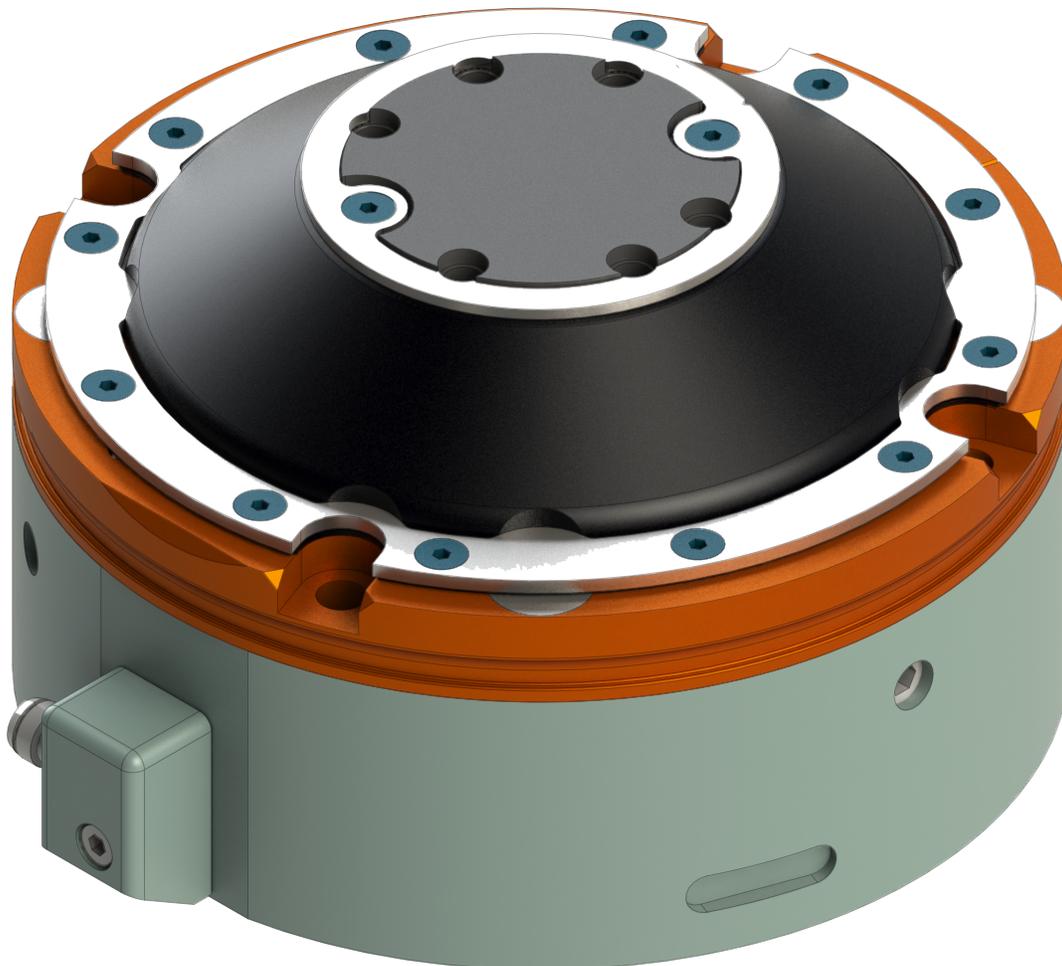




**Robotic Collision Sensor
SR-81, SR-101, SR-131, SR-176, SR-221
C1 Boot and C2 Weld Shield Manual**

U.S. Patent Nos. 6069415 and 6690208



Document #: 9610-60-1011

Engineered Products for Robotic Productivity

Pinnacle Park • 1031 Goodworth Drive • Apex, NC 27539 • Tel: +1-919.772.0115 • Fax: +1-919.772.8259 • www.ati-ia.com • Email: info@ati-ia.com

Foreword

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



CAUTION: This manual describes the function, application and safety considerations of this product. This manual must be read and understood before any attempt is made to install or operate the product. Failure to read and understand the information in this manual may result in damage to equipment or injury to personnel.

