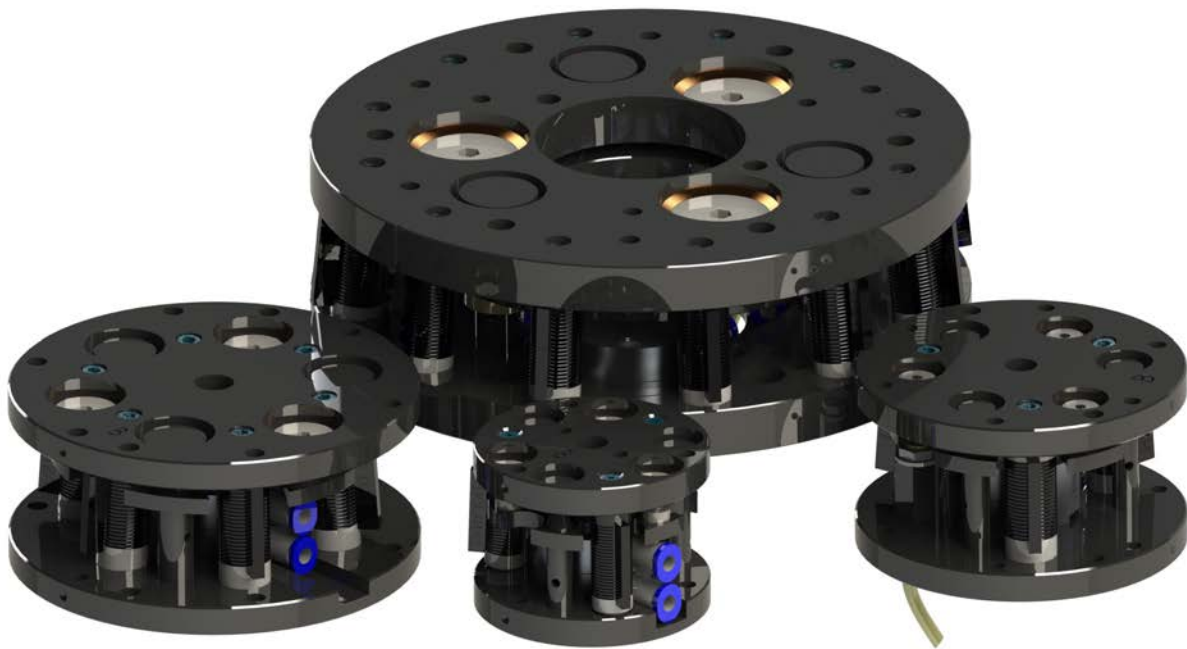




Compensator

9116 Series 000, 100, 200, and 400

Installation and Operation Manual



Document #: 9610-15-1000

Engineered Products for Robotic Productivity

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Foreword



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 of Terms

Term	Definition
Top Plate	Plate that interfaces Compensator to robot or assembly machine.
Bottom Plate	Plate that interfaces customer tooling to Compensator.
overload pin	Component that limits amount of the compliance to prevent damage to Compensator when overloaded.
shear pad	Component that provides compliance in the lateral, cocking, axial, and torsional directions.
Lock-up	Pneumatically-powered locking mechanism that locks Compensator rigid for accelerated movements to reduce wear on the shear pads.
Lock-up Screw	Locking mechanism component that is pulled into bottom plate by the lock-up to help securely lock unit.
Lock-up Screw Bushing	Wear bushing for lock-up screw.
Lock Sensing	Proximity sensor mounted in the sensor fitting detects when Compensator is locked.
Sensor Ready	Compensator with sensor fitting. Customer supplies proximity sensor for lock sensing.
Insertion Contact Point	Point at which part being inserted contacts its mating part. At this point a contact force is created.
Center-of-Compliance (C-of-C)	The point in the space at which a contact force will cause a translation with no rotation and a torque will cause a rotation with no translation.
RCC	Remote Center-of-Compliance or Remote Compliance Center (same as C-of-C).

1. Safety

The safety section describes general safety guidelines to be followed with this product, explanation of the notification found in this manual, and safety precaution that apply to the product. More specific notification are imbedded within the sections of the manual were they apply.

1.1 Explanation of Notifications

The notifications included here 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, installation, or setup of the product that if not followed could result in damage to equipment. The notification can emphasize but is not limited to specific grease types, good operating practices, or maintenance tips.

1.2 General Safety Guidelines

Prior to purchase and installation, the customer should verify that the Compensator selected is rated for the maximum loads expected during operation (refer to *Section 8—Specifications* in this manual or contact ATI for assistance).

The customer is responsible for understanding the function of the Compensator and implementing the proper hardware and/or software to operate the Compensator safely.

All pneumatic fittings and tubing must be capable of withstanding the repetitive motions of the application without failing. The routing of the electrical and pneumatic lines must minimize the possibility of stress pullout, kinking, rupture, etc.

All electrical power and pneumatics should be disconnected during servicing.

1.3 Safety Precautions



WARNING: Do not perform maintenance or repair on the Compensator unless all energized circuits (e.g. air, etc.) have been turned off. Injury or equipment damage can occur with energized circuits on. Turn off all energized circuits before performing maintenance or repair on the Compensator.



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



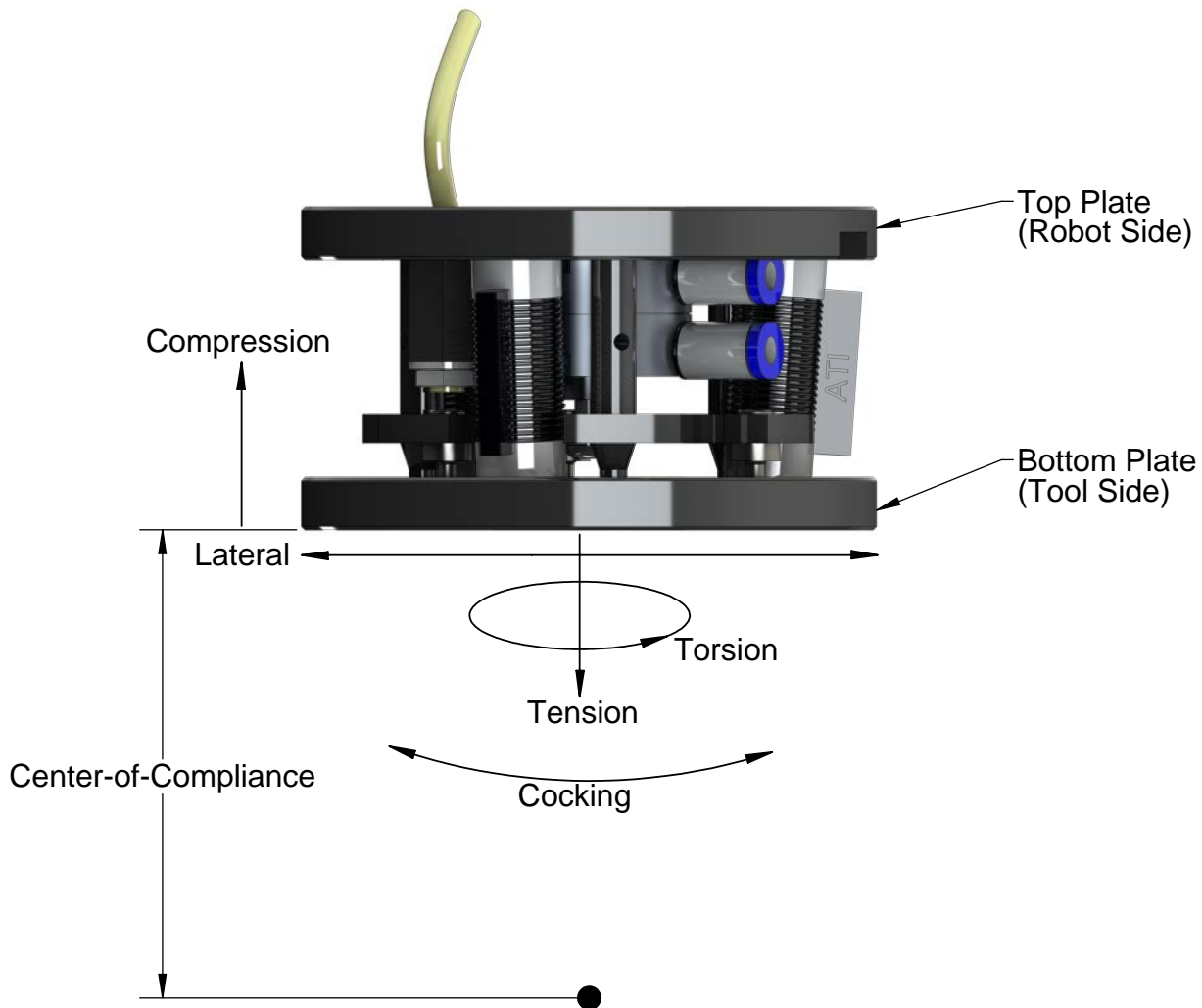
CAUTION: During operation, the area inside the Compensator must be kept clear. Failure to keep area clear will result in damage to Compensator.

2. Product Overview

The Compensator is a compliance device that enhances the flexibility and reliability of a robot or assembly machine. Compensators are used in the automated assembly applications to provide compliance for misalignment during assembly. The sizes covered in this manual include 9116 Series 000, 100, 200, and 400.

The Compensator is designed to provide compliance in the lateral, cocking, axial, and torsional directions (see Figure 2.1). A key feature to the Compensator is the projected (remote) compliance center. The Center-of-Compliance (C-of-C) is the point in the space at which a contact force will cause a translation with no rotation and a torque will cause a rotation with no translation. When the Center-of-Compliance is near the insertion contact point, the insertion part axis will align with the location axis during assembly. The Compensator consists of a single device with all components contained within the unit's outside diameter. The Compensator is available in various sizes and configurations, refer to [Section 8—Specifications](#).

Figure 2.1—Product Description

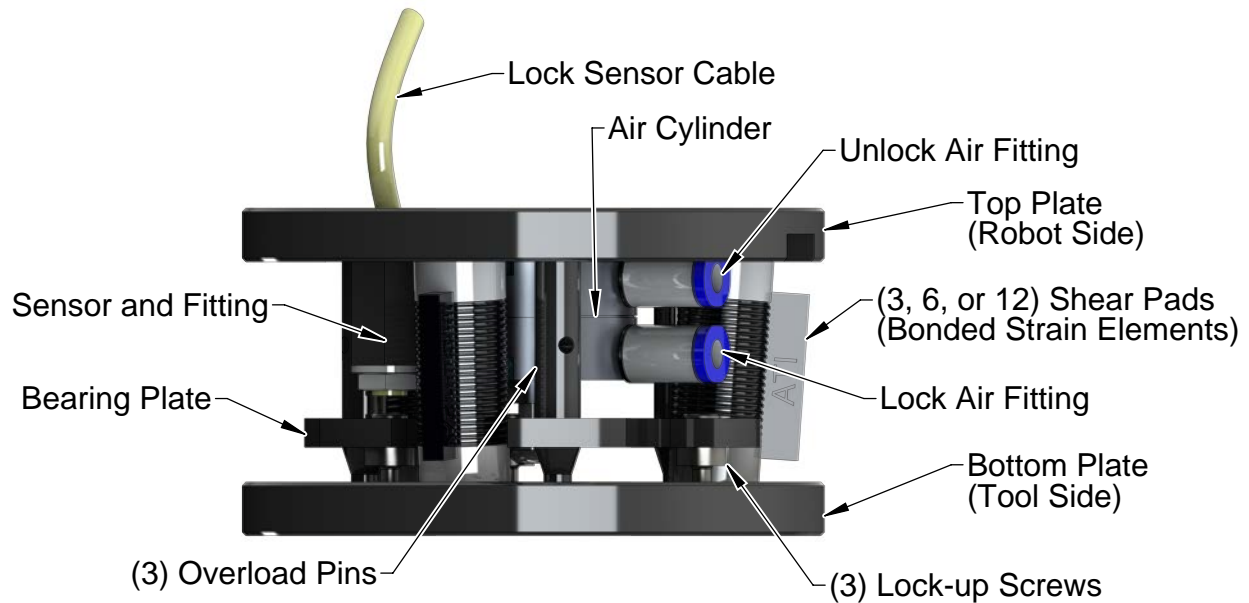


2.1 9116 Series 000, 100, 200, and 400 Compensator Assemblies

The base 9116 Series Compensator assembly includes anodized aluminum top and bottom plates, hardened steel overload pins, and shear pads. The 000 and 100 use 3 shear pads. The 200 uses either 3 or 6 shear pads. The 400 uses either 6 or 12 shear pads. Units with lock-up include air cylinder(s), bearing plate, lock-up screws, and lock-up screw bushings. Units with lock sensing also require a sensor fitting and cabled proximity sensor (see [Figure 2.2](#)).

Lock-up and lock sensing is optional. Lock-up is available on all sizes; lock sensing is only available on the 100, 200, and 400 sizes.

Figure 2.2—9116 Series Compensator Assembly (Lock-up Screw Bushing Not Shown)



2.2 Application

The following section provides information about using the Compensator in the application.

2.2.1 Intended Use

The Compensator is intended to be used in the “peg-in-hole” type operations in the vertical orientation. The peg-in-hole example is an application involving the insertion of the one part into another. There are a variety of the peg-in-hole type applications that include: dowel pin insertion, mold alignment, washer insertion, bearings into housings, and shafts into bearings. If the Compensator is used in the horizontal orientation, over time the shear pads will develop sag. Rubber and most rubber-like materials have memorization characteristics. Over time the rubber material memorizes the repeated position and will return to this position. When this occurs, the shear pads have developed sag. Use of Lock-up option is recommended to prevent shear pad sag.

2.2.2 Compensator Selection

1. Compare possible assembly misalignment with Compensator allowable misalignment:

Follow the (2) steps below (see [Figure 2.3](#)).

Step 1: Perform a tolerance study of the your worst case assembly misalignment.

- a. Tolerance to which your assembly machine can position part A.
- b. Tolerance to which your feeder can position part B.
- c. Repeatability of the tooling handling part A.
- d. Locational tolerance of the part B’s feature (i.e.; hole)
- e. Repeatability of the Compensator is +/- 0.002” in the vertical position.

Assembly misalignment (worst case) = a) + b) + c) + d) + e)

Step 2: Find your total clearance.

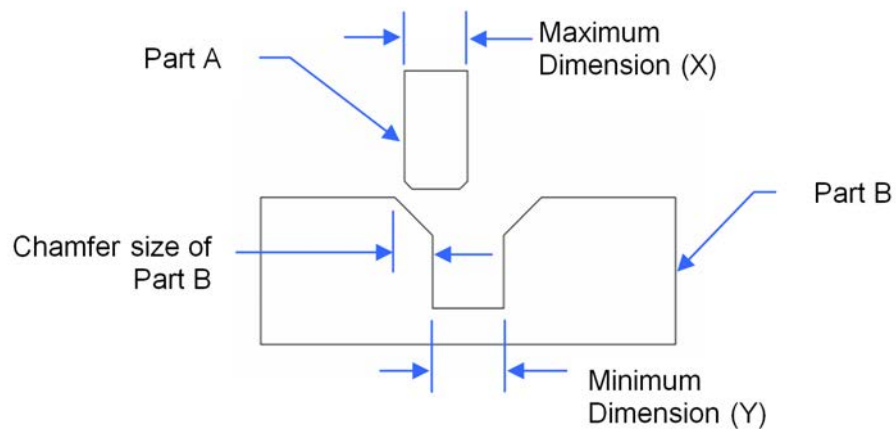
- a. Chamfer size on the part A (a lead in the is required on the at least one part).
- b. Chamfer size on the part B.
- c. Worst case part clearance, Y subtract X.

