ATI INDUSTRIAL AUTOMATION
ISO 9001 Registered

Protector™

Robotic Collision Sensor
SR-131, SR-176, SR-221

U.S. Patent Nos. 6069415 and 6690208

Switch Replacement Instruction Manual

Document #9610-60-1009-02
June 2008

Engineered Products for Robotic Productivity

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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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Table of Contents

Glossary of Terms

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 balls mounted to the stem are nested.
Collision	The accidental impact between the end-of-arm tooling and some obstruction in its path.
Cover Plate	Disk-shaped aluminum cover for Protector™ Body.
Crash	The result of a disturbance that displaces the Protector™ components from their standard working position.
Interface Plate	Optional component used to adapt the Protector™ Body or Stem to the user's robot or tooling.
Nano Connector	8mm electrical connector mounted in block attached to the side of the Body.
Reset	The ability of the Protector™ to return to its working position when a disturbing force or displacement is removed.
Stem	Round tapered post containing tapped holes and dowel pins. An interface plate to the user's tooling is usually attached here.

1. General Maintenance Instructions

CAUTION: The customer should lock out and discharge all energy to the work cell prior to working on any Protector™ system.

CAUTION: In all instances where the Protector™ is to be examined, installed, or removed from service, insure that air pressure has been vented from the unit, that electrical current is not supplied to the Protector's™ signal circuit, and that the robot is in a safe, locked-out condition, consistent with local and national safety standards.

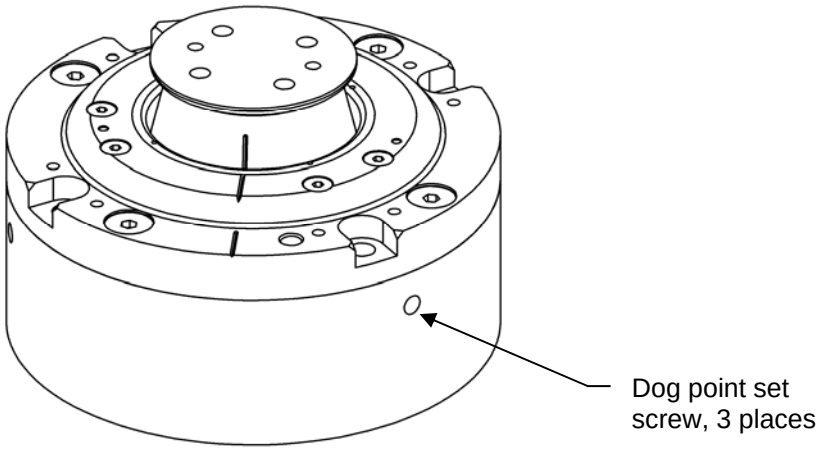


Figure 1.1—Location of Set screws

CAUTION: Do not adjust or remove any of the three (3) set screws installed in the wall of the Body. Doing so may result in personal injury and/or damage to the unit.

2. Switch Replacement

2.1 Removal of Connector Block Assembly and Switch Wiring

1. Remove the mounting screw and nylon washer using a 2.5mm hex key.
2. Pull the Connector Block Assembly away from the Protector™ as shown in Figure 2.1 and cut the wires as shown in Figure 2.2.
3. Unplug the wires and connector from PCB Header and discard the connector and wires.
4. Remove and discard the wire channel gasket (see Figure 2.1).