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How to Reach Us

Sale, Service and Information about ATI products:

ATI Industrial Automation

1031 Goodworth Drive

Apex, NC 27539 USA

www.ati-ia.com

Tel: 919.772.0115

Fax: 919.772.8259

E-mail: info@ati-ia.com

Technical support and questions:

Application Engineering

Tel: 919.772.0115, Option 2, Option 2

Fax: 919.772.8259

E-mail: mech_support@ati-ia.com

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Glossary

Term	Definition
Body	Cylindrical aluminum housing and air pressure chamber. An interface plate to the user's robot is usually attached here.
Cam	A hardened steel ring mounted inside the cover on which the hardened steel ball segments mounted to the stem are nested.
Collision	The accidental impact between the end of arm tooling and some obstruction in its path.
Collision Sensing Switch	A mechanical switch that changes state to an open circuit when a crash is detected. It is mounted in the center of the body.
Cover Plate	Disk-shaped aluminum cover for Collision Sensor body.
Crash	The result of a disturbance that displaces the Collision Sensor components from their standard, working position.
Interface Plate	Optional component used to adapt the Collision Sensor body or stem to the user's robot or tooling.
8 mm Connector	8 mm electrical connector mounted in block attached to the side of the body.
Piston	The component which, together with the body, creates a pressure chamber. Varying the pressure in this chamber varies the load required to move the piston.
Reset	The ability of the Collision Sensor to return to its working position when a disturbing force or displacement is removed.
Stem	Round tapered post containing tapped holes and a dowel pin hole. An interface plate to the user's tooling is usually attached here.
Switch Target	A steel block mounted on top of the piston, the position of which is sensed by the collision sensing switch.

1. Safety

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

1.1 Explanation of Notifications

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

1.2 General Safety Guidelines

The Collision Sensor is not designed for, nor should it be used in, situations involving the safety of humans or animals. The Collision Sensor is designed as a safety device to protect industrial components and machinery from damage resulting from collisions and impacts. In all situations the user is responsible for insuring that applicable safety practices are followed as outlined by the manufacturer of the equipment on which the Collision Sensor is used.

The routing of electrical and pneumatic lines must minimize the possibility of stress, pullout, kinking, rupture, etc. Failure of critical electrical and/or pneumatic lines to function properly may result in injury to personnel and damage to equipment.



CAUTION: The customer should lock out and discharge all energy to the work cell prior to working on any Collision Sensor system. Failure to do so may result in damage to equipment or injury to personnel.

1.3 Safety Precautions



WARNING: Do not perform maintenance or repair on the Collision Sensor with air pressure applied, current supplied to the sensor, or the robot not in a safe condition. Injury or equipment damage can occur if this is not observed. Always ensure that air pressure has been vented from the unit, that electrical current is not supplied to the Collision Sensor's signal circuit, and that the robot is in a safe, locked-out condition consistent with local and national safety standards before performing maintenance or repair on the Collision Sensor.

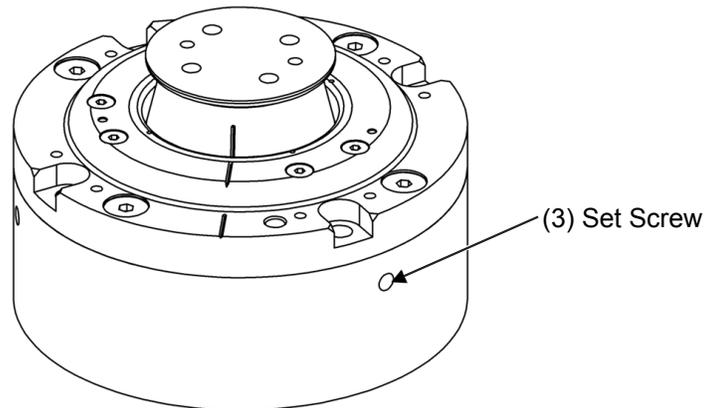


WARNING: The Collision Sensor is only to be used for intended applications and applications approved by the manufacturer. Using the Collision Sensor in applications other than intended will result in damage to Collision Sensor or end-of-arm tooling and could cause injury to personnel.



CAUTION: Do not adjust or remove either of the (3) set screws installed in the wall of the body. Doing so may result in damage to the unit or failure of the switch to operate. See [Figure 1.1](#).

Figure 1.1—Location of Set Screws



2. Product Overview

The Collision Sensor is a pneumatically-pressurized device offering protection to industrial robots and tooling in the event of accidental impacts and unanticipated loads. The Collision Sensor works by “breaking away” from its working geometry in the event of excessive torsional, moment, or compressive axial forces, or any combination of these. The Collision Sensor cannot respond to pure axial tension, which is an unlikely mode of loading. Removal of the upsetting force or moment allows the Collision Sensor to return to its normal working position.

As a collision occurs, internal motion of the Collision Sensor components cause a switch to change state to an open circuit. The switch circuit may be monitored by robotic controllers to stop operations before damage to the robot or tooling occurs. The load threshold at which the Collision Sensor breaks away is adjustable by controlling the air pressure supplied to the unit.