Total Clearance = a) + b) +c)

- The Compensator is needed when your assembly misalignment is greater than your part clearance.
- Your total clearance must be greater than your assembly misalignment or (2) parallel surfaces will contact. If the your total clearance is less than your assembly misalignment, then increase the chamfer size on the part an and/or part B.
- Select a Compensator with allowable misalignment greater than your assembly misalignment, refer to [Section 8—Specifications](#).

When the insertion axis is not vertical, the initial offset of the Compensator due to the weight of the tooling and part must be taken into consideration as there is some lateral and cocking deflection of the flexing shear pads. This reduces the allowable misalignment in the downward direction, while increasing it in the upward direction.

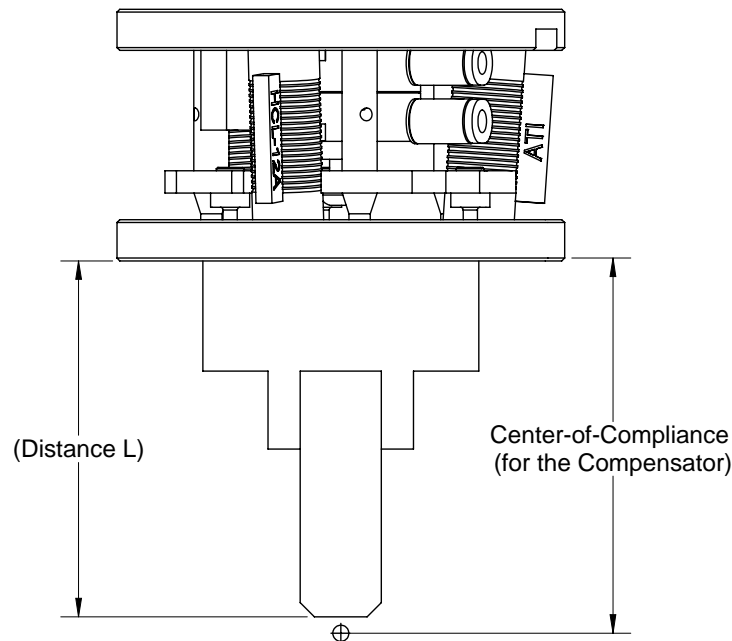
Figure 2.3—Assembly Inaccuracy



2. Determine the Distance L and Select the Compensator with the Optimum (C-of-C)

Calculate the total distance, L, from the tool side (bottom) plate of the Compensator to the initial contact point of the part being inserted (see [Figure 2.4](#)). Take into account any interface plates. Select the model with a Center-of Compliance (C-of-C) within 30% of the distance L. It is better to have a C-of-C below the insertion point than above. If the fit between the peg and hole is loose, a model with a C-of-C within 60% of the distance L is allowable.

Figure 2.4—Determine the Distance L and Select the Compensator with the Optimum (C-of-C)



3. Determine the required load capacity:

Observe the following guidelines:

- The tension load capacity for a vertical application is the weight of the tool and part.
- Use HCL-13A shear pad for high-impact loads.
- Use lock-up device to reduce high inertia loads due to acceleration.
- A high compression load capacity will be needed for tight tolerance applications (i.e.; press fit).
- When needed, use (6) shear pads on the 200 and (12) on the 400 to double the load capacity. Refer to [Section 8—Specifications](#) for model lateral and cocking load specifications.

4. Minimize insertion force:

Calculate your maximum insertion force by multiplying your assembly misalignment by the lateral stiffness. Refer to [Section 8—Specifications](#) for lateral stiffness.

- Make sure your assembly device can overcome the insertion force.
- Minimize Compensator stiffness when handling lightweight or delicate parts.
- Longer, heavier parts can usually tolerate a greater insertion force.

The 100 and 200 use (3) types of shear pads. The HCL-12A is the softest shear pad, while the HCL-11A is nearly as soft, but with a longer C-of-C. The HCL-13A is the stiffest shear pad with a C-of-C similar to the HCL-12A.

The 000 uses (2) types of shear pads, HCL-01A2 and HCL-02A. The HCL-01A2 is the softest shear pad. The HCL-02A is stiffer axially and laterally.

Find the lowest stiffness model that is within the applications load capacity and near the optimum C-of-C.

The 400 uses one type of shear pad, HCL-13A.

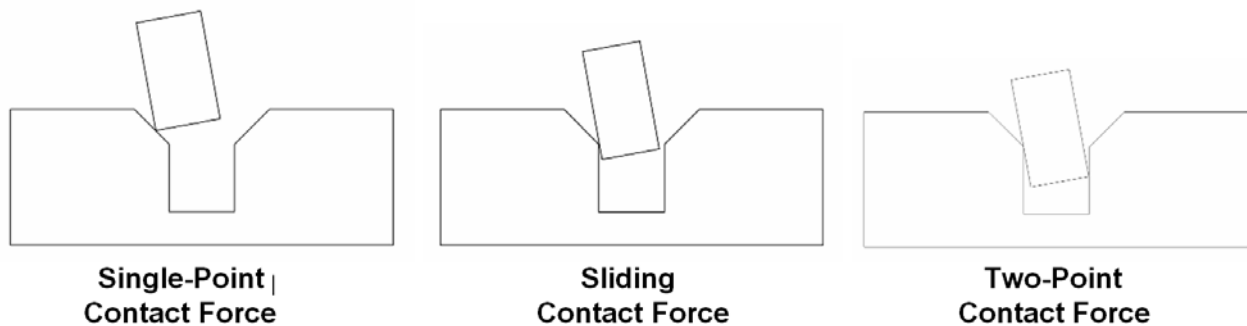
5. Environment

The shear pads performance can be affected by the environment, such as temperature and oil. Refer to [Section 8—Specifications](#) for shear pad specifications.

2.2.3 Contact Force

Excessive contact force is the main problem in the many assembly applications. Excessive contact force causes galling, jamming, and broken parts. During a typical assembly process, there are (3) main contact forces: single-point, sliding, and two-point (see [Figure 2.5](#)). The key to reducing single-point or sliding contact force is using a compliance device with a low lateral stiffness. Two-point contact force is reduced with a low cocking stiffness.

Figure 2.5—Contact Forces



2.2.4 Repeatability

The Compensator has a positional repeatability of the $\pm .026$ mm (.001") when in the locked position. When unit is unlocked, shear pads have a positional repeatability of the $\pm .051$ mm (.002").

3. Installation

3.1 Robot Side Interface

The 000, 100, 200, and 400 have (2) options for interfacing to a robot or assembly machine. Units can be mounted by using the tapped holes on the robot side (top) plate or by bolting through robot side (top) plate to robot or assembly machine. All sizes have (2) dowel holes for location. Robot or assembly machine interface must accommodate sensor cable. If the unit is equipped with lock sensing. For size and location of the mounting features and lock sensor cable exit, refer to [Section 9.1—Customer Drawings](#). Mounting hardware not provided.

3.2 Tool Side Interface

The tool side (bottom) plate uses the same (2) methods for mounting tooling to unit as the robot side (top) plate. This plate also has (2) dowel holes for location. Refer to See [Section 9.1—Customer Drawings](#) for size and location of the mounting features.

3.3 Pneumatic Connections for Units with Lock-up (optional)

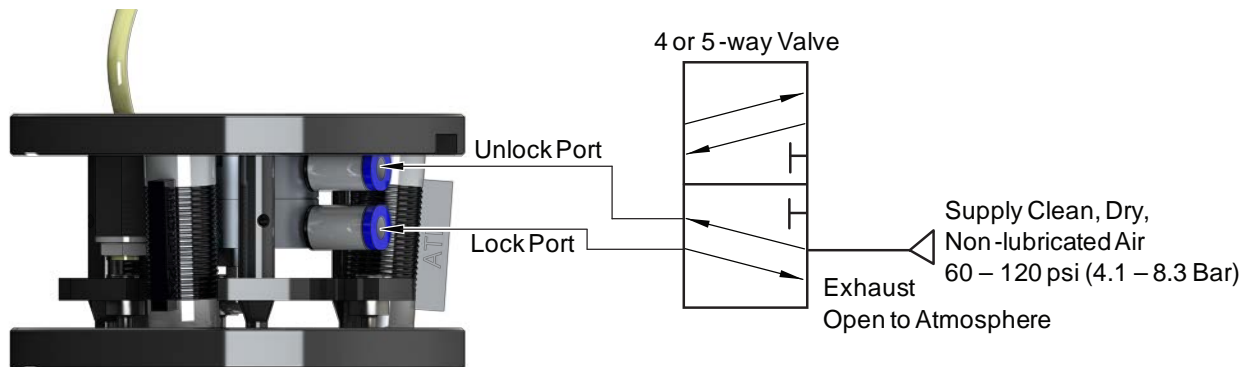


CAUTION: The routing of the pneumatic lines must minimize the possibility of stress pullout, kinking, etc. Failure of the pneumatic lines to operate the unit properly may result in damage to equipment.


Units equipped with lock-up require an air supply from the 60 to 120 psi (4.1 to 8.3 bar) to operate lock-up. Air supply should be clean, dry, and non-lubricated. Air supply is connected to Compensator by 5/32" or 4 mm O.D. flexible, pneumatic tubing. See [Figure 3.1](#) for air fitting identification.

It is recommended that a single 4-way valve be used to actuate the lock-up cylinder. The valve may be of the either 4-port or 5-port configuration. When air is supplied to the Lock or Unlock Port on the Compensator, the opposite port must be vented to 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 vacuum on the inactive port will negate the locking force of the lock-up cylinder.

Figure 3.1—Lock-up Pneumatic Connection



3.4 Electrical Connection for Units with Lock Sensing (optional)

 **CAUTION:** The routing of the electrical lines must minimize the possibility of stress pullout, kinking, etc. Failure of the electrical lines to operate the unit properly may result in damage to equipment.

Units equipped with lock sensing use a M5 x 0.5 x 25 mm long threaded barrel proximity sensor. For power requirements and additional specifications, refer to [Section 8—Specifications](#). Customers that order units sensor-ready should use the same type proximity sensor as specified.

Figure 3.2—PNP Type Lock Sensor

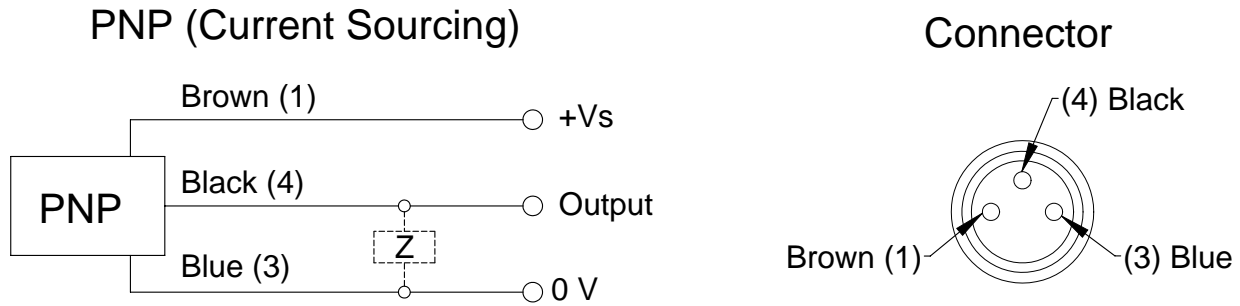
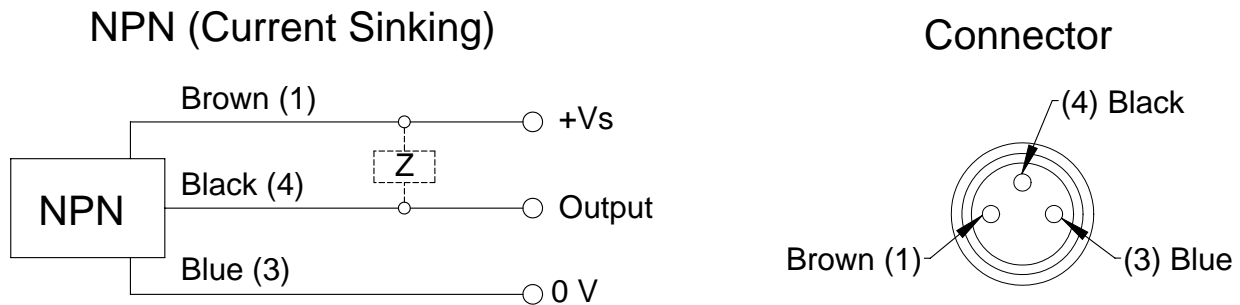
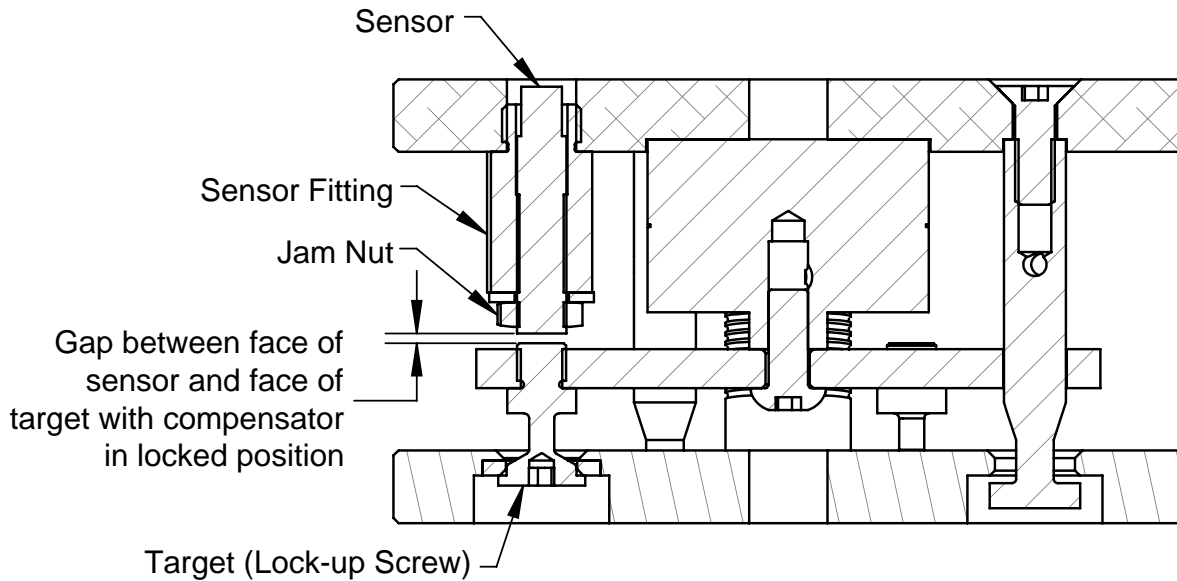


Figure 3.3—NPN Type Lock Sensor



Sensor gap should be set at 1.02 mm (.040") on the 100 and 200 with unit locked. Sensor gap should be set at 0.5 mm (0.020") on the 400 with unit locked, refer to [Figure 3.4](#).

