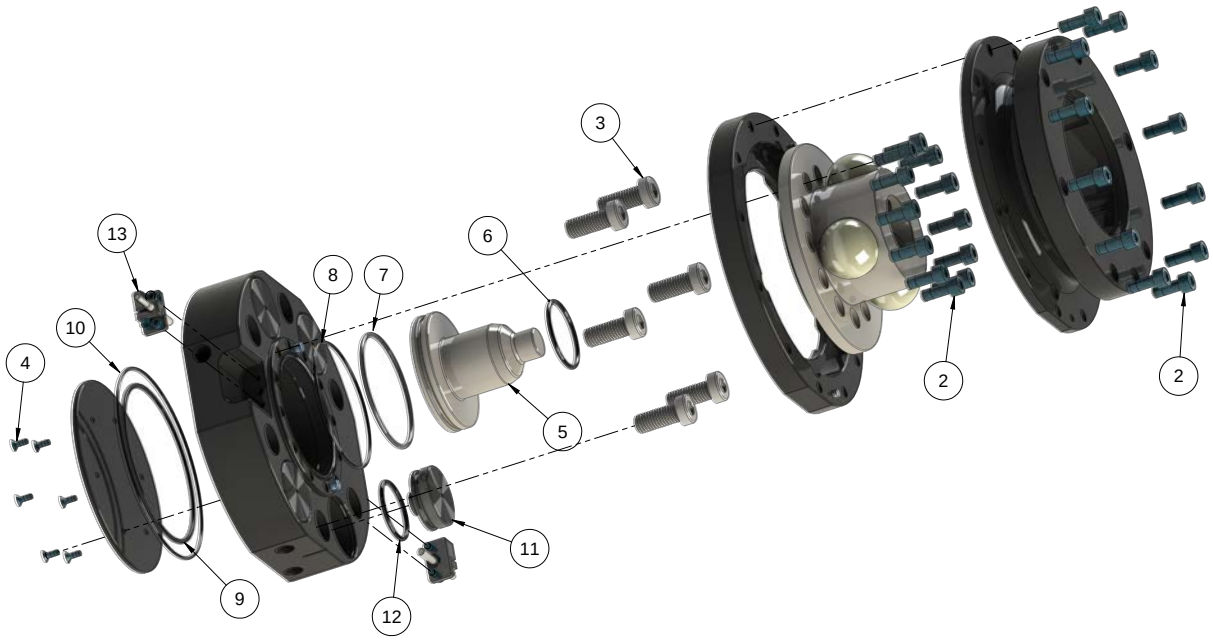


Table 7.1—Serviceable Parts			
Item No.	**Qty**	**Part Number**	**Description**
1	1	9117-L1A-125-SG-E-2100-H	Lateral Compliance Compensator, 125 mm BC, L, UL PNP N.O. Sensor Quick Connect, Position Hold, 1/8” BSPP Ports
2	24	3500-1066016-15A	M6x16 Socket Head Cap Screw, 12.9, ISO4762/DIN912, Corrosion Protection Coating, YL M-spheres/IFI 525
3	6	3500-1070025-13	M10 x 25 Socket Head Cap Screw, Class 8.8 Low Head
4	6	3500-1258008-15A	M3-0.5X8 Flat Head Socket Cap Screw, 10.9, ISO10642/DIN7991, Corrosion Protection Coating, YL M-Spheres/IFI 525
5	1	3700-15-2116	Compensator Cam, TDC, Prox Version, For L1-125
6	1	3410-0001094-01	O-Ring AS568-042 Buna-N D70
7	1	3410-0001116-01	O-Ring AS-568A-141 Buna
8	1	3410-0001186-01	O-Ring AS568-038, 2-5/8x1/16
9	1	3410-0001000-01	O-Ring AS568-042 Nitrile
10	1	3410-0001196-01	O-Ring 4” ID x 1/16” C/S AS568A-045
11	4	3700-15-2101	Position Lock Piston
12	4	3410-0001420-01	O-Ring, AS568-122, Buna-N D70
13	2	9005-20-1743	Lock/Unlock Sensor Assembly, (PNP)