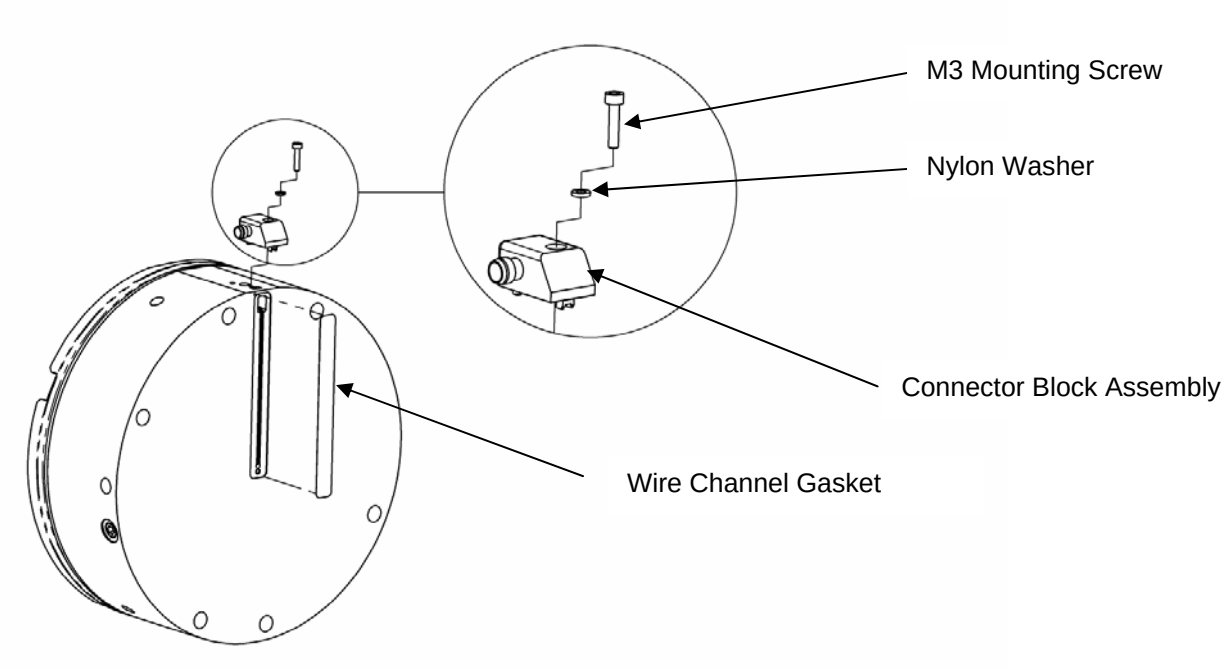


Figure 2.1—Removal of Connector Block Assembly and Switch Wiring

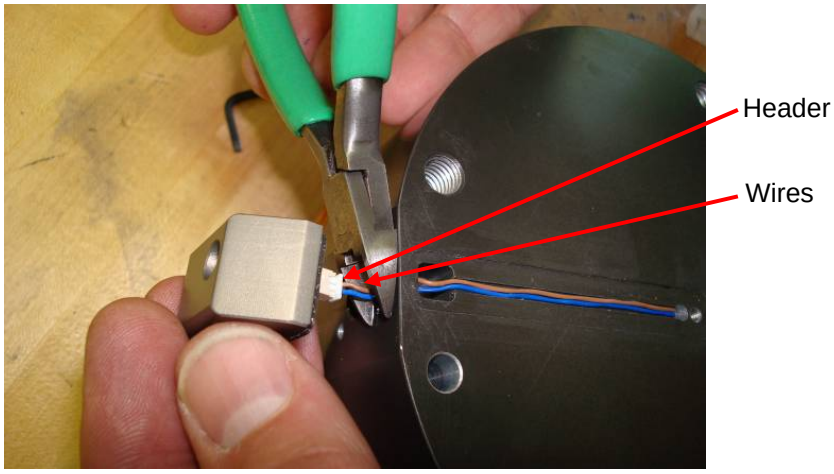


Figure 2.2—Cutting the wires.

2.2 Removal of Cover Plate, Stem, and Cover O-ring

1. Remove the four (4) socket head cap screws securing the Cover Plate assembly to the Body.

   Note: 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.

> ⚠ **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.