Figure 3.4—Lock Sensor Gap Setting



4. Operation

4.1 Compliance

The Compensator's compliance is limited by (3) overload pins. When the unit has reached maximum compliance, the overload pins support the load to prevent damage to shear pads. Refer to [Figure 2.1](#) for compliant directions.

4.2 Lock-up (optional)

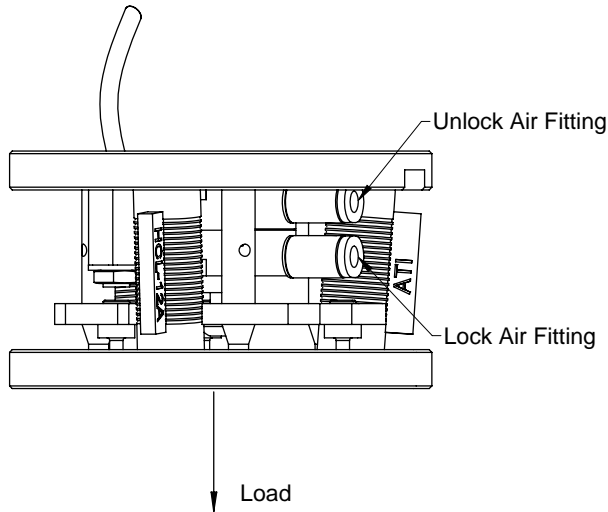
Units equipped with lock-up are recommended to use an air supply from the 60 to 120 psi (4.1 to 8.3 bar). In the severe locking conditions, air supply can be adjusted to a maximum of the 120 psi (8.3 bar). Refer to [Section 8—Specifications](#) for air cylinder force factors. Lock-up is operated by applying air to the desired fitting (lock or unlock). Opposite fitting must be exhausted for cylinder to operate correctly. Unit is recommended to be locked in the vertical position. This creates a normal locking condition. Severe locking condition occurs when the unit is locked in the horizontal position under load. Load is being lifted by lock-up mechanism, refer to [Figure 4.1](#). Please note that severe locking conditions will create above normal wear on the lock-up screw bushings. For recommended lubrication periods for normal and severe locking conditions, refer to [Section 5—Maintenance](#). Using a flow control valve to reduce acceleration of the lock-up screw into the tool side (bottom) plate will help reduce wear on the lock-up screw bushings.



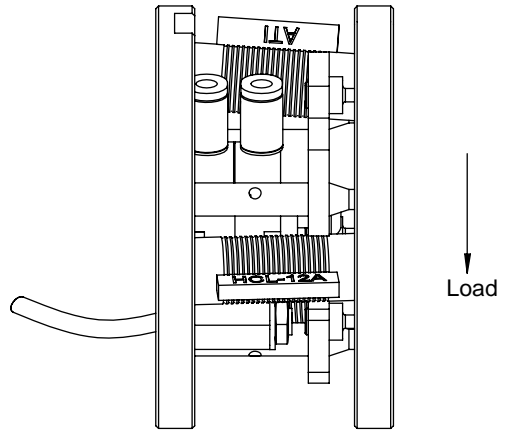
CAUTION: Unit must be in the unlocked position for full compliance.

Figure 4.1—Locked Positions

Vertical Lock Position / Normal



Horizontal Lock Position / Severe



4.3 Lock Sensing (optional)

Lock sensing is achieved by monitoring the position of the lock-up screw on the 100 and 200. The bearing plate position is monitored on the 400 to achieve lock sensing. When air pressure is applied to the air cylinder to lock unit, the lock-up screw is pulled into the tool side (bottom) plate. The lock-up screw or bearing plate enters the sensing range of the proximity sensor sending a lock signal. Refer to [Figure 3.4](#).



WARNING: Stay clear of the Compensator when lock-up is being cycled. Injury could result from the moving parts.

5. Maintenance

The Compensators are designed to provide a long life with regular maintenance. A visual inspection and preventive maintenance schedule is provided in [Section 5.1—Preventive Maintenance](#).

Refer to [Section 9.2—Assembly Drawings](#), for assembly drawings and instructions.



WARNING: Do not perform maintenance or repair on the Compensator unless the tool is safely supported or docked in the tool stand and all energized circuits (e.g. electrical, air, water, etc.) have been turned off. Injury or equipment damage can occur with tool not docked and energized circuits on. Dock the tool safely in the tool stand and turn off all energized circuits before performing maintenance or repair on the Compensator.

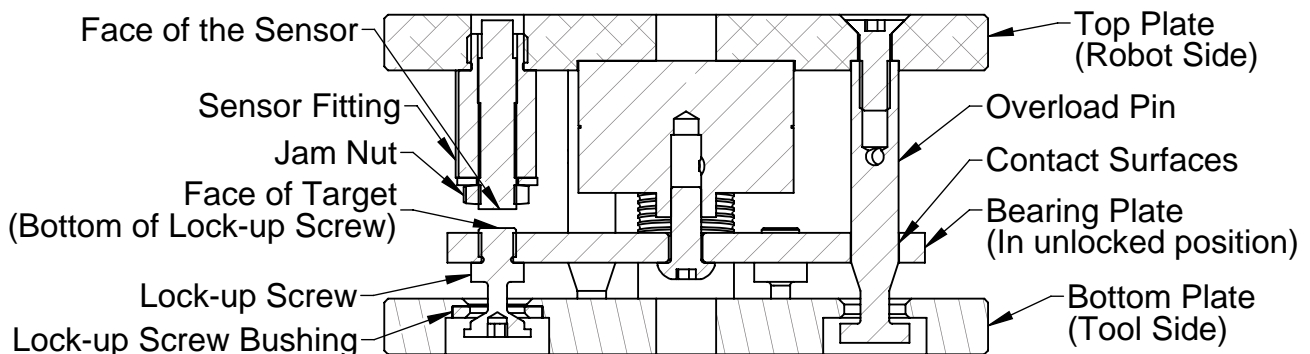
5.1 Preventive Maintenance

Units should be visually inspected for debris build-up, that mounting fasteners are secure, and the unit is functioning properly. Units with optional lock-up mechanism should be inspected periodically to ensure that it is operating freely and is free of the debris. Units with optional lock sensing should be inspected for debris and sensor and target faces cleaned. Routine inspection of the pneumatic and electrical lines is recommended to avoid possible failure.

Table 5.1—Preventive Maintenance Checklist

General preventive maintenance	Maintenance Schedule	
<input type="checkbox"/> Inspect mounting fasteners for tightness. If the lose tighten.	At lubrication periods	
<input type="checkbox"/> If equipped, clean sensor face and sensor target using a lint free cloth. Refer to Figure 2.1 .		
<input type="checkbox"/> If equipped, Inspect sensor jam nut and fitting for tightness, if the lose tighten. Refer to Section 9.2—Assembly Drawings for proper torque.		
<input type="checkbox"/> If equipped, inspect pneumatic lines and sensor cable for wear or damage, replace as required.		
Inspection and Lubrication	Normal locking conditions	Severe locking conditions
<input type="checkbox"/> Lubricate overload pins with a light machine oil where the pins contact the Bearing Plate. Refer to Figure 5.1 .	Every 50,000 cycles	Every 25,000 cycles
<input type="checkbox"/> Inspect Lock-up screws and bushing for debris and lubrication. If required clean and lubricate using anti-Seize (MIL-A-907E). Lubricant should be applied under head of the lock-up screw between lock-up screw bushing and lock-up screw Refer to Figure 5.1 .	Every 250,000 cycles	Every 100,000 cycles

Figure 5.1—Section View



6. Troubleshooting



WARNING: Do not perform maintenance or repair on the Compensator unless the tool is safely supported or docked in the tool stand and all energized circuits (e.g. electrical, air, water, etc.) have been turned off. Injury or equipment damage can occur with tool not docked and energized circuits on. Dock the tool safely in the tool stand and turn off all energized circuits before performing maintenance or repair on the Compensator.

Refer to the following table for trouble shooting information.

Table 6.1—Troubleshooting		
Symptom	Possible Cause	Resolution
Unit not returning to initial position when compliance force is removed. (without actuating lock-up).	Mounting fasteners are lose.	Inspect mounting fasteners and tighten If the lose.
	shear pads (Bonded Strain elements) are damaged or worn.	Inspect shear pads for damage, replace If required. Refer to Section 6.1—Replacing shear pads.
Unit will not lock or unlock.	Debris caught between lock-up mechanism.	Verify area between bearing plate and bottom plate is clear. Verify the area between the Lock-up screws and Lock-up screw bushings are clear.
	Air leak at unit.	Verify pneumatic tubing is fully inserted into air fittings.
	Air lines are connected to incorrect air fittings.	Verify that air lines are connected to correct air fittings and test lock-up. Refer to Section 3.3—Pneumatic Connections for Units with Lock-up (optional).
	Air is trapped in the opposite port being actuated or incorrect valve being used.	Verify that when air is supplied to one port, the opposite port is being exhausted and the correct valve is installed. Refer to Section 3.3—Pneumatic Connections for Units with Lock-up (optional).
	Air supply not to specification.	Check air supply. Pneumatic cylinder rod should be compressed during locked condition. Cylinder rod should be fully extended during unlock condition. Refer to Section 3.3—Pneumatic Connections for Units with Lock-up (optional).
	Damaged or worn Locking screws or bushings.	Verify locking mechanism is operating freely and is lubricated properly.
Lock sensor not operating properly.	There is debris between the sensor and target.	Inspect and clean If necessary the sensing face of the sensor and sensor target using a lint free cloth. Refer to Figure 5.1.
	The Gap between the Sensor and the target is not adjusted properly.	Verify that sensor gap is set at correct distance and jam nut and sensor fitting are tight. Refer to Section 3.4—Electrical Connection for Units with Lock Sensing (optional).
	Sensor is wired incorrectly to power source.	Verify sensor is wired correctly to power source. Refer to Section 3.4—Electrical Connection for Units with Lock Sensing (optional).
Unit is not compliant.	Unit is locked.	Verify unit is unlocked.

6.1 Replacing shear pads

Refer to the following section for shear pad Replacement:

[Section 6.1.1—9116 000 Series shear pad Replacement.](#)

[Section 6.1.2—9116 100 and 200 Series shear pad Replacement](#)

[Section 6.1.3—9116 400 Series shear pad Replacement](#)

6.1.1 9116 000 Series shear pad Replacement

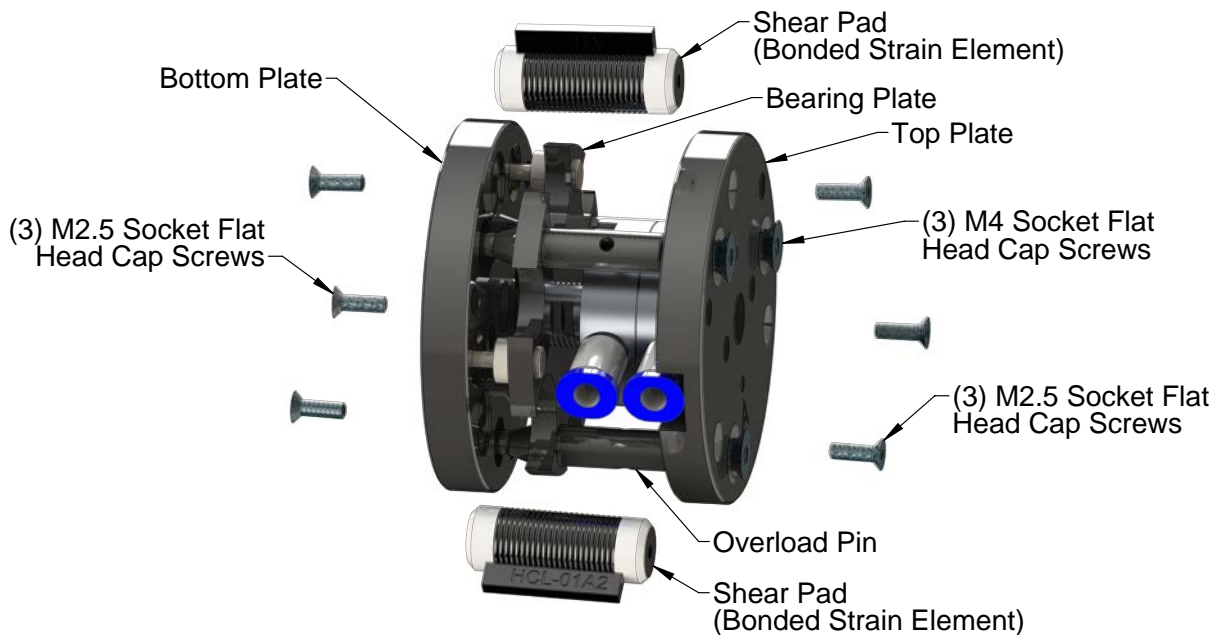
Parts required: [Section 9.2.1—Compensator 9116 Series 000 with Lock-up](#)

Supplies required: Loctite Primer 7649 and 222

Tools required: 1.5 mm, 2 mm, and 2.5 mm Allen wrench (hex key), torque wrench

1. Turn off all energized circuits and remove the tooling from the Compensator.
2. If equipped, remove the air lines from the Compensator.
3. Remove the Compensator from the robot.
4. Remove the (3) M2.5 socket flat head cap screws securing the shear pads to the bottom plate.
Note: Be careful not to strip the hex socket while removing the screws.
5. If equipped with locking option, move the bearing plate into the unlocked position. Push towards the bottom plate.
6. Loosen the (3) M4 socket flat head cap screws securing the overload pins to the top plate. Insert a pin in the hole in the overload pin to keep it from turning. **Note:** This will allow you to separate the top and bottom plates enough to get the shear pads out.
7. Remove the (3) M2.5 socket flat head cap screws securing the shear pads to the top plate. **Note:** Be careful not to strip the hex socket while removing the screws.
8. Gently remove the shear pads from the Compensator.

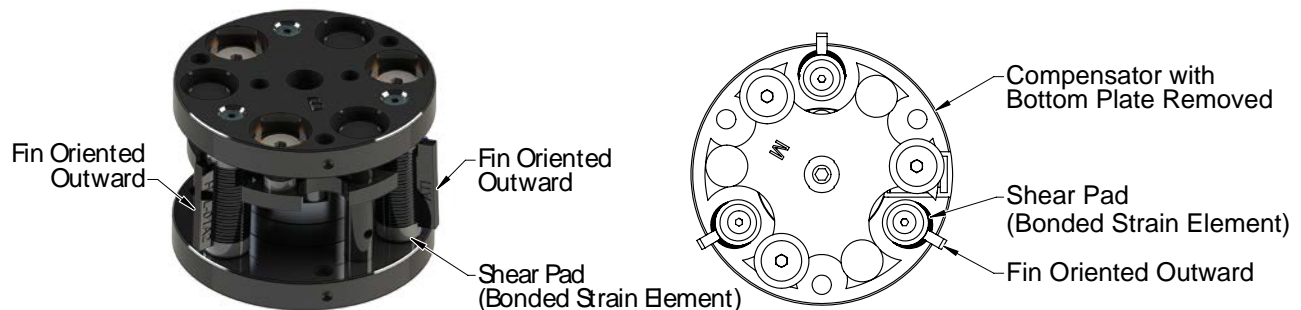
Figure 6.1—Replace shear pads (Bonded Strain Elements)



9. Make sure the seats for the shear pads on the inside of the top and bottom plates are clean. Install the new shear pads in the Compensator.
10. Apply Loctite Primer 7649 and Loctite 222 to (6) M2.5 socket flat head cap screws.