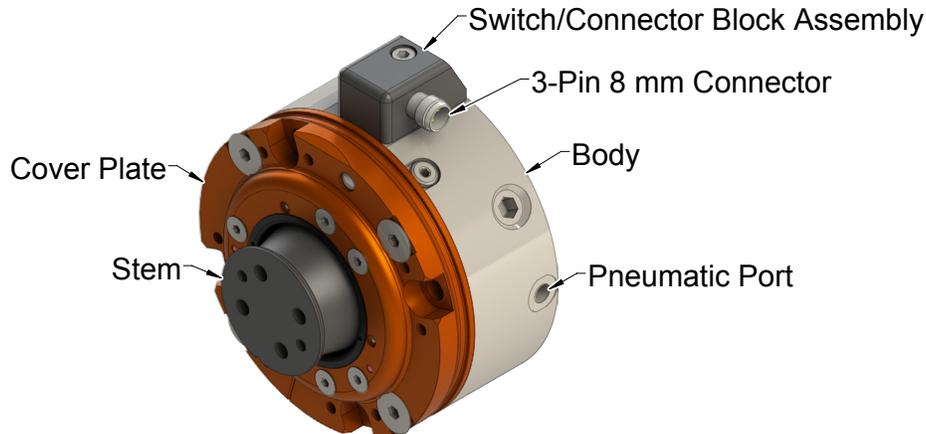
All Collision Sensor devices provide axial (compression only), torsional, and moment compliance.

2.1 Product Description

The Collision Sensor consists of a piston housing (body) closed with a cover plate assembly. A stem assembly protrudes through the cover plate assembly. The cover plate assembly incorporates a cam to accurately and repeatably position the stem assembly. The stem assembly is forced into position against the cam by a piston. The piston is supported by user supplied compressed air and an optional assist spring. The stem provides a mounting surface for customized interface plates. Tapped and through holes on the back surface of the body allow mounting of the Collision Sensor. All load-bearing components and those with wear surfaces are made of hard-coat anodized aluminum, hardened bearing steel, or hardened tool steel.

A collision sensing switch is inside the body. A connector block assembly containing a 8 mm connector is mounted on the side of the Collision Sensor body. The user connects to the switch using the connector for which a variety of cables are available, refer to [Section 8.1—Cable Replacement](#). The user must supply the Collision Sensor with dry, regulated, compressed air through a port on the side of the Collision Sensor body.

Figure 2.1—Collision Sensor



3. C1 Boot Installation

Steps 1 and 2 are only necessary when adding kit to units built prior to 2008. If unit contains a serial number label with a bar code and the first (2) digits are 08 or higher the unit was built with the joint sealed between the cover and body.

NOTICE: During factory assembly, Loctite is applied to the screws to prevent them from coming loose in operation. As a result, it may be necessary to use a hot air gun to individually heat the screws (and the immediate areas of the body) in order to soften the Loctite and allow the screws to be removed.

3.1 Removal of Cover Plate and stem

Tools required: Variety of Allen wrenches (hex keys)

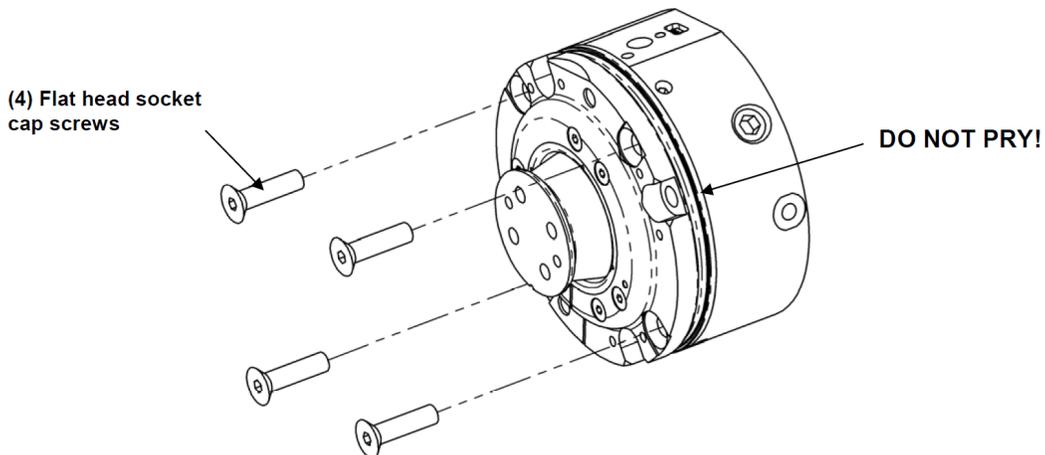
Supplies required: Loctite 222

1. Remove the (4) flat head socket cap screws (socket head cap screws on SR-221) securing the cover plate assembly to the body.