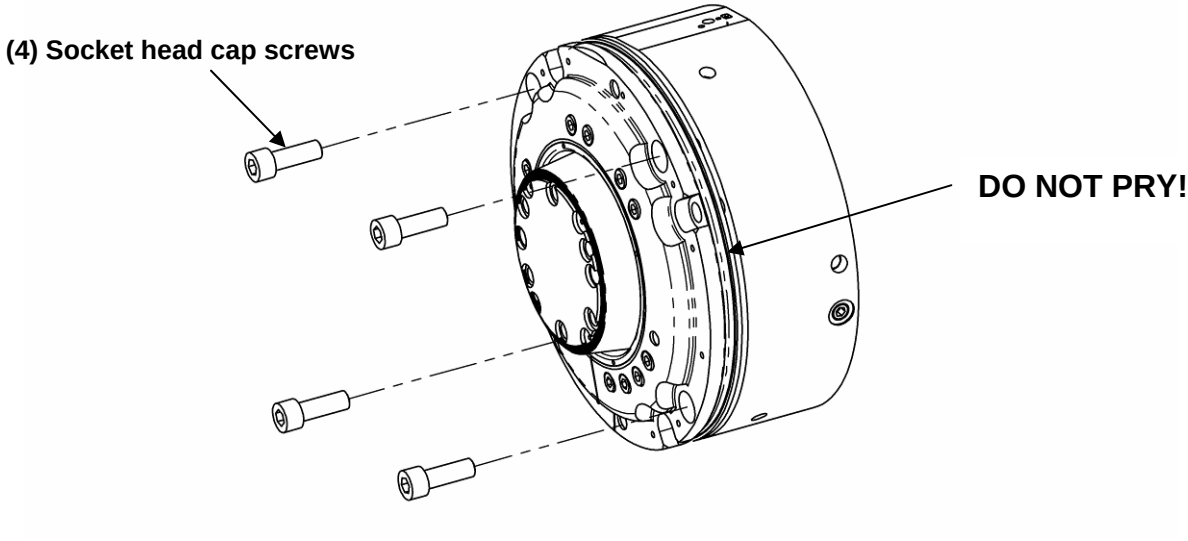


Figure 2.3—Removal of Cover Plate

2. Remove the Cover Plate assembly 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. It may be necessary to hold the unit up by the Cover Plate and lightly tap on the Stem with a rubber or plastic mallet.

   Note: The dowel pins are pressed into the Cover Plate and are a slip fit into the Body.

3. Remove the stem assembly and cover o-ring and set aside (see Figure 2.4).

> ⚠ **CAUTION:** The Cover Plate assemblies and Stem assemblies are factory assembled as matched parts. Do not allow either of these assemblies to be mixed with those from other units.