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

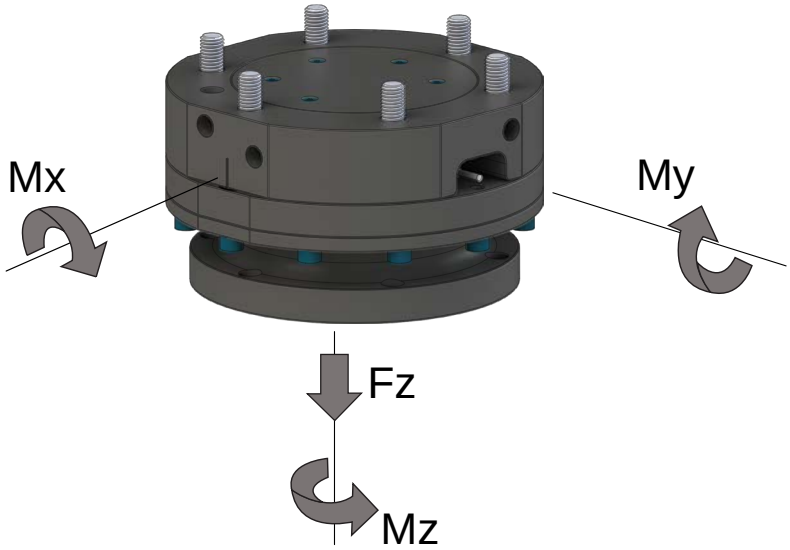


Figure 8.2—Horizontal Orientation

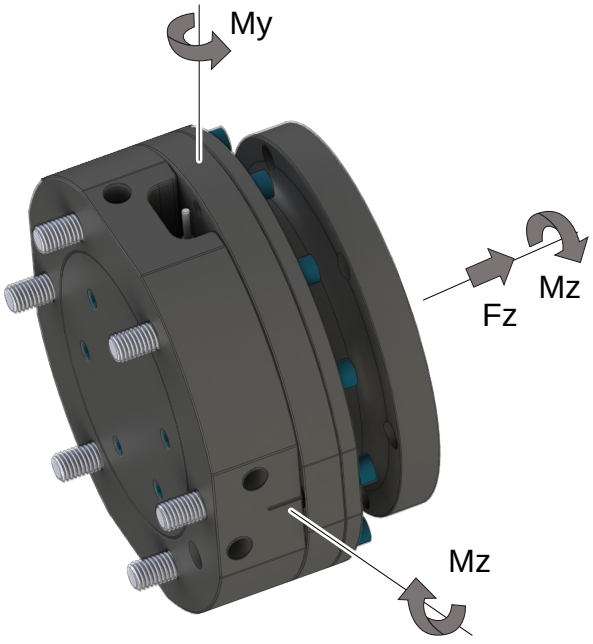


Table 8.1—Specifications for Specifications for 9117-L1X-125		
Specification	**Value**	**Description**
Lateral Compliance in the X-Y plane	±0.175 in (4.5 mm)	The unit complies laterally about the X-Y plane and rotationally about the Z axis simultaneously.
Rotational Compliance about the Z axis	±18 degrees	
Re-center, Max Vertical Payload	220 lbf (100 kg)[1, 2]	The maximum weight the unit can re-center vertically.
Re-center, Max Horizontal Payload	100 lbf (45 kg)[1, 2] Offset 6 in (150 mm)	The maximum weight the unit can re-center horizontally.
Re-center, Max Moment (X-Y)	480 lbf-in (54 Nm)[1, 2]	The maximum torque the unit can re-center.
Re-center, Max Moment (Z)	80 lbf-in (9 Nm)[1, 2]	The maximum torque the unit can re-center..
Locked Stiffness at the Max Moment (X-Y)	±0.2 degrees at ±6,940 lbf-in (780 Nm)	The stiffness accounts for the free play and additional linear (elastic) deflection under the max rating.
Locked Stiffness at the Max Moment (Z)	±0.4 degrees at ±540 lbf-in (61 Nm)	
Positional Hold, Max Lateral Force[4]	80 lbf (360 N)	The maximum force the unit can withstand in a Position Hold state.
Positional Hold, Max Moment Z[4]	130 lbf-in (15 Nm)	The maximum Z axis torque the unit can withstand in a Position Hold state.
Positional Hold, Max Recommended Payload[4]	45 lbf (20 kg)	The advised weight for the unit to withstand in a Position Hold state.
Weight	13 lbf (5.9 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	±0.0015 in (0.038 mm)	Measured in the unloaded condition after 1 million cycles at the rated load.
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	G 1/8 (BSPP)	For Lock, Unlock, and Position Hold.