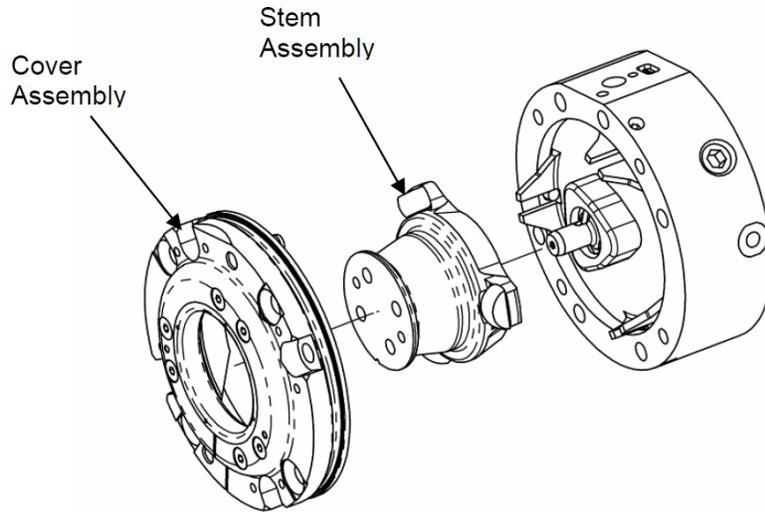
CAUTION: Do not attempt to pry or wedge the cover plate assembly and body apart. Doing so can damage the mating surfaces and may render the parts unusable.

Figure 3.1—Removing the Cover Plate



2. Remove the cover plate by carefully pulling it straight up and off of the body. This may be difficult due to the close fit of the dowel pins used to align the parts and the sealer used between the cover and body. It may be necessary to tap the cover with a rubber or plastic mallet.

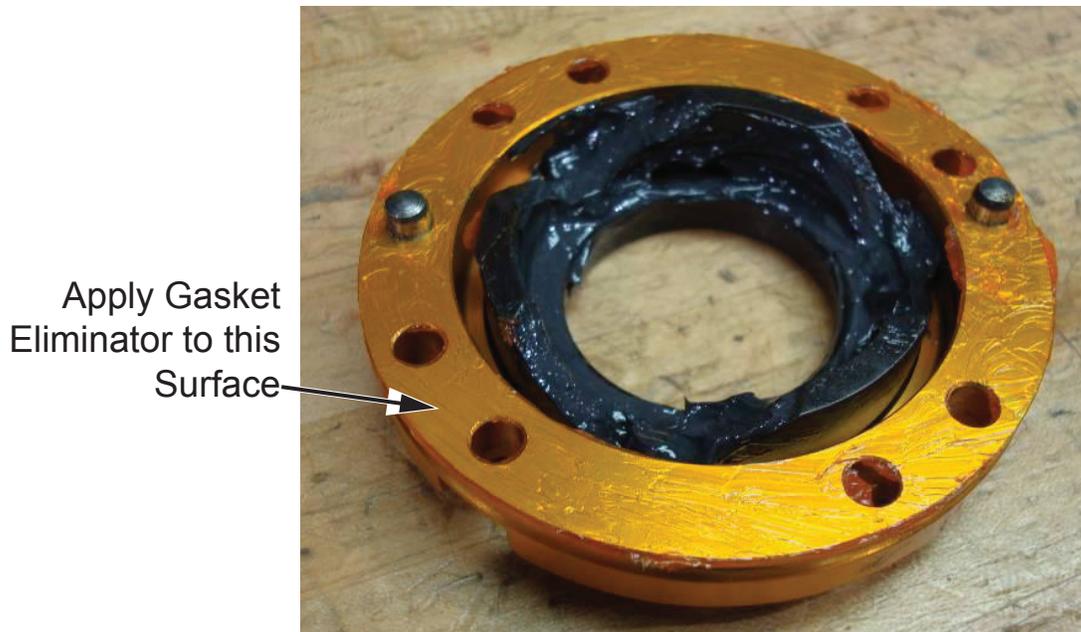
Figure 3.2— Removing the Cover and stem Assembly