11. Orient each shear pad with fin pointing outward as shown in [Figure 6.2](#) and secure to the top plate with a M2.5 socket head cap screws. Tighten to 64 in-oz. **Note:** The shear pad will twist when securing with screw, hold the element in the proper orientation while securing to top plate.

Figure 6.2—Proper Orientation



12. Secure the overload pins to the top plate, tighten the M4 socket flat head cap screws to 25 in-lbs. Insert a pin in the hole in the overload pin to keep it from the turning If required.
13. If equipped with locking option, move the bearing plate into the locked position. Push towards the top plate.
14. Secure each shear pad to the bottom plate with a M2.5 socket head cap screws. Tighten to 64 in-oz. **Note:** The shear pad will twist when securing with screw, hold the element in the proper orientation while securing to bottom plate.
15. If equipped run air lines to Compensator and test functionality, if the functioning properly, install the Compensator to robot. If not make any necessary adjustments and retest.
16. If equipped attach air lines to Compensator.
17. Reinstall the tooling.

6.1.2 9116 100 and 200 Series shear pad Replacement

Parts required: [Section 9.2.2—Compensator 9116 Series 100](#),
[Section 9.2.3—Compensator 9116 Series 200 - \(3\) shear pads Location A](#),
[Section 9.2.4—Compensator 9116 Series 200 - \(3\) shear pads Location B](#),
[Section 9.2.5—Compensator 9116 Series 200 - \(6\) shear pads Location C](#)

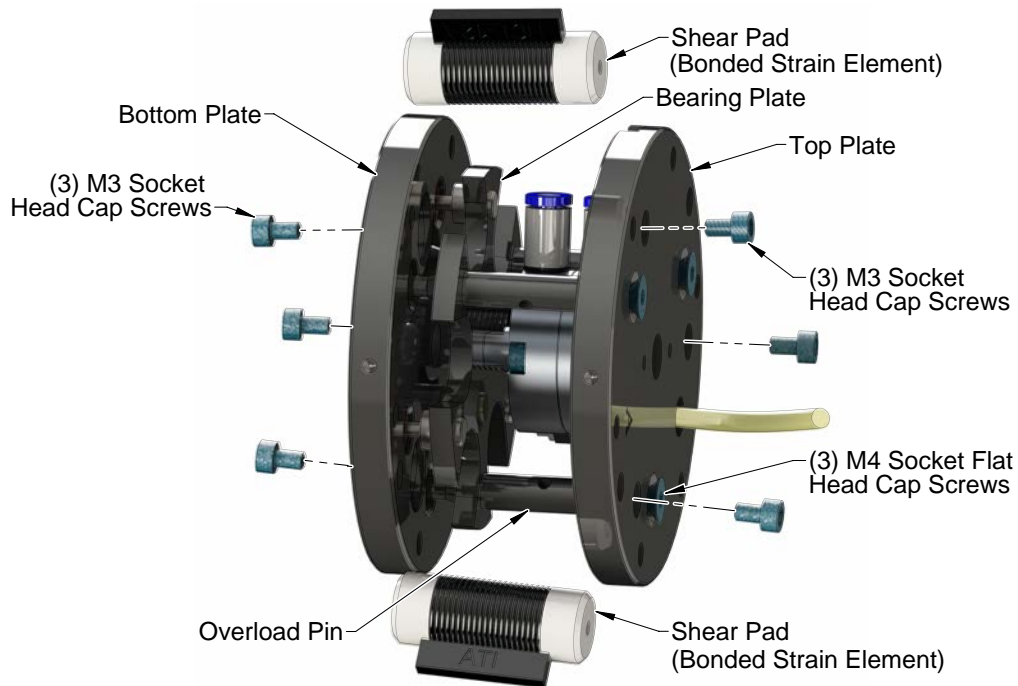
Supplies required: Loctite Primer 7649 and 222

Tools required: 2 mm, and 2.5 mm Allen wrench (hex key), torque wrench

1. Turn off all energized circuits and remove the tooling from the Compensator.
2. If equipped remove the air line from the Compensator.
3. Remove the Compensator from the robot.
4. Remove the M3 socket head cap screws securing the shear pads to the bottom plate. Refer to [Figure 6.3](#)
5. If equipped with locking option, move the bearing plate into the unlocked position. Push towards the bottom plate.
6. Loosen the (3) M4 socket flat head cap screws securing the overload pins to the top plate. Insert a pin in the hole in the overload pin to keep it from the turning If required. **Note:** This will allow you to separate the top and bottom plates enough to get the shear pads out.
7. Remove the M3 socket head cap screws securing the shear pads to the top plate.
8. Gently remove the shear pads from the Compensator.
9. Make sure the seats for the shear pads on the inside of the top and bottom plates are clean. Install the new shear pads in the Compensator.

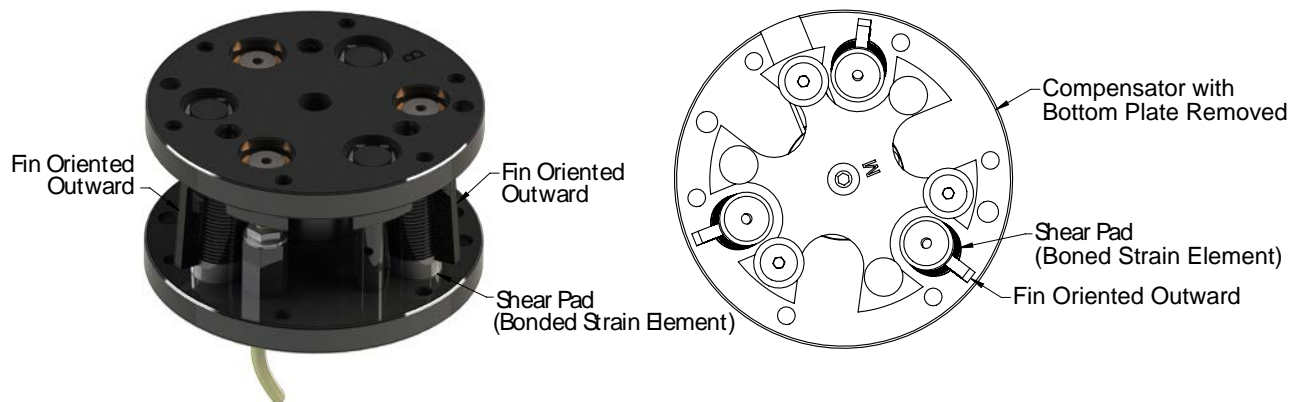
10. Apply Loctite Primer 7649 and Loctite 222 to (6) M3 socket head cap screws.

Figure 6.3—Replace shear pads (Bonded Strain Elements)



11. Orient each shear pad with fin pointing outward as shown in [Figure 6.4](#) and secure to the top plate with a M3 socket head cap screws. Tighten to 14 in-lbs. **Note:** The shear pad will twist when securing with screw, hold the element in the proper orientation while securing to top plate.

Figure 6.4—Proper Orientation



12. Secure the overload pins to the top plate, tighten the M4 socket flat head cap screws to 25 in-lbs. Insert a pin in the hole in the overload pin to keep it from the turning If required.
13. If equipped with locking option, move the bearing plate into the locked position. Push towards the top plate.
14. Secure each shear pad to the bottom plate with a M3 socket head cap screws. Tighten to 14 in-lbs. Note: The shear pad will twist when securing with screw, hold the element in the proper orientation while securing to bottom plate.
15. If equipped, run air lines to Compensator and test functionality, if the functioning properly, install the Compensator to robot. If not make any necessary adjustments and retest.

16. If equipped, attach air lines to Compensator.
17. Reinstall the tooling.

6.1.3 9116 400 Series shear pad Replacement

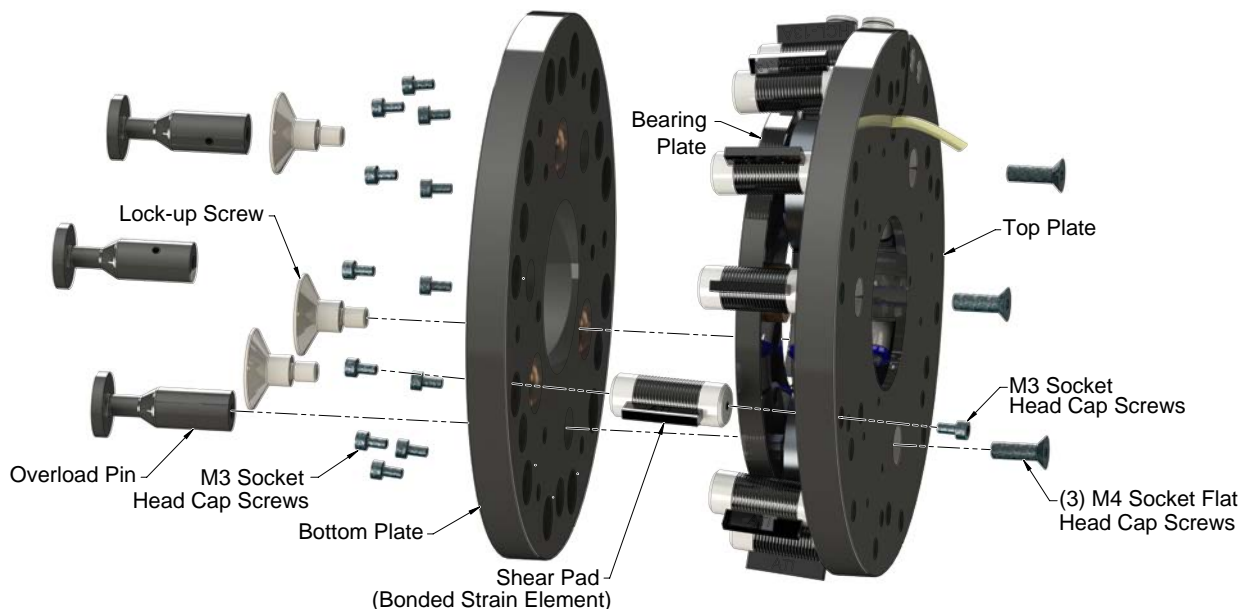
Parts required: *Section 9.2.6—Compensator 9116 Series 400 - (6) shear pads Location C, Section 9.2.7—Compensator 9116 Series 400 - (12) shear pads Location D*

Supplies required: *Loctite Primer 7649 and 222, anti-seize (MIL-A-907E)*

Tools required: *2 mm, 2.5 mm, and 3 mm Allen wrench (hex key), torque wrench*

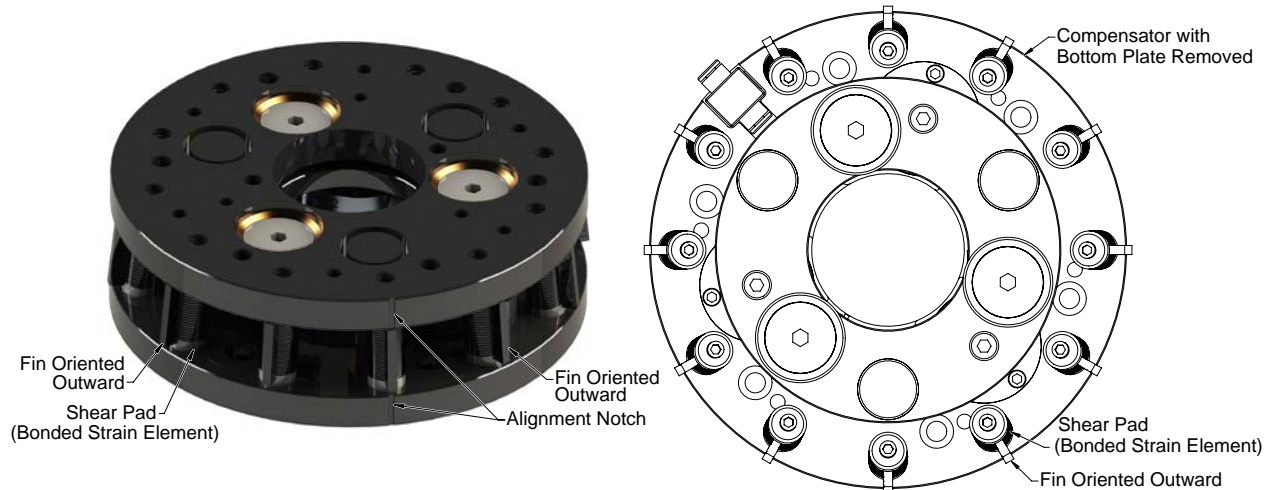
1. Turn off all energized circuits and remove the tooling from the Compensator.
2. If equipped, remove the air line from the Compensator.
3. Remove the Compensator from the robot.
4. Remove the M3 socket head cap screws securing the shear pads to the bottom plate.
5. If equipped with locking option, move the bearing plate into the unlocked position. Push towards the bottom plate.
6. Remove the (3) M5 socket flat head cap screws securing the overload pins to the top plate. Insert a pin in the hole in the overload pin to keep it from turning if required.
7. Remove the (3) overload pins.
8. If equipped, remove the (3) lock-up screws from the bottom plate.
9. Lift the bottom plate off the Compensator.
10. Remove the M3 socket head cap screws securing the shear pads to the top plate.
11. Remove the shear pads from the Compensator.
12. Make sure the seats for the shear pads on the inside of the top and bottom plates are clean. Install the new shear pads in the to the top plate.
13. Apply Loctite Primer 7649 and Loctite 222 to (6) M3 socket head cap screws.

Figure 6.5—Replace shear pads (Bonded Strain Elements)



14. Orient each shear pad with fin pointing outward as shown in [Figure 6.6](#) and secure to the top plate with a M3 socket head cap screws. Tighten to 14 in-lbs. **Note:** The shear pad will twist when securing with screw, hold the element in the proper orientation while securing to top plate.

Figure 6.6—Proper Orientation



15. Clean the (3) lock-up bushings in the bottom plate.
16. Assemble the bottom plate to the Compensator make sure all the shear pads are seated in the plate properly.
17. Apply anti-seize (MIL-A-907E) to the taper on the (3) lock-up screws.
18. Apply Loctite 222 to the threads of the lock-up screws and secure the bottom plate to the Compensator. Tighten to 35 in-lbs.
19. Insert the (3) overload pins through the bottom plate and bearing plate.
20. Apply Loctite 222 to the (3) M5 socket flat head screws, and secure the overload pins to the top plate, tighten the M5 socket flat head cap screws to 30 in-lbs. Insert a pin in the hole in the overload pin to keep it from the turning if required.
21. If equipped with locking option, move the bearing plate into the locked position. Push towards the top plate.
22. Secure each shear pad to the bottom plate with a M3 socket head cap screws. Tighten to 14 in-lbs. Note: The shear pad will twist when securing with screw, hold the element in the proper orientation while securing to bottom plate.
23. If equipped, run air lines to Compensator and test functionality, if the functioning properly, install the Compensator to robot. If not make any necessary adjustments and retest.
24. If equipped attach air lines to Compensator.
25. Reinstall the tooling.