Notes:

1. The rating assumes unlocking 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.

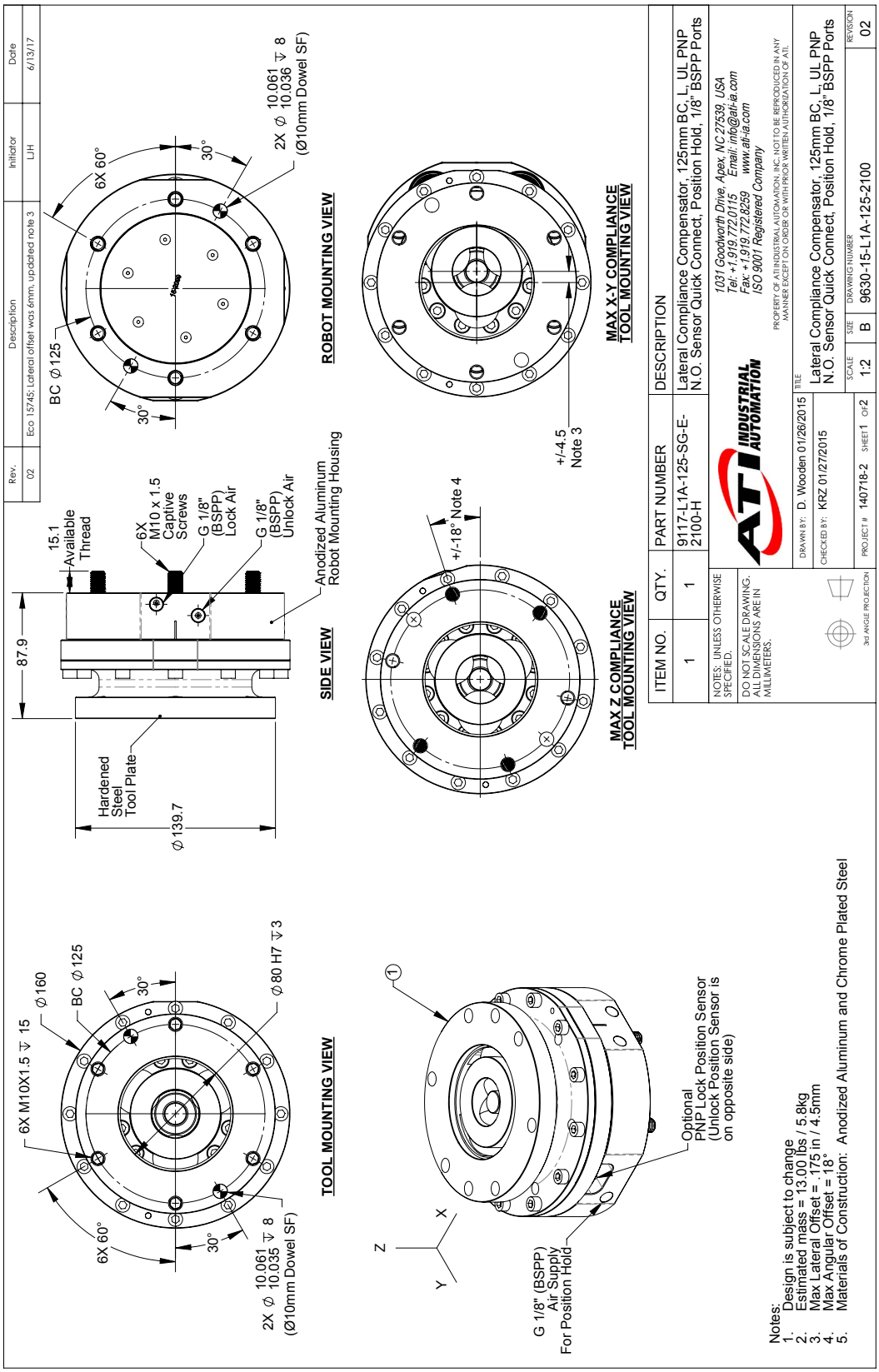
Table 8.1—Specifications for Specifications for 9117-L1X-125		
Specification	**Value**	**Description**
Mounting Pattern	125 mm BC, (6) M10 Socket Head Cap Screw, (2) M10 Dowel	Robot mounting.
	125 mm BC, (6) M10 Socket Head Cap Screw, (2) M10 Dowel	Tool mounting. (Custom tooling plates available upon request)
Sensing	Locked (Center) & Unlocked (Floating)	Sensor options: "SG-" 4 mm wired sensor
Construction	Anodized aluminum	Housing and compliance base ring.
	Alloy steel	Tool plate and internal compliance components.
	Seals	Nitrile (Buna-N).