3.2 Reassembly of stem and Cover Plate

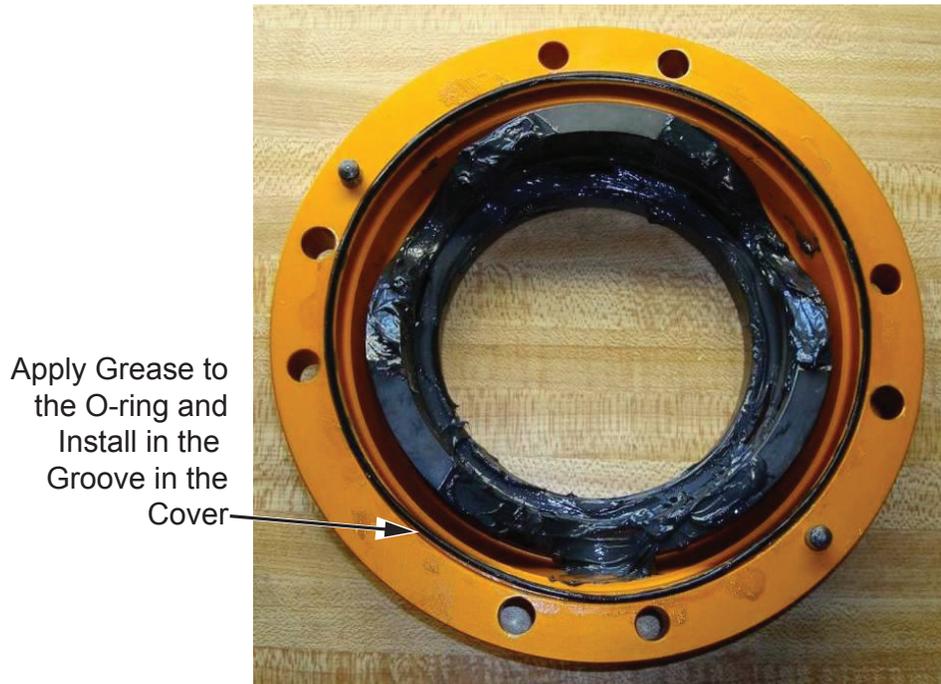
1. On SR-081 and SR-101 size Collision Sensors, apply Loctite Quickstix™ 548 Gasket Eliminator® Flange Sealant to the underside of the cover.

Figure 3.3—Apply Gasket Eliminator



2. On SR-131, SR-176, and SR-221 size Collision Sensors, apply grease to the O-ring cover seal and insert into the groove in the cover plate.

Figure 3.4—Assembling O-ring to Cover (SR-131, SR-176, and SR-221)



3. With the stem assembly upright, set the cover plate assembly onto it. Make certain that the alignment grooves are properly aligned.

Figure 3.5—Cover Plate and stem Alignment



4. Place the stem and cover plate together onto the body. Make certain that the dowel pins in the cover plate are aligned with the holes in the body and that the alignment grooves in the cover plate and the stem are still aligned.

5. Press the cover plate down onto the body. Apply Loctite 222MS thread locker to the (4) screws and thread them into the body.

Note: On units with the spring assist option, it is necessary to use (2) opposing screws to evenly pull the cover plate down against the body. Tighten the screws per the following table:

Table 3.1—Torque Values		
Model	Screw Size / Type	Recommended Torque
SR-081	M5 X 20 Flat Head Socket Cap Screw	55 in-lbs (6.21 Nm)
SR-101	M5 X 20 Flat Head Socket Cap Screw	55 in-lbs (6.21 Nm)
SR-131	M6 X 25 Flat Head Socket Cap Screw	70 in-lbs (7.91 Nm)
SR-176	M8 x 40 Flat Head Socket Cap Screw	175 in-lbs (19.77 Nm)
SR-221	M10 x 30 Socket Head Cap Screw	420 in-lbs (47.45 Nm)