7. Serviceable Parts

Refer to the following section for serviceable parts for each model:

Section 9.2.2—Compensator 9116 Series 100

Section 9.2.3—Compensator 9116 Series 200 - (3) shear pads Location A

Section 9.2.4—Compensator 9116 Series 200 - (3) shear pads Location B

Section 9.2.5—Compensator 9116 Series 200 - (6) shear pads Location C

Section 9.2.6—Compensator 9116 Series 400 - (6) shear pads Location C

Section 9.2.7—Compensator 9116 Series 400 - (12) shear pads Location D

8. Specifications

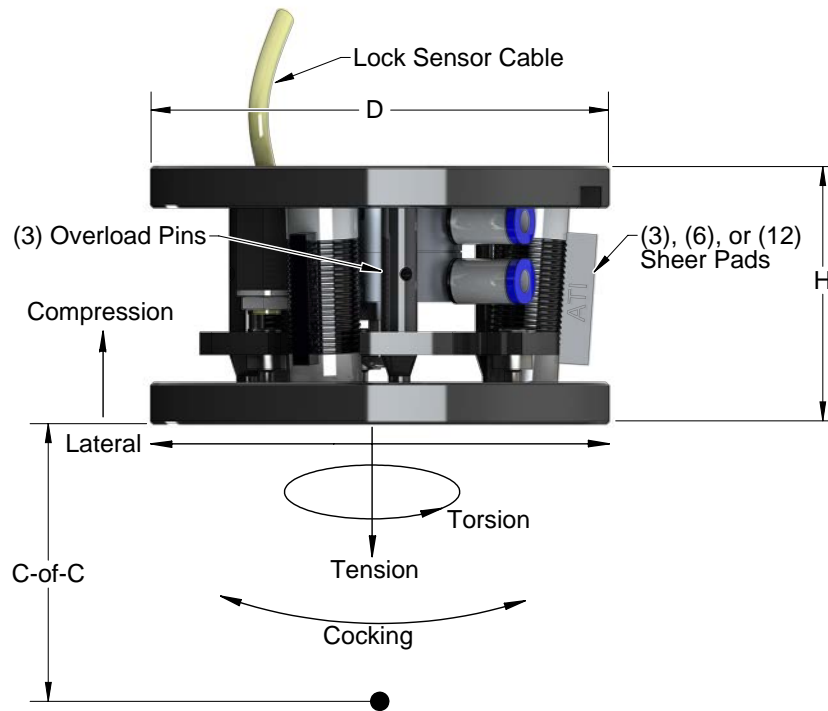
The tables below provide specification in the metric and standard units.

Size	Overall Size mm (in)		Weight w/ (3) shear pads N (lbs)		Allowable Misalignment (Standard)		
	D	H	Standard	w/ Lock-up & Sensor	Lateral mm (in)	Cocking rad (degree)	Torsion rad (degree)
000 ¹	56.9 (2.24)	41.4 (1.63)	1.3 (0.3)	1.8 (0.4)	1.7 (0.065)	0.017 (1.0)	0.079 (4.5)
100	80.0 (3.15)	45.0 (1.77)	2.2 (0.5)	3.1 (0.7)	2.2 (0.085)	0.019 (1.1)	0.087 (5.0)
200	99.1 (3.90)	45.0 (1.77)	3.6 (0.8)	4.9 (1.1)	2.2 (0.085)	0.019 (1.1)	0.070 (4.0)
400 ²	160.0 (6.3)	50.8 (2.0)	12.3 (2.76)	16.1 (3.62)	2.2 (0.085)	0.006 (0.3)	0.044 (2.5)

Notes:

1. Lock sensing currently not available.
2. Weight shown is with (12) shear pads.

Figure 8.1—Compensator Assembly (9116 Series 100 Shown)



Model Number ²³⁴⁵	C of the C mm (in)	Maximum Load Capacities				Stiffness	
		Vertical N (lbs) ¹	Horizontal N (lbs) ¹	Compression N (lbs)	Cocking N-m (in-lbs)	Lateral N/mm (lbs/in)	Cocking N-m/rad (in-lbs/rad)
9116-001-A	23 (0.9)	22.2 (5)	6.7 (1.5)	355.9 (80)	3.4 (30)	5.8 (33)	180.8 (1600)
9116-111-B	122 (4.8)	44.5 (10)	8.9 (2)	1290.9 (290)	5.1 (45)	11.4 (65)	372.8 (3300)
9116-112-B	69 (2.7)	44.5 (10)	8.9 (2)	533.8 (120)	5.1 (45)	7.2 (41)	180.8 (1600)
9116-113-B	61 (2.4)	80.1 (18)	26.7 (6)	1290.0 (290)	7.9 (70)	26.3 (150)	632.7 (5600)
9116-211-A	140 (5.5)	53.4 (12)	8.9 (2)	1334.5 (300)	6.8 (60)	11.4 (65)	474.5 (4200)
9116-211-B	155 (6.1)	53.4 (12)	8.9 (2)	1378.9 (310)	7.3 (65)	11.4 (65)	553.6 (4900)
9116-211-C	148 (5.8)	106.9 (24)	17.8 (4)	2713.4 (610)	14.1 (125)	22.8 (130)	1028.1 (9100)
9116-212-A	82 (3.2)	62.3 (14)	8.9 (2)	622.8 (140)	6.8 (60)	7.2 (41)	226.0 (2000)
9116-212-B	92 (3.6)	62.3 (14)	8.9 (2)	711.7 (160)	7.3 (65)	7.2 (41)	271.2 (2400)
9116-212-C	87 (3.4)	124.6 (28)	17.8 (4)	1334.5 (300)	14.1 (125)	14.4 (82)	497.1 (4400)
9116-213-A	74 (2.9)	97.9 (22)	26.7 (6)	1334.5 (300)	8.5 (75)	26.3 (150)	790.9 (7000)
9116-213-B	82 (3.2)	97.9 (22)	26.7 (6)	1378.9 (310)	9.0 (80)	26.3 (150)	949.0 (8400)
9116-213-C	79 (3.1)	195.7 (44)	53.4 (12)	2713.4 (610)	17.5 (155)	52.5 (300)	1739.9 (15400)
9116-413-C	229 (9)	195.7 (44)	26.7 (6)	2713.4 (610)	39.7 (350)	70.0 (400)	9038.3 (80000)
9116-413-D	229 (9)	391.4 (88)	53.4 (12)	5426.8 (1220)	79.4 (700)	140.1 (800)	18076.7 (160000)

Notes:

1. When used in the vertical position, use the Vertical maximum load capacities. When used in the horizontal position, use the Horizontal maximum load capacities.
2. -A and -B models use (3) shear pads, -C uses (6), -D uses (12).
3. 9116 Series 100 and 200 use (3) types of shear pads: HCL-11A, -12A and -13A.
4. 9116 Series 000 uses (2) types of shear pads: HCL-01A2 and -02A.
5. 9116 Series 400 uses one type of shear pad: HCL-13A.

Table 8.1—Component Specifications	
Lock Sensor	
Type	M5x0.5 Threaded Barrel Proximity Sensor, NPN or PNP, Normally Open
Supply Voltage Range	10–30 VDC
Output Current	200 mA
Rated Operating Distance (Sensing Range)	1.5 mm (.059")
Air Cylinder	
9116 Series 000 and 100	
Force Factor	0.25 lb/psi (15 N/bar)
9116 Series 200 and 400	
Force Factor	0.4 lb/psi (28 N/bar)

Figure 8.2—shear pad Specifications

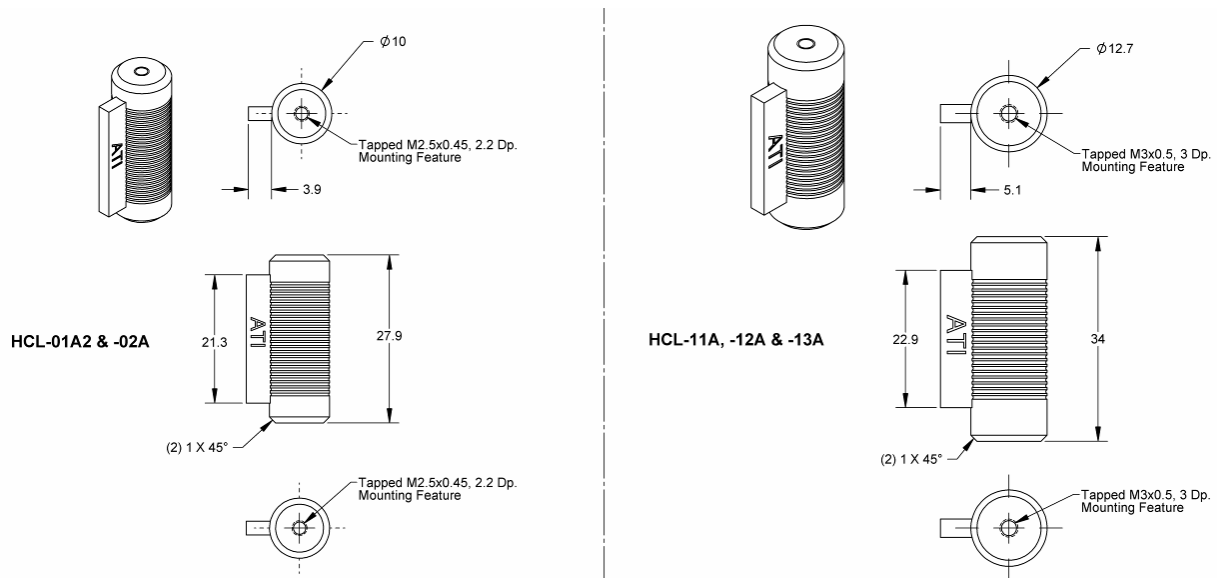
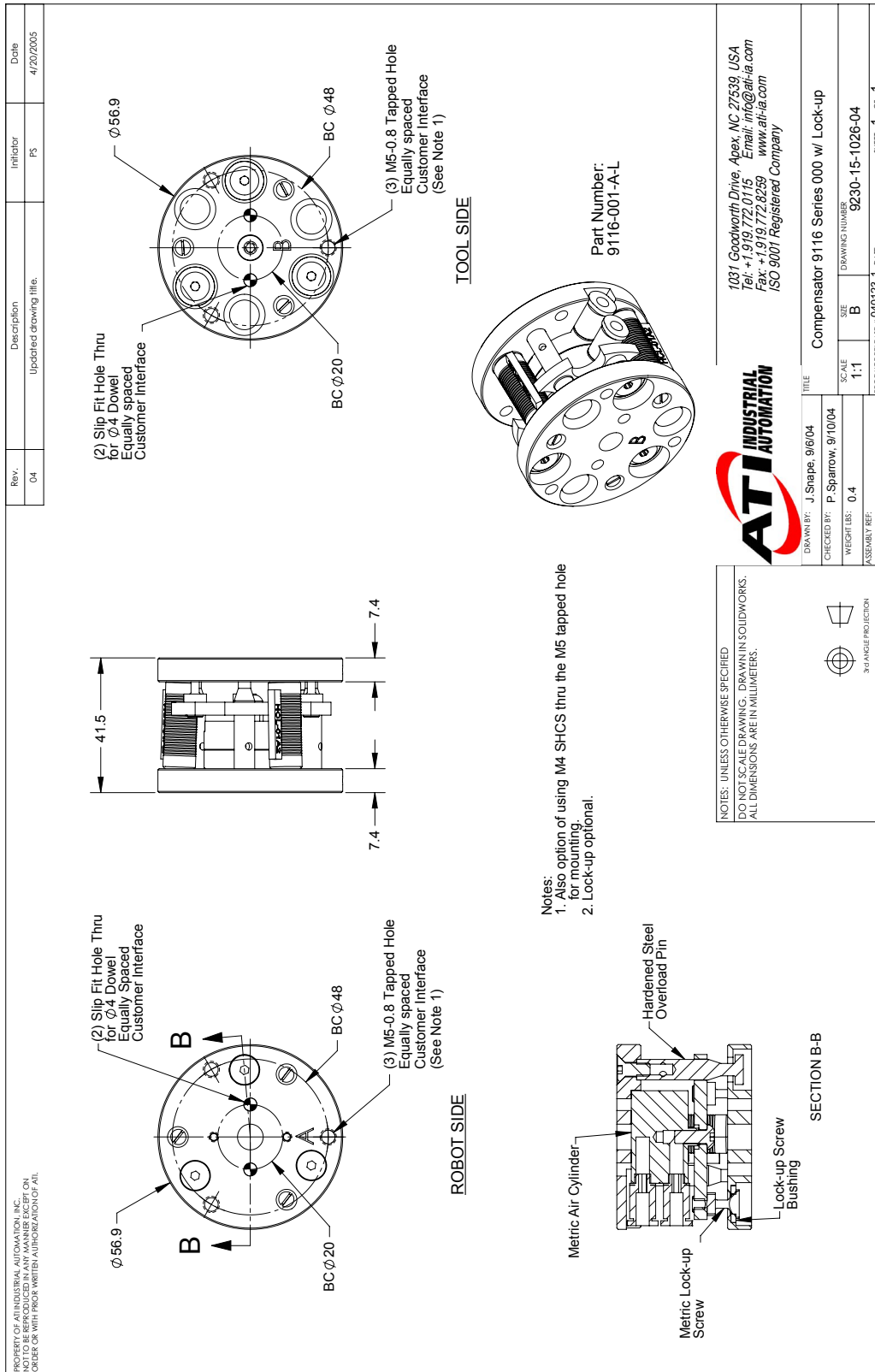


Table 8.2—shear pad Specifications					
Properties	shear pad Number				
	HCL-01A2	HCL-02A	HCL-11A	HCL-12A	HCL-13A
Compatible Compensator Size	000	000	100, 200	100, 200	100, 200, 400
Elastomer	Neoprene	Nitrile	Neoprene	Neoprene	Nitrile
Operating Temperature, Celsius	-29 to 82	-29 to 82	-29 to 82	-29 to 82	-29 to 82
Oil Resistance	Good	Excellent	Good	Good	Excellent
Ozone Resistance	Good	Good	Good	Good	Good
Lateral Stiffness (lbs/in)	6 (Very Low)	28 (High)	20 (Low)	14 (Very Low)	34 (High)
Axial Stiffness (lbs/in)	2329	10498	24889	6075	8300