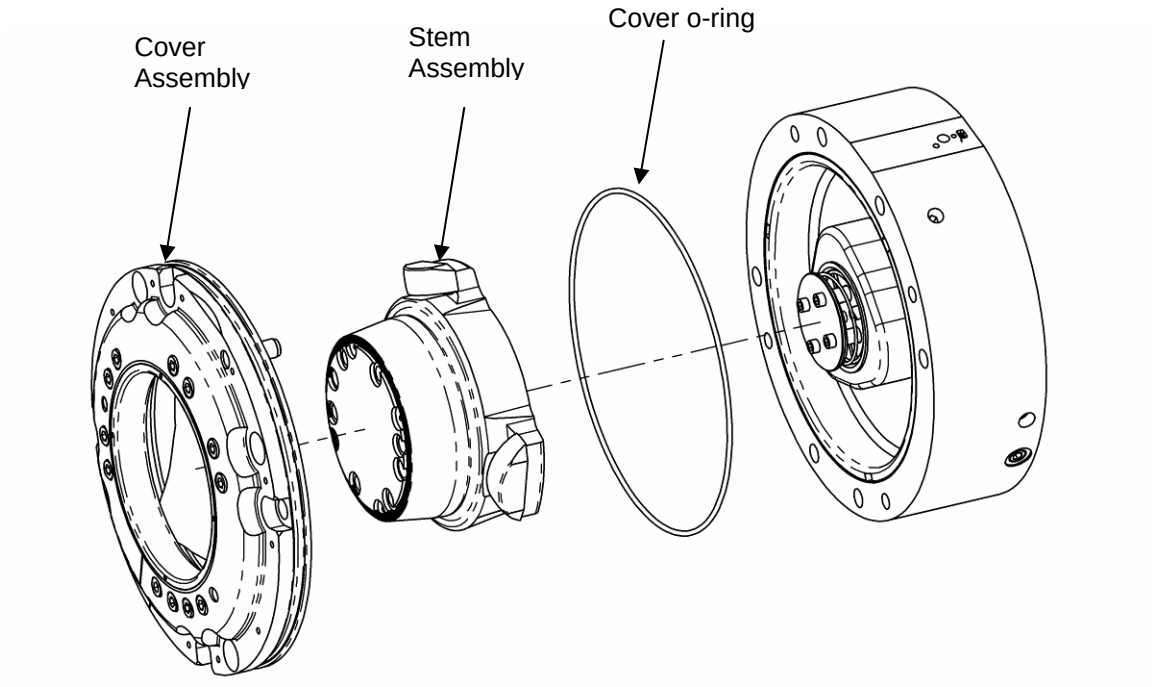


Figure 2.4—Removal of Cover Plate, Stem Assembly, and O-ring

2.3 Removal of Switch Actuator Mechanism

1. Remove the Screws, Spring Plate, Spring, Actuation Plate, and Stand offs.

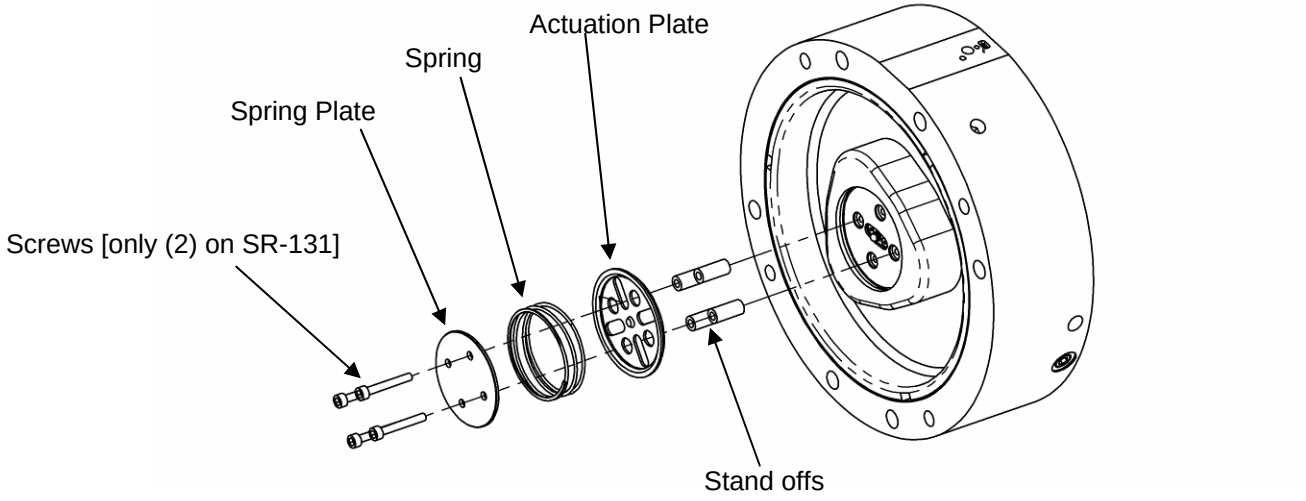


Figure 2.5—Removal of Switch Actuator Mechanism

3. Switch Removal

1. Remove the (2) Flat Head Screws using a 1.5mm hex key.
2. Remove the Spring Stop.
3. Remove the Switch Carrier Spring and the Switch Assembly.
4. Discard all of the parts removed in steps 1 through 3.