3.3 Boot Installation SR-081 and SR-101

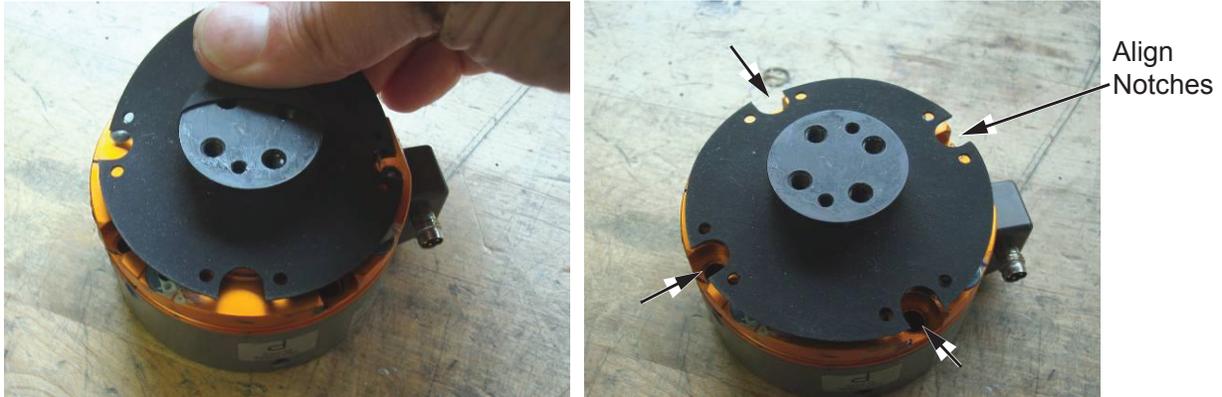
1. Provide 20 psi to the air supply port (not required if equipped with preload springs) and insure that the Collision Sensor returns to its reset or working position with the stem fully-extended and the alignment mark on the stem in line with the alignment mark on the cover plate.
2. Apply a bead of Permatex® Form-A-Gasket® 2C to the stem at the top of the tapered diameter under the flange. Apply another bead of Permatex Form-A-Gasket 2C to the upper surface on the cover plate.

Figure 3.6—Application of Permatex Form-A-Gasket



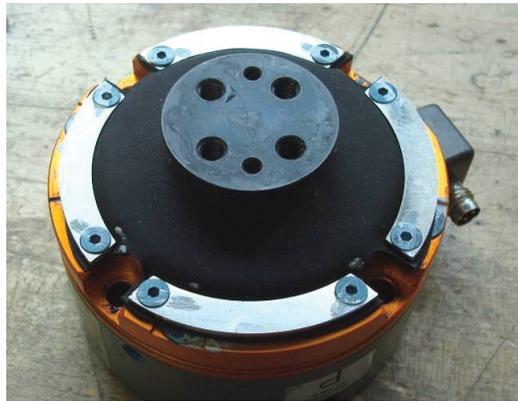
3. Install boot by stretching the center hole over the stem. Line up the screw holes and clearance slots with those in the cover plate.

Figure 3.7—Boot Installation and Alignment



4. Insert the flat head socket head cap screws with pre-applied thread locker through the boot retainers and into the installed boot. Screw them into the tapped holes in the cover plate. Tighten these screws to 32 in-oz (0.23 Nm). (Boot should be slightly compressed.)