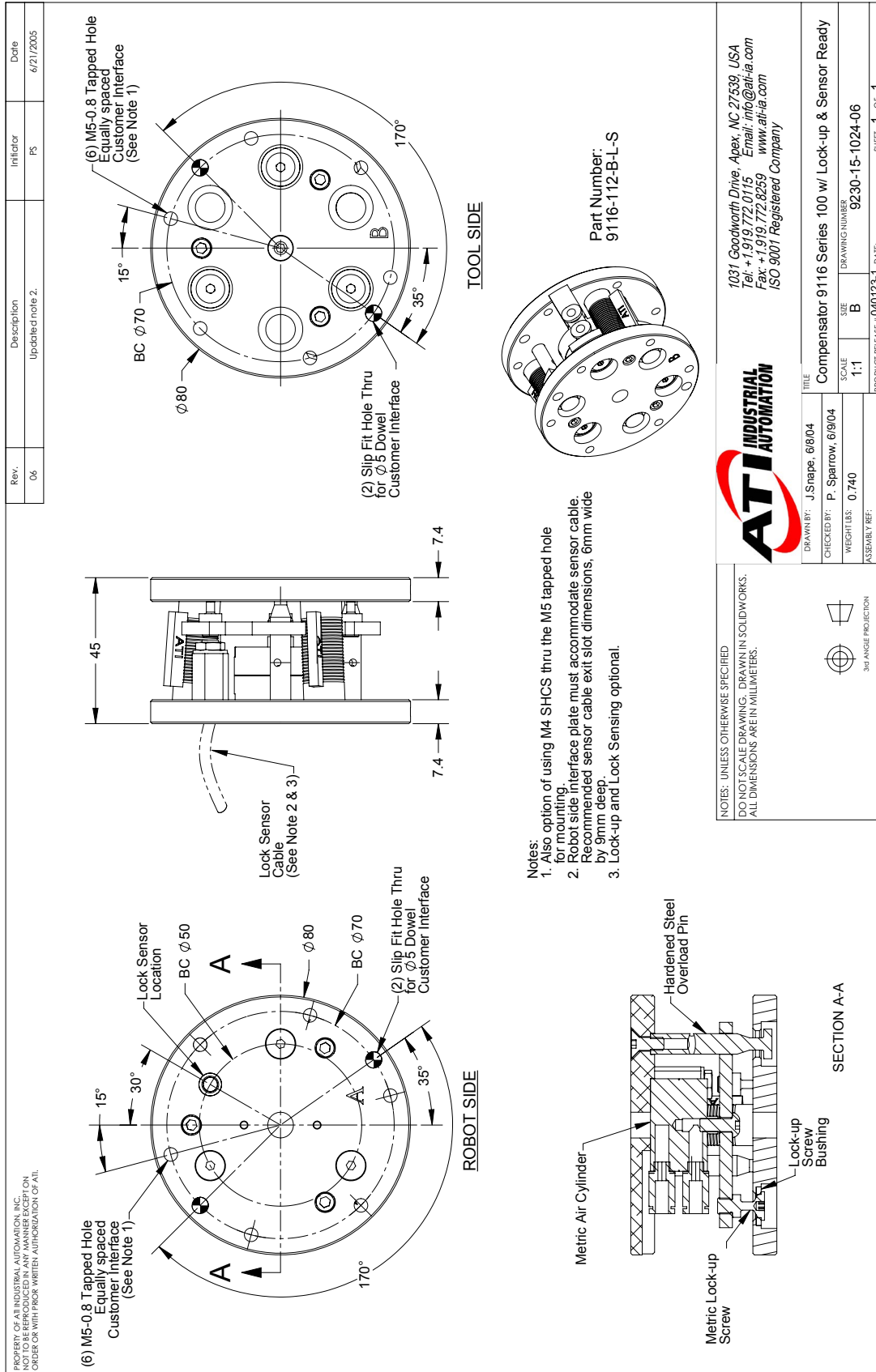
9. Drawings

9.1 Customer Drawings

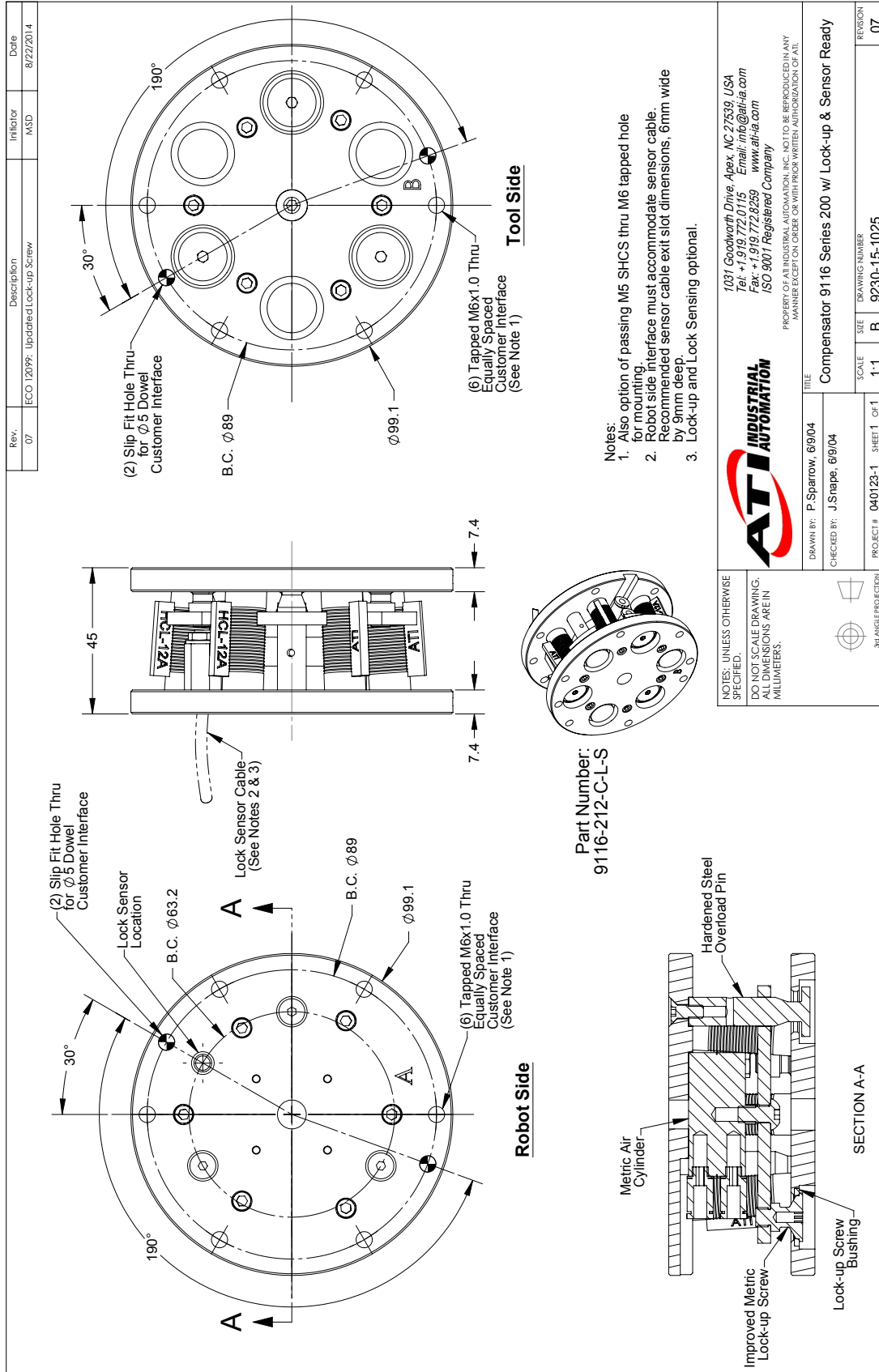
9.1.1 Compensator 9116 Series 000 with Lock-up



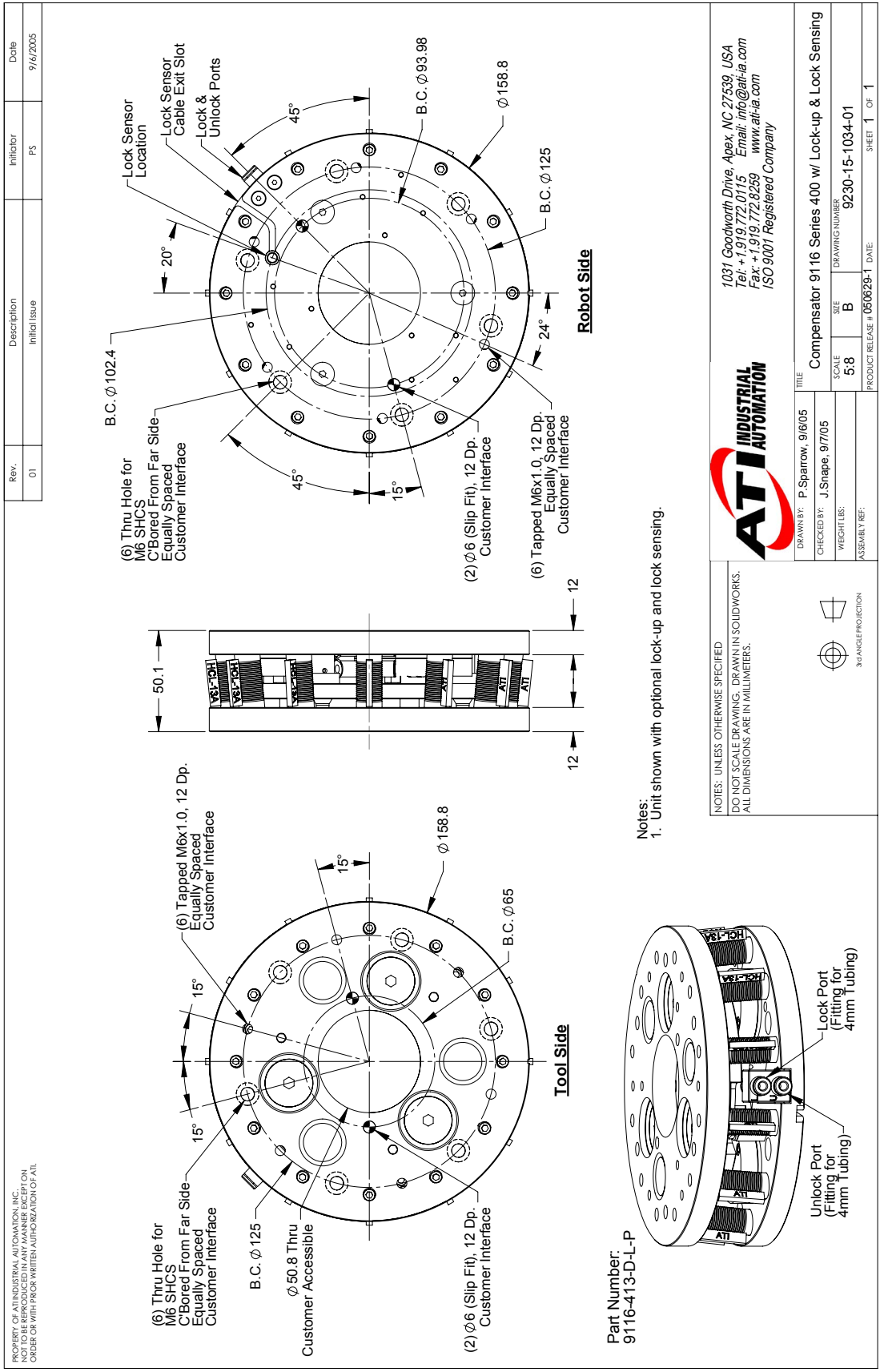
9.1.2 Compensator 9116 Series 100 with Lock-up and Sensor Ready



9.1.3 Compensator 9116 Series 200 with Lock-up and Sensor Ready



9.1.4 Compensator 9116 Series 400 with Lock-up and Lock Sensing



9.2 Assembly Drawings

9.2.1 Compensator 9116 Series 000 with Lock-up

Rev. 01	Description Initial Drawing	Initiator DAW	Date 3/20/2014
------------	--------------------------------	------------------	-------------------

Assembly No.	Bonded Strain Element Part No.
9116-001-A	3710-15-1008
9116-001-A-L	3710-15-1008
9116-002-A	3710-15-1005
9116-002-A-L	3710-15-1005

Notes:

- Not a recommended spare part. Consult ATI for availability.
- Only present on units with assembly number ending in "L" (Lock-up).

ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
1	2 (Note 2)	3405-1220004-01	Air Fitting, Festo QSM-M5-4i
2	1 (Note 2)	3415-0020002-01	Bimba FM-023.2 Meiric Cylinder, 14mm Bore
3	2 (Note 2)	3500-1058018-11	M3 x 18mm SHCS 12.9
4	6	3500-1256008-11	M2.5 x 8mm SFHCS Black Oxide w/Microspheres
5	3	3500-1262010-15A	M4 x 10 Button Head Screw
6	1 (Note 2)	3500-9962010-11	Pin, overload for 000 series compensator
7	3	3700-15-1056	Compensator 9116 Series 000/100 Lock-up Screw
8	3 (Note 2)	3700-15-2019	Compensator 9116 Series 000/100 Lock-up Screw Bushing
9	3 (Note 2)	Note 1	Compensator 9116 Series 000 Top Plate
10	1	Note 1	Compensator 9116 Series 000 Bottom Plate
11	1	Note 1	Compensator 9116 Series 000 Bearing Plate
12	1 (Note 2)	3700-15-2024	Bonded Strain Element
13	3	See Table A	

NOTES: UNLESS OTHERWISE SPECIFIED, DO NOT SCALE DRAWING. ALL DIMENSIONS ARE IN MILLIMETERS.

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DRAWN BY: D. Wagner 3/19/14	TITLE: Compensator 9116 Series 000 (Parts Identification)	SCALE: 3:4	DRAWING NUMBER: B	PROJECT #:	REVISION: 01
CHECKED BY: DSS 4/24/14					
SHEET 1 OF 1					

9.2.2 Compensator 9116 Series 100

Rev.	Description	Initiator	Date
01	Initial Drawing	DAW	3/20/2014

Units without sensing

Notes:

- Not a recommended spare part. Consult ATI for availability.
- Only present on units with assembly number ending in "L" (Lock-up).

ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
1	2 (Note 2)	3405-1220004-01	Air Fitting, Festo QSM-M5-4i
2	1 (Note 2)	3415-0020002-01	Bimba FM-023.2 Metric Cylinder, 14mm Bore
3	6	3500-1057005-11	M3 x 5mm SHCS Black Oxide
4	2 (Note 2)	3500-1058020-15A	M3 x 20mm SHCS Blue Dyed Magni-565; ND Microspheres
5	3	3500-1262012-15A	M4 x 12mm SFHCS Blue Dyed Magni-565 w/Microspheres
6	1	3500-9962010-11	M4 x 10 Button Head Screw
7	3	3700-15-1026	Compensator 100 Overload Pin
8	1	Note 1	Compensator 9116 Series 100 Top Plate
9	1	Note 1	Compensator 9116 Series 100 Bottom Plate
10	3 (Note 2)	3700-15-2019	Compensator 9116 Series 000/100 Lock-up Screw
11	1 (Note 2)	3700-15-2020	Compensator 9116 Series 100 Bearing Plate
12	3 (Note 2)	Note 1	Compensator 9116 Series 000/100 Lock-up Screw Bushing
13	3	See Table A	Bonded Strain Element

Assembly No.	Bonded Strain Element Part No.
9116-111-B	3710-15-1001
9116-111-B-L	3710-15-1001
9116-112-B	3710-15-1002
9116-112-B-L	3710-15-1002
9116-113-B	3710-15-1003
9116-113-B-L	3710-15-1003