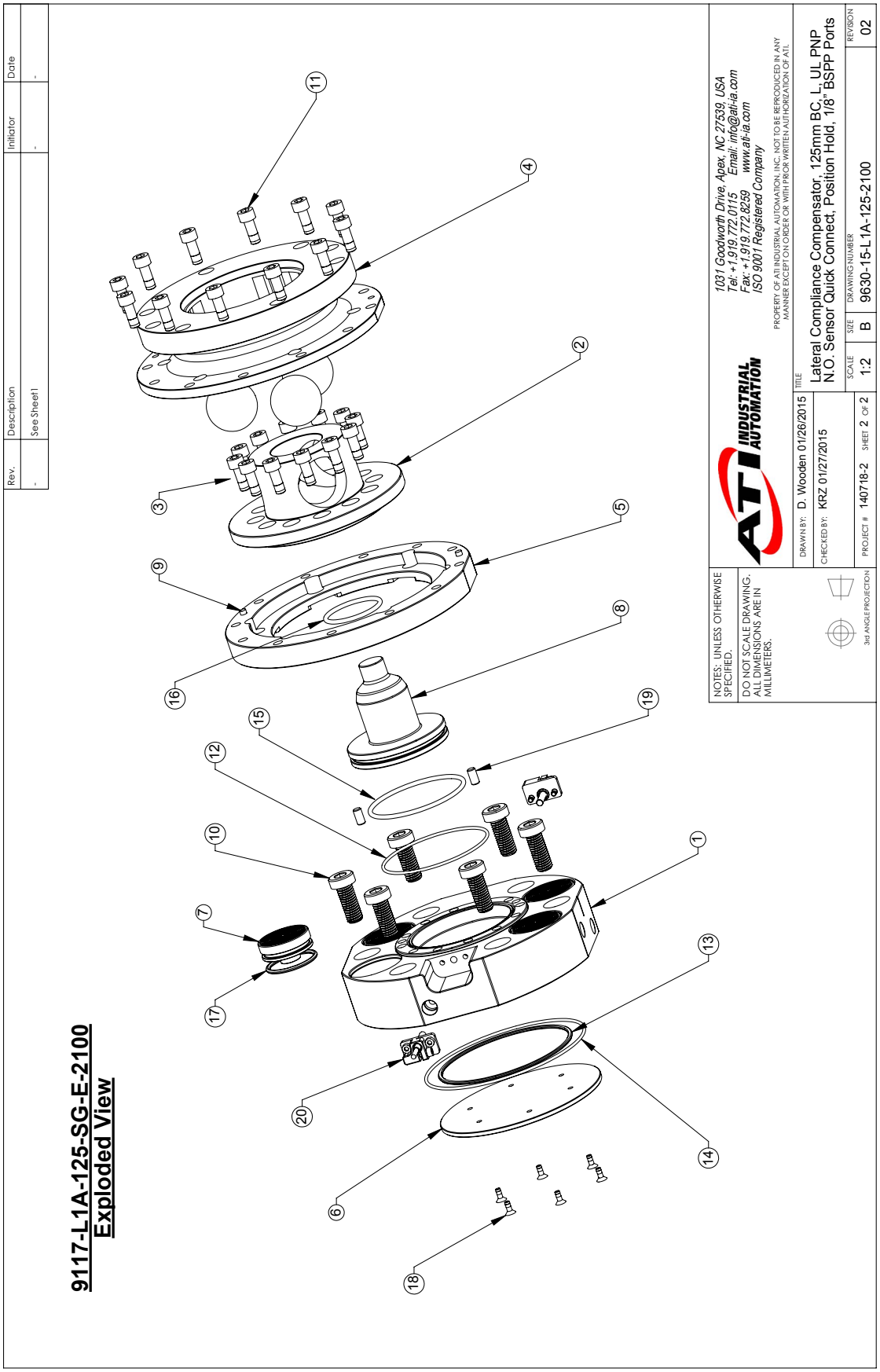
Notes:

1. The rating assumes unlocking 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-L1A-125-2100




Rev. | Description | Initiator | Date
- | See Sheet1 | - | -
9117-L1A-125-SG-E-2100
Exploded View
1031 Goodworth Drive, Apex, NC 27539, USA
Tel: +1.919.772.0115 Email: info@ati-ia.com
Fax: +1.919.772.8259 www.ati-ia.com
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INDUSTRIAL AUTOMATION
NOTES: UNLESS OTHERWISE SPECIFIED.
DO NOT SCALE DRAWING. ALL DIMENSIONS ARE IN MILLIMETERS.
DRAWN BY: D. Wooden 01/26/2015
CHECKED BY: KRZ 01/27/2015
TITLE
Lateral Compliance Compensator, 125mm BC, L, UL PNP N.O. Sensor Quick Connect, Position Hold, 1/8" BSPP Ports
SCALE 1:2
SIZE B
DRAWING NUMBER 9630-15-L1A-125-2100
REVISION 02
PROJECT # 140718-2
SHEET 2 OF 2
3rd ANGLE PROJECTION
1
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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.