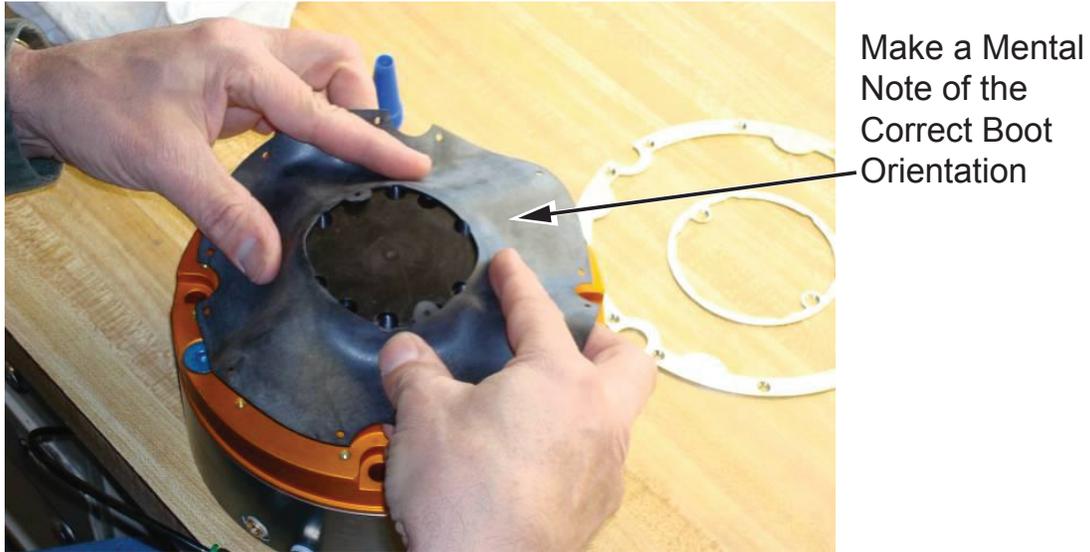
Figure 3.8—Boot Installation Complete



3.4 Boot Installation SR-131, SR-176, and SR-221

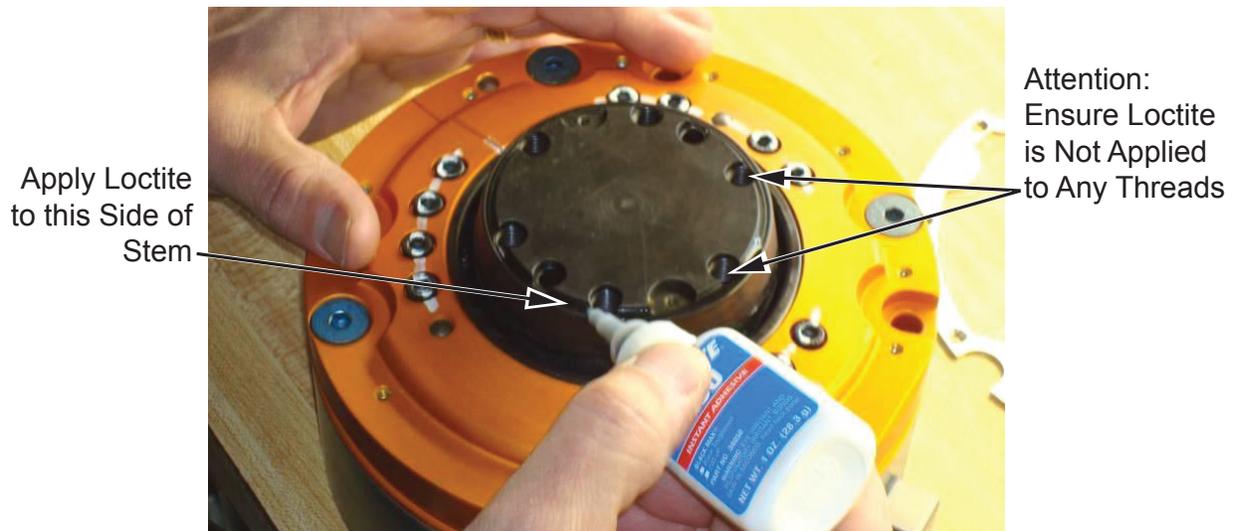
1. Provide 20 psi to the air supply port (not required if equipped with preload springs) and insure that the Collision Sensor returns to its reset or working position with the stem fully-extended and the alignment mark on the stem in line with the alignment mark on the cover plate.
2. Place the boot over the stem and orient in the manner shown in the image below. Make a mental note of the correct orientation and set the boot aside.

Figure 3.9—Determining Correct Orientation of Boot



3. Apply Loctite BlackMax® 380™ Instant Adhesive to one side of the stem surface indicated below.

Figure 3.10—Application of Loctite



4. Affix the boot to the side of the stem that had the Loctite applied.

Figure 3.11—Affixing First Side of Boot



5. Apply the Loctite BlackMax 380 Instant Adhesive to the other side of the stem and then affix the boot to the other side of the stem.

Figure 3.12—Application of Loctite



6. Place the upper retainer onto the stem. Thread the flat head socket head cap screws into the tapped holes in the stem. Tighten screws to 96 in-oz (0.68 Nm).

Figure 3.13—Assembly of Upper Retainer



7. Place the lower retainer over the boot and cover plate. Thread the (12) flat head socket head cap screws into the tapped holes in the cover plate. Do this progressively to pull the boot down evenly. Tighten screws to 32 in-oz (0.23 Nm).

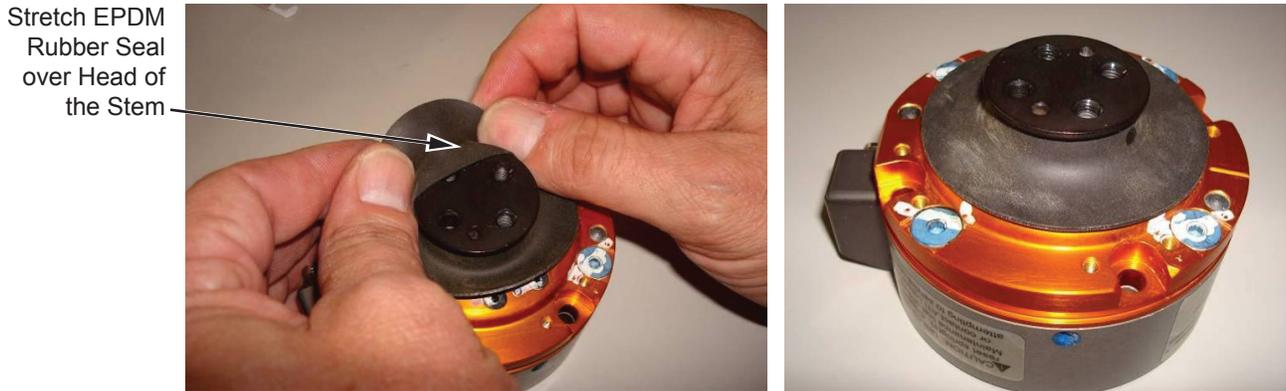
Figure 3.14—Assembly of Lower Retainer



3.5 Weld Shield Installation SR-081 and SR-101

1. Provide 20 psi to the air supply port (not required if equipped with preload springs) and insure that the Collision Sensor returns to its reset or working position with the stem fully-extended and the alignment mark on the stem in line with the alignment mark on the cover plate.
2. Install the EDPM rubber seal over the head of the stem and push down to the cover.