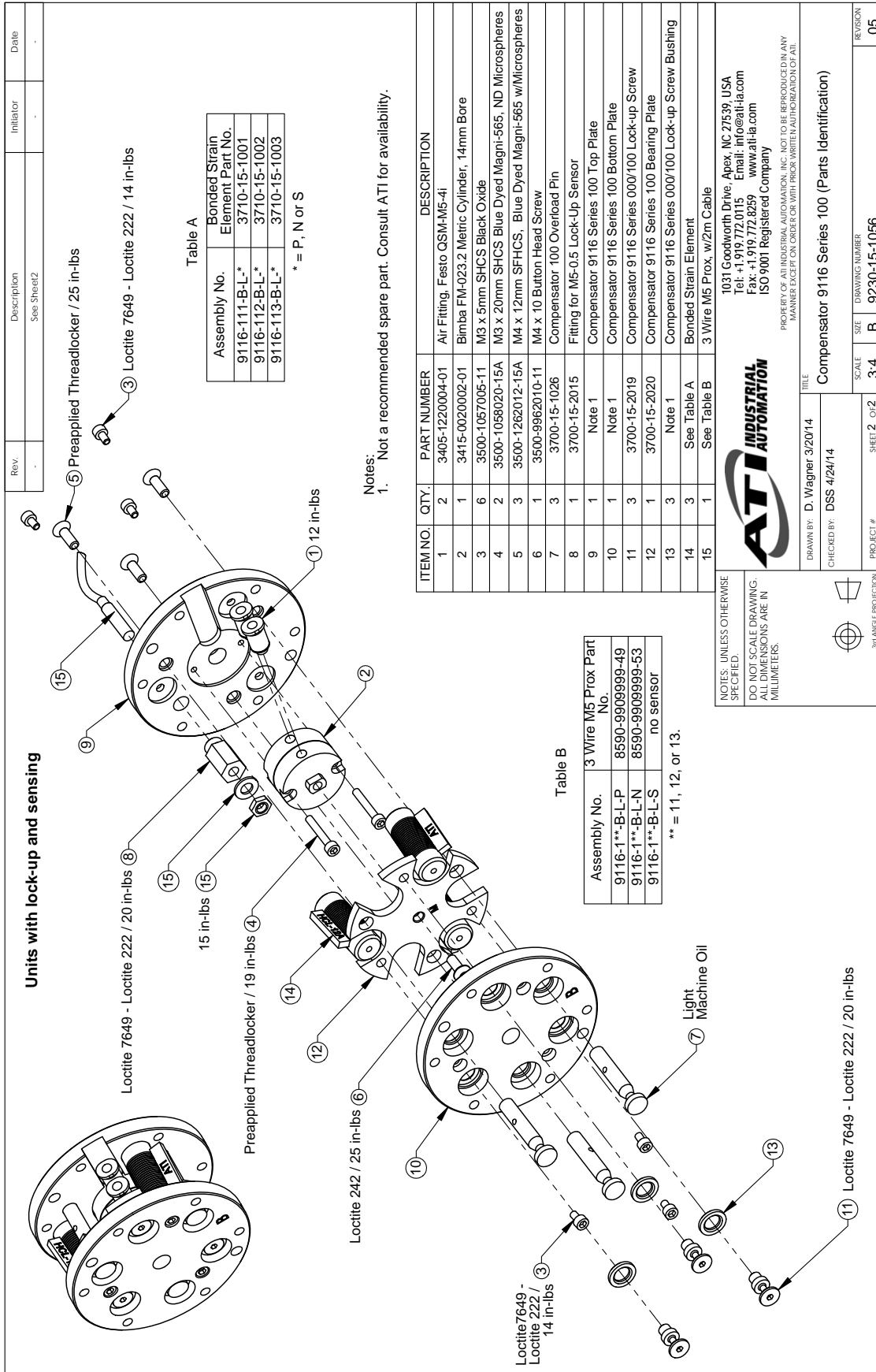
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DRAWN BY: D. Wagner 3/20/14	TITLE: Compensator 9116 Series 100 (Parts Identification)
CHECKED BY: DSS 4/24/14	SCALE: 3:4
PROJECT #: SHEET 1 OF 2	DRAWING NUMBER: B 9230-15-1056
	REVISION: 05



Units with lock-up and sensing

Table A

Assembly No.	Bonded Strain Element Part No.
9116-111-B-L*	3710-15-1001
9116-112-B-L*	3710-15-1002
9116-113-B-L*	3710-15-1003

* = P, N or S

Notes:
1. Not a recommended spare part. Consult ATI for availability.

ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
1	2	3405-1220004-01	Air Fitting, Festo GSM-M5-4i
2	1	3415-0020002-01	Bimba FM-023.2 Metric Cylinder, 14mm Bore
3	6	3500-1057005-11	M3 x 5mm SHCS Black Oxide
4	2	3500-1058020-15A	M3 x 20mm SHCS Blue Dyed Magni-565, ND Microspheres
5	3	3500-1262012-15A	M4 x 12mm SFHCS, Blue Dyed Magni-565 w/Microspheres
6	1	3500-9962010-11	M4 x 10 Button Head Screw
7	3	3700-15-1026	Compensator 100 Overload Pin
8	1	3700-15-2015	Fitting for M5-0.5 Lock-Up Sensor
9	1	Note 1	Compensator 9116 Series 100 Top Plate
10	1	Note 1	Compensator 9116 Series 100 Bottom Plate
11	3	3700-15-2019	Compensator 9116 Series 000/100 Lock-up Screw
12	1	3700-15-2020	Compensator 9116 Series 100 Bearing Plate
13	3	Note 1	Compensator 9116 Series 000/100 Lock-up Screw Bushing
14	3	See Table A	Bonded Strain Element
15	1	See Table B	3 Wire M5 Prox, w/2m Cable

Table B

Assembly No.	3 Wire M5 Prox Part No.
9116-1**-B-L-P	8590-9909999-49
9116-1**-B-L-N	8590-9909999-53
9116-1**-B-L-S	no sensor

** = 11, 12, or 13.

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DRAWN BY: D. Wagner 3/20/14	TITLE: Compensator 9116 Series 100 (Parts Identification)
CHECKED BY: DSS 4/24/14	
SHEET 2 OF 2	SCALE: 3:4
PROJECT #	DRAWING NUMBER: 9230-15-1056
	REVISION: 05

9.2.3 Compensator 9116 Series 200 - (3) shear pads Location A

Rev.	01
Description	Initial Drawing
Initiator	DAW
Date	3/24/2014

Units with shear pads on inner bolt circle but no sensor

Assembly No.	Bonded Strain Element Part No.
9116-211-A	3710-15-1001
9116-211-A-L	3710-15-1001
9116-212-A	3710-15-1002
9116-212-A-L	3710-15-1002
9116-213-A	3710-15-1003
9116-213-A-L	3710-15-1003

Notes:

- Not a recommended spare part. Consult ATI for availability.
- Only present on units with assembly number ending in "L" (Lock-up).

ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
1	2 (Note 2)	3405-1220004-01	Air Fitting, Festo QSM-M5-4i
2	1 (Note 2)	3415-0020001-01	Bimba FM-043.2 Metric Cylinder, 19mm Bore
3	6	3500-1057005-11	M3 x 5mm SHCS Black Oxide
4	4 (Note 2)	3500-1058020-15A	M3 x 20mm SHCS Blue Dyed Magni-565, ND Microspheres
5	3	3500-1262012-15A	M4 x 12mm SFHCS, Blue Dyed Magni-565 w/Microspheres
6	1 (Note 2)	3500-9964010-11	M5 x 10 Button Head Screw
7	3	3700-15-1036	Compensator 200 Overload Pin
8	3 (Note 2)	3700-15-2010	Compensator 9116 Series 200 Lock-up Screw
9	1	Note 1	Compensator 9116 Series 200 Top Plate
10	1	Note 1	Compensator 9116 Series 200 Bottom Plate
11	1 (Note 2)	3700-15-2014	Compensator 9116 Series 200 Bearing Plate
12	3 (Note 2)	Note 1	Compensator 9116 Series 200 Lock-up Screw Bushing
13	3	See Table A	Bonded Strain Element

NOTES: UNLESS OTHERWISE SPECIFIED, DO NOT SCALE DRAWING. ALL DIMENSIONS ARE IN MILLIMETERS.

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DRAWN BY: D. Wagner 3/24/14
 CHECKED BY: DSS 4/24/14
 TITLE: Compensator 9116 Series 200, Shear Pad Location A (Parts Identification)

SCALE: 1:2
 SHEET 1 of 2
 DRAWING NUMBER: 9230-15-1057
 REVISION: 04

Rev. _____

Initiator _____

Date _____

Description
See Sheet

Units with shear pads on inner bolt circle with lock-up and sensing

Table A

Assembly No.	Bonded Strain Element Part No.
9116-211-A-L*	3710-15-1001
9116-212-A-L*	3710-15-1002
9116-213-A-L*	3710-15-1003

* - P, N or S

Table B

Assembly No.	3 Wire M5 Prox Part No.
9116-2**-A-L-P	8590-9909999-49
9116-2**-A-L-N	8590-9909999-53
9116-2**-A-L-S	no sensor

** - 11, 12 or 13.

Notes:
1. Not a recommended spare part. Consult ATI for availability.

ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
1	2	3405-1220004-01	Air Fitting, Festo QSM-M5-4i
2	1	3415-0020001-01	Bimba FM-043.2 Metric Cylinder, 19mm Bore
3	6	3500-1057005-11	M3 x 5mm SHCS Black Oxide
4	4	3500-1058020-15A	M3 x 20mm SHCS Blue Dyed Magni-565, ND Microspheres
5	3	3500-1262012-15A	M4 x 12mm SFHCS, Blue Dyed Magni-565 w/Microspheres
6	1	3500-9964010-11	M5 x 10 Button Head Screw
7	3	3700-15-1036	Compensator 200 Overload Pin
8	3	3700-15-2010	Compensator 9116 Series 200 Lock-up Screw
9	1	Note 1	Compensator 9116 Series 200 Top Plate
10	1	Note 1	Compensator 9116 Series 200 Bottom Plate
11	1	3700-15-2014	Compensator 9116 Series 200 Bearing Plate
12	1	3700-15-2015	Fitting for M5-0.5 Lock-Up Sensor
13	3	Note 1	Compensator 9116 Series 200 Lock-up Screw Bushing
14	3	See Table A	Bonded Strain Element
15	1	See Table B	3 Wire M5 Prox

NOTES: UNLESS OTHERWISE SPECIFIED,
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DRAWN BY: D. Wagner 3/24/14	TITLE: Compensator 9116 Series 200, Shear Pad Location A (Parts Identification)
CHECKED BY: DSS 4/24/14	SCALE: 1:2
PROJECT #	DRAWING NUMBER: 9230-15-1057
SHEET 2 OF 2	REVISION: 04

9.2.4 Compensator 9116 Series 200 - (3) shear pads Location B

Rev.	Description	Initiator	Date
01	Initial Drawing	DAW	3/25/2014

Assembly No.	Item 6 Part No.
9116-211-B	3710-15-1001
9116-211-B-L	3710-15-1001
9116-212-B	3710-15-1002
9116-212-B-L	3710-15-1002
9116-213-B	3710-15-1003
9116-213-B-L	3710-15-1003

Units with shear pads on outer bolt circle with lock-up but without sensor

Notes:

- Not a recommended spare part. Consult ATI for availability.
- Only present on units with assembly number ending in "L" (Lock-up).

ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
1	2 (Note 2)	3405-1220004-01	Air Fitting, Festo QSM-M5-4i
2	1 (Note 2)	3415-0020001-01	Bimba FM-043.2 Metric Cylinder, 19mm Bore
3	6	3500-1057005-11	M3 x 5mm SHCS Black Oxide
4	4	3500-1058020-15A	M3 x 20mm SHCS Blue Dyed Magni-565, ND Microspheres
5	3	3500-1262012-15A	M4 x 12mm SFHCS, Blue Dyed Magni-565 w/Microspheres
6	1 (Note 2)	3500-9964010-11	M5 x 10 Button Head Screw
7	3	3700-15-1036	Compensator 200 Overload Pin
8	3 (Note 2)	3700-15-2010	Compensator 9116 Series 200 Lock-up Screw
9	1	Note 1	Compensator 9116 Series 200 Top Plate
10	1	Note 1	Compensator 9116 Series 200 Bottom Plate
11	1 (Note 2)	3700-15-2014	Compensator 9116 Series 200 Bearing Plate
12	3 (Note 2)	Note 1	Compensator 9116 Series 200 Lock-up Screw Bushing
13	3	See Table A	Bonded Strain Element

NOTES: UNLESS OTHERWISE SPECIFIED:

1. TO NOT SCALE DRAWING AND DIMENSIONS ARE IN INCHES.

2. 3rd ANGLE PROJECTION

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DRAWN BY: D. Wagner 3/25/14	TITLE: Compensator 9116 Series 200, Shear Pad Location B (Parts Identification)
CHECKED BY: DSS 4/24/14	SCALE: 1:2
PROJECT #: SHEET 1 of 2	DRAWING NUMBER: 9230-15-1058
	REVISION: 05

Rev. _____

Description
See Sheet _____

Initiator _____

Date _____

Units with shear pads on outer bolt circle with lock-up and sensor

Table A

Assembly No.	Item 6 Part No.
9116-211-B-L*	3710-15-1001
9116-212-B-L*	3710-15-1002
9116-213-B-L*	3710-15-1003

* - P, N or S.

Table B

Assembly No.	3 Wire M5 Prox Part No.
9116-2-**-B-L-P	8590-9909999-49
9116-2-**-B-L-N	8590-9909999-53
9116-2-**-B-L-S	no sensor

** - 11, 12 or 13

Notes:

- Not a recommended spare part. Consult ATI for availability.

ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
1	2	3405-1220004-01	Air Fitting, Festo QSM-M5-4i
2	1	3415-0020001-01	Bimba FM-043.2 Metric Cylinder, 19mm Bore
3	6	3500-1057005-11	M3 x 5mm SHCS Black Oxide
4	4	3500-1058020-15A	M3 x 20mm SHCS Blue Dyed Magni-565, ND Microspheres
5	3	3500-1262012-15A	M4 x 12mm SFHCS, Blue Dyed Magni-565 w/Microspheres
6	1	3500-9964010-11	M5 x 10 Button Head Screw
7	3	3700-15-1036	Compensator 200 Overload Pin
8	3	3700-15-2010	Compensator 9116 Series 200 Lock-up Screw
9	1	Note 1	Compensator 9116 Series 200 Top Plate
10	1	Note 1	Compensator 9116 Series 200 Bottom Plate
11	1	3700-15-2014	Compensator 9116 Series 200 Bearing Plate
12	1	3700-15-2015	Fitting for M5-0.5 Lock-Up Sensor
13	3	Note 1	Compensator 9116 Series 200 Lock-up Screw Bushing
14	3	See Table A	Bonded Strain Element
15	1	See Table B	3 Wire M5 Prox

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Drawn By: D. Wagner 3/25/14
Checked By: DSS 4/24/14

Scale: 1:2
Sheet: 2 of 2
Project #: 9230-15-1058

Revision: 05

9.2.5 Compensator 9116 Series 200 - (6) shear pads Location C

Rev. 01

Description: Initial Drawing

Initiator: DAW

Date: 3/25/2014

Units with shear pads on inner and outer bolt circles without sensor

Table A

Assembly No.	Bonded Strain Element Part No.
9116-211-C	3710-15-1001
9116-211-C-L	3710-15-1001
9116-212-C	3710-15-1002
9116-212-C-L	3710-15-1002
9116-213-C	3710-15-1003
9116-213-C-L	3710-15-1003

Notes:

- Not a recommended spare part. Consult ATI for availability.
- Only present on units with assembly number ending in 'L' (Lock-up).

ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
1	2 (Note 2)	3405-1220004-01	Air Fitting, Festo QSM-M5-4i
2	1 (Note 2)	3415-0020001-01	Bimba FM-043.2 Metric Cylinder, 19mm Bore
3	12	3500-1057005-11	M3 x 5mm SHCS Black Oxide
4	4 (Note 2)	3500-1058018-21	M3 x 18mm SHCS, Stainless
5	3	3500-1262012-15A	M4 x 12mm SFHCS, Blue Dyed Magni-565 w/Microspheres
6	1 (Note 2)	3500-9964010-11	M5 x 10 Button Head Screw
7	3	3700-15-1036	Compensator 200 Overload Pin
8	3 (Note 2)	3700-15-2010	Compensator 9116 Series 200 Lock-up Screw
9	1	Note 1	Compensator 9116 Series 200 Top Plate
10	1	Note 1	Compensator 9116 Series 200 Bottom Plate
11	1 (Note 2)	3700-15-2014	Compensator 9116 Series 200 Bearing Plate
12	3 (Note 2)	Note 1	Compensator 9116 Series 200 Lock-up Screw Bushing
13	6	See Table A	Bonded Strain Element

NOTES: UNLESS OTHERWISE SPECIFIED:

1. TO NOT SCALE DRAWING. ALL DIMENSIONS ARE IN MILLIMETERS.

2. 3RD ANGLE PROJECTION

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Compensator 9116 Series 200 Shear Pad Location C (Parts Identification)

DRAWN BY: D. Wagner 3/25/14
 CHECKED BY: DSS 4/24/14

SCALE: 1:2
 SHEET 1 of 2
 DRAWING NUMBER: 9230-15-1059
 PROJECT # -

REVISION: 04

Rev. - - -

Description
See Sheet1

Initiator - - -

Date - - -

Units with shear pads on inner and outer bolt circles with lock-up and sensor

Notes:
1. Not a recommended spare part. Consult ATI for availability.

** - 11, 12 or 13.

ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
1	2	3405-1220004-01	Air Fitting, Festo GSM-M5-4i
2	1	3415-0020001-01	Bimba FM-043.2 Metric Cylinder, 19mm Bore
3	12	3500-1057005-11	M3 x 5mm SHCS Black Oxide
4	4	3500-1058020-15A	M3 x 20mm SHCS Blue Dyed Magni-565, ND Microspheres
5	3	3500-1262012-15A	M4 x 12mm SFHCS, Blue Dyed Magni-565 w/Microspheres
6	1	3500-9964010-11	M5 x 10 Button Head Screw
7	3	3700-15-1036	Compensator 200 Overload Pin
8	3	3700-15-2010	Compensator 9116 Series 200 Lock-up Screw
9	1	Note 1	Compensator 9116 Series 200 Top Plate
10	1	Note 1	Compensator 9116 Series 200 Bottom Plate
11	1	3700-15-2014	Compensator 9116 Series 200 Bearing Plate
12	1	3700-15-2015	Fitting for M5-0.5 Lock-Up Sensor
13	3	Note 1	Compensator 9116 Series 200 Lock-up Screw Bushing
14	6	See Table A	Bonded Strain Element
15	1	See Table B	3 Wire M5 Prox

Table A

Assembly No.	Item 14 Part No.
9116-211-C-L*	3710-15-1001
9116-212-C-L*	3710-15-1002
9116-213-C-L*	3710-15-1003

* - P, N or S

Table B

Assembly No.	Item 15 Part No.
9116-2**C-L-P	8590-9909999-49
9116-2**C-L-N	8590-9909999-53
9116-2**C-L-S	no sensor

Notes:
1. Not a recommended spare part. Consult ATI for availability.

** - 11, 12 or 13.

NOTES: UNLESS OTHERWISE SPECIFIED:
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3/4 ANGLE PROJECTION

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DRAWN BY: D. Wagner 3/25/14
CHECKED BY: DSS 4/24/14

TITLE: Compensator 9116 Series 200 Shear Pad Location C (Parts Identification)

SCALE: 1:2 SHEET 2 OF 2 DRAWING NUMBER: 9230-15-1059 REVISION: 04

9.2.6 Compensator 9116 Series 400 - (6) shear pads Location C

Rev.	Description	Initiator	Date
01	Initial Drawing	DAW	3/25/2014

ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
1	10 (Note 2)	3405-1220004-01	Air Fitting, Festo QSM-M5-4i
2	2 (Note 2)	3405-1230002-01	Quick Disconnect Straight Union for 4mm / 5/32" Tubing
3	1 (Note 2)	3415-0020001-01	Bimba FM-043.2 Metric Cylinder, 19mm Bore
4	2 (Note 2)	3415-0021019-01	Bimba Flat Air Cylinder (4) Ports 19mm Bore
5	12	3500-1057006-15	M3-0.5x6 SHCS, Blue Dyed Magni-565
6	12 (Note 2)	3500-1058018-11	M3 x 18mm SHCS 12.9
7	3 (Note 2)	3500-1064010-11	M5 x 10mm SHCS Black Oxide
8	2 (Note 2)	3500-1258010-11	M3 x 10mm SFHCS Black Oxide
9	1 (Note 2)	3500-1262016-11	M4 x 16mm SFHCS Black Oxide
10	3	3500-1263016-11	M5 x 16mm SFHCS Black Oxide
11	3	3700-15-1072	Overload Pin
12	1	Note 1	Compensator 9116 Series 400 Top Plate
13	1	Note 1	Compensator 9116 Series 400 Bottom Plate
14	1	Note 1	Compensator 9116 Series 400 Bearing Plate
15	3 (Note 2)	Note 1	Compensator 9116 Series 400 Lock-up Screw Bushing
16	1 (Note 2)	3700-15-2036	Compensator 9116 Series 400 Air Fitting Block
17	3 (Note 2)	Note 1	Compensator 9116 Series 400 Bearing Plate Bushing
18	3 (Note 2)	3700-15-2056	Compensator 9116 Series 400 Lock-up Screw
19	6	3710-15-1003	HCL-13A Bonded Strain Element

NOTES: UNLESS OTHERWISE SPECIFIED:

1. TO NOT SCALE DRAWING. ALL DIMENSIONS ARE IN MILLIMETERS.

2. 3rd ANGLE PROJECTION.

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DRAWN BY: D. Wagner 3/25/14	TITLE: Compensator 9116 Series 400, Shear Pad Location C (Parts Identification)
CHECKED BY: DSS 4/24/14	SCALE: 1:4
PROJECT #	DRAWING NUMBER: 9230-15-1060
SHEET 1 of 2	REVISION: 01

Notes:

- Not a recommended spare part. Consult ATI for availability.
- Only present on units with assembly number ending in "L" (Lock-up).

Rev. _____

Description
See SHEET1

Initiator _____

Date _____

Table A

Assembly No.	3 Wire M5 Prox Part No.
9116-413-C-L-P	8590-9909999-49
9116-413-C-L-N	8590-9909999-53
9116-413-C-L-S	no sensor

Units with lock-up and sensing

ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
1	10	3405-1220004-01	Air Fitting, Festo QSM-M5-4i
2	2	3405-1230002-01	Quick Disconnect Straight Union for 4mm / 5/32" Tubing
3	1	3415-0020001-01	Bimba FM-043.2 Metric Cylinder, 19mm Bore
4	2	3415-0021019-01	Bimba Flat Air Cylinder (4) Ports 19mm Bore
5	12	3500-1057006-15	M3-0.5x6 SHCS, Blue Dyed Magni-565
6	12	3500-1058018-11	M3 x 18mm SHCS 12.9
7	3	3500-1064010-11	M5 x 10mm SHCS Black Oxide
8	2	3500-1258010-11	M3 x 10mm SFHCS Black Oxide
9	1	3500-1262016-11	M4 x 16mm SFHCS Black Oxide
10	3	3500-1263016-11	M5 x 16mm SFHCS Black Oxide
11	3	3700-15-1072	Overload Pin
12	1	3700-15-2015	Fitting for M5-0.5 Lock-Up Sensor
13	1	Note 1	Compensator 9116 Series 400 Top Plate
14	1	Note 1	Compensator 9116 Series 400 Bottom Plate
15	1	3700-15-2033	Compensator 9116 Series 400 Bearing Plate
16	3	Note 1	Compensator 9116 Series 400 Lock-up Screw Bushing
17	1	3700-15-2036	Compensator 9116 Series 400 Air Fitting Block
18	3	3700-15-2037	Compensator 9116 Series 400 Bearing Plate Bushing
19	3	3700-15-2056	Compensator 9116 Series 400 Lock-up Screw (Soft)
20	6	3710-15-1003	HCL-13A Bonded Strain Element
21	1	See Table A	3 Wire M5 Prox, w/2m Cable

NOTES: UNLESS OTHERWISE SPECIFIED:
DO NOT SCALE DRAWING.
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3/4 ANGLE PROJECTION

6X Shear Pad Equally Spaced (C- option)

Top Plate

Notes:

- Not a recommended spare part. Consult ATI for availability.

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DRAWN BY: D. Wagner 3/25/14

CHECKED BY: DSS 4/24/14

TITLE: Compensator 9116 Series 400, Shear Pad Location C (Parts Identification)

SCALE: 1:4

SIZE: B

DRAWING NUMBER: 9230-15-1060

PROJECT #: _____

SHEET 2 OF 2

9.2.7 Compensator 9116 Series 400 - (12) shear pads Location D

**9116-413-D and 9116-413-D-L
Units without sensor**

ITEM NO.	NO sensor/QTY.	PART NUMBER	DESCRIPTION
1	10 (Note 2)	3405-1220004-01	Air Fitting, Festo QSM-M5-4i
2	2 (Note 2)	3405-1230002-01	Quick Disconnect Straight Union for 4mm / 5/32" Tubing
3	1 (Note 2)	3415-0020001-01	Bimba FM-043.2 Metric Cylinder, 19mm Bore
4	2 (Note 2)	3415-0021019-01	Bimba Flat Air Cylinder (4) Ports 19mm Bore
5	24	3500-1057006-15	M3-0.5x6 SHCS, Blue Dyed Magni-565
6	12 (Note 2)	3500-1058018-11	M3 x 18mm SHCS 12.9
7	3 (Note 2)	3500-1064010-11	M5 x 10mm SHCS Black Oxide
8	2 (Note 2)	3500-1258010-11	M3 x 10mm SFHCS Black Oxide
9	1 (Note 2)	3500-1262016-11	M4 x 16mm SFHCS Black Oxide
10	3	3500-1263016-11	M5 x 16mm SFHCS Black Oxide
11	3	3700-15-1072	Overload Pin
12	1	Note 1	Compensator 9116 Series 400 Top Plate
13	1	Note 1	Compensator 9116 Series 400 Bottom Plate
14	1 (Note 2)	Note 1	Compensator 9116 Series 400 Bearing Plate
15	3 (Note 2)	Note 1	Compensator 9116 Series 400 Lock-up Screw Bushing
16	1 (Note 2)	3700-15-2036	Compensator 9116 Series 400 Air Fitting Block
17	3 (Note 2)	Note 1	Compensator 9116 Series 400 Bearing Plate Bushing
18	3 (Note 2)	3700-15-2056	Compensator 9116 Series 400 Lock-up Screw (Soft)
19	12	3710-15-1003	HCL-13A Bonded Strain Element

NOTES: UNLESS OTHERWISE SPECIFIED:

1. TO NOT SCALE DRAWING. ALL DIMENSIONS ARE IN MILLIMETERS.

2. NOT A recommended spare part. Consult ATI for availability.

3. Only present on units with assembly number ending in "L" (Lock-up).

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Rev. 01 Description Initial Drawing Initiator DAW Date 3/25/2014

SCALE 1:4 SIZE B DRAWING NUMBER 9230-15-1061 REVISION 06

Rev. _____ Description
See SHEET 1

Initiator _____ Date _____

Table A

Assembly No.	3 Wire M5 Prox Part No.
9116-413-D-L-P	8590-9909999-49
9116-413-D-L-N	8590-9909999-53
9116-413-D-L-S	no sensor

ITEM NO.	Default/ QTY.	PART NUMBER	DESCRIPTION
1	10	3405-1220004-01	Air Fitting, Festo QSM-M5-4i
2	2	3405-1230002-01	Quick Disconnect Straight Union for 4mm / 5/32" Tubing
3	1	3415-0020001-01	Bimba FM-043.2 Metric Cylinder, 19mm Bore
4	2	3415-0021019-01	Bimba Flat Air Cylinder (4) Ports 19mm Bore
5	24	3500-1057006-15	M3-0.5x6 SHCS, Blue Dyed Magni-565
6	12	3500-1058018-11	M3 x 18mm SHCS 12.9
7	3	3500-1064010-11	M5 x 10mm SHCS Black Oxide
8	2	3500-1258010-11	M3 x 10mm SFHCS Black Oxide
9	1	3500-1262016-11	M4 x 16mm SFHCS Black Oxide
10	3	3500-1263016-11	M5 x 16mm SFHCS Black Oxide
11	3	3700-15-1072	Overload Pin
12	1	3700-15-2015	Fitting for M5-0.5 Lock-Up Sensor
13	1	Note 1	Compensator 9116 Series 400 Top Plate
14	1	Note 1	Compensator 9116 Series 400 Bottom Plate
15	1	Note 1	Compensator 9116 Series 400 Bearing Plate
16	3	Note 1	Compensator 9116 Series 400 Lock-up Screw Bushing
17	1	3700-15-2036	Compensator 9116 Series 400 Air Fitting Block
18	3	Note 1	Compensator 9116 Series 400 Bearing Plate Bushing
19	3	3700-15-2056	Compensator 9116 Series 400 Lock-up Screw (Soft)
20	12	3710-15-1003	HCL-13A Bonded Strain Element
21	1	See Table A	3 Wire M5 Prox, w/2m Cable

Units with lock-up and sensing
Loc 222 / 20 in.-lbs. (12)
12 in.-lbs. (1)
Loc 222 / 19 in.-lbs. (6)
Loc 222 / 14 in.-lbs. (5)
Loc 222 / 14 in.-lbs. (13)
Loc 222 / 14 in.-lbs. (4)
Loc 222 / 14 in.-lbs. (3)
Loc 222 / 14 in.-lbs. (17)
Loc 222 / 14 in.-lbs. (2)
Loc 222 / 14 in.-lbs. (9)
Sensor Jam Nut 15 in.-lbs. (21)
Loc 222 / 35 in.-lbs. (7)
Loc 222 / 35 in.-lbs. (15)
Loc 222 / 35 in.-lbs. (18)
Light Machine Oil (11)
Loc 222 / 14 in.-lbs. (5)

Notes:
1. Not a recommended spare part. Consult ATI for availability.

NOTES: UNLESS OTHERWISE SPECIFIED:
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ALL DIMENSIONS ARE IN MILLIMETERS.

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DRAWN BY: D. Wagner 3/25/14
CHECKED BY: DSS 4/24/14

PROJECT # _____ SHEET 2 OF 2
SCALE 1:4
DRAWING NUMBER 9230-15-1061
REVISION 06

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 Tool Changer products purchased hereunder will be free from the defects in the material and workmanship under normal use for a period of (3) years from the date of shipment. This warranty does not cover components subject to wear and tear under normal usage or those requiring periodic replacement. 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 the any event not later than the last day of the warranty period; and (b) the defective item is received by ATI not later (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 the improper installation, operation, maintenance or repair by anyone other than ATI.

ATI will in the 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 the 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 the 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 the writing and signed by an executive officer of ATI.

Unless otherwise agreed in the 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 the ATI and such information is licensed to Purchaser only for Purchaser's use in the operating the products supplied by ATI hereunder in the 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 the ATI; (b) is thereafter published or otherwise enters the public domain through no fault of Purchaser; (c) is in the Purchaser's possession prior to receipt from the ATI; (d) is lawfully obtained by Purchaser from the 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.