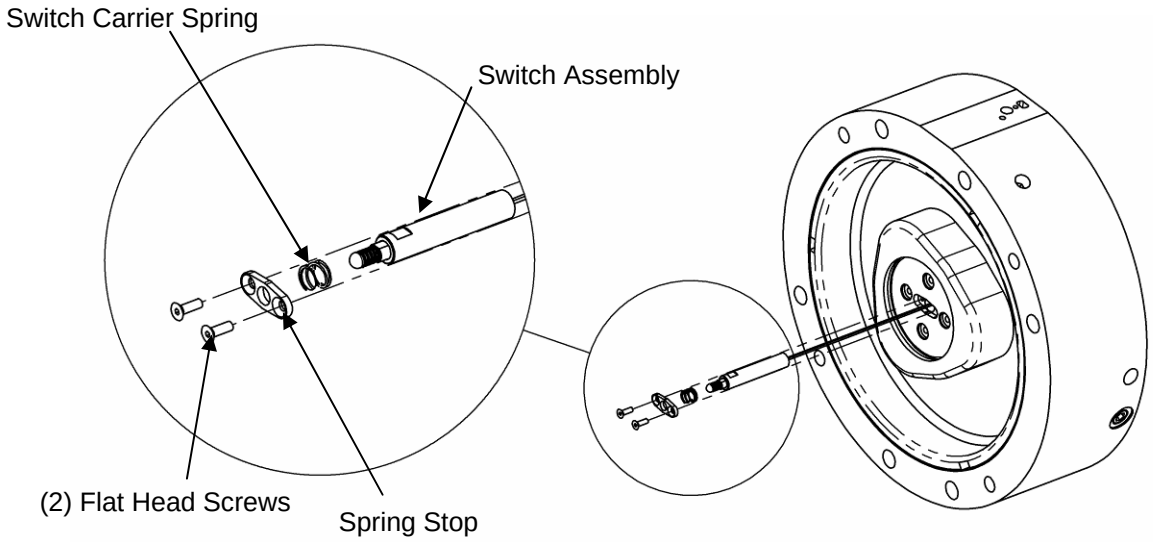


Figure 3.1—Removal of Switch

3.1 New Switch Installation

1. Insert the wires of the new Switch Assembly through the body post. Slide the Switch Assembly into position. Twisting the Switch wires (as shown below) will simplify insertion of the wires into the Body Post.

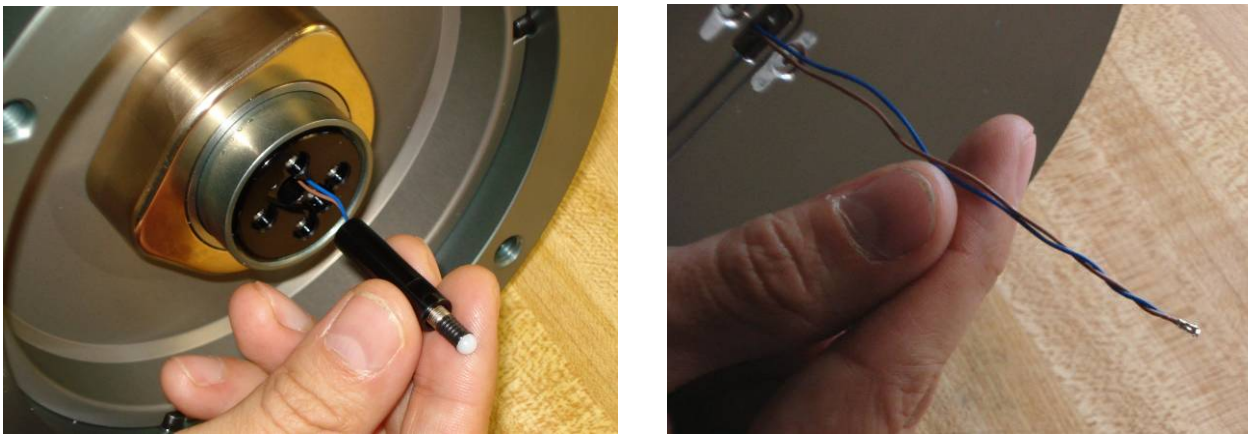


Figure 3.2—Inserting New Switch

2. Untwist the wires and feed them through the slot leading to the cavity on the side of the Body. Ensure that the wires will lie side-by-side in the channel once the assembly has been completed. To prevent damage to the wires, temporarily apply masking tape to the channel once the wires are correctly positioned.