Figure 3.15—EDPM Rubber Seal Installation



3. Place the weld splatter shield over the top of the stem and EDPM rubber seal and push down to the cover. Line up the slots in the weld splatter shield with the screw holes in the cover.

Figure 3.16—Weld Shield Installation and Alignment



4. Insert the flat head socket head cap screws through the boot retainer and place the boot retainers onto the installed weld splatter shield. Screw them into the tapped holes in the cover plate.

Figure 3.17—Assembly of Retainers and Screws

Thread the
Screws down
Evenly and
Progressively



5. Tighten these screws to 32 in-oz (0.23 Nm).

Figure 3.18—Complete Assembly



3.6 Weld Installation SR-131, SR-176, and SR-221

1. Provide 20 psi to the air supply port (not required if equipped with preload springs) and insure that the Collision Sensor returns to its reset or working position with the stem fully-extended and the alignment mark on the stem in line with the alignment mark on the cover plate.
2. Place the upper boot retainer on top of the stem. Thread the flat head socket head cap screws into the tapped holes in the stem. Tighten these screws to 32 in-oz (0.23 Nm).

Figure 3.19—Assembly of Upper Boot Retainer



Fasten Upper
Boot Retainer
to the Stem

3. Install the EPDM rubber seal over the top of the stem and slide down to the cover.

Figure 3.20—Assembly of EPDM Rubber Seal

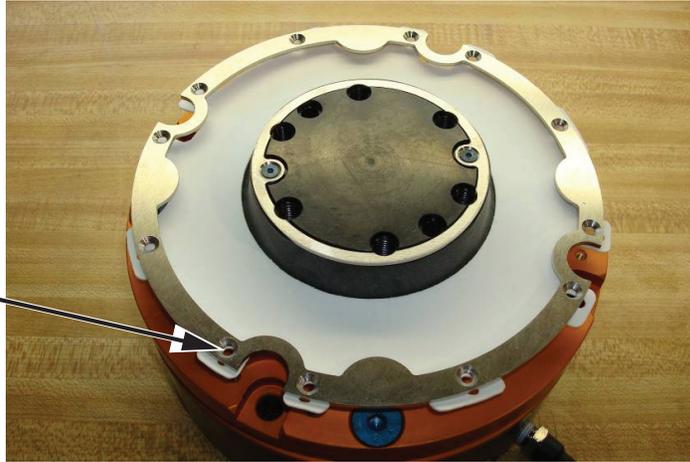


EPDM Rubber Seal

4. Place the weld splatter shield and lower boot retainer over the top of the stem and EDPM rubber seal and push down to the cover. Line up the slots in the weld splatter shield with the screw holes in the cover.

Figure 3.21—Alignment of Shield and Lower Retainer

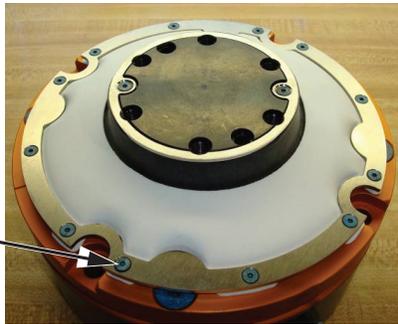
Line up the slots
in the Weld Splatter
Shield with the screw
holes in the Cover



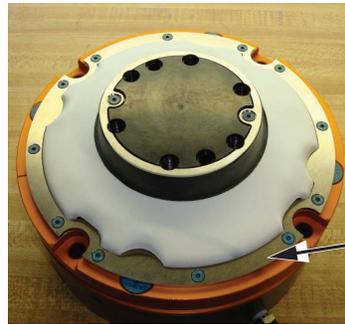
5. Thread the flat head socket head cap screws into the tapped holes in the cover plate and progressively thread them down. Tighten these screws to 32 in-oz (0.23 Nm).

Figure 3.22—Assembly of Lower Retainer

Thread the screws
down evenly and
progressively



Completed assembly
should look like this



4. 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 Collision Sensor 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 (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 occurred.

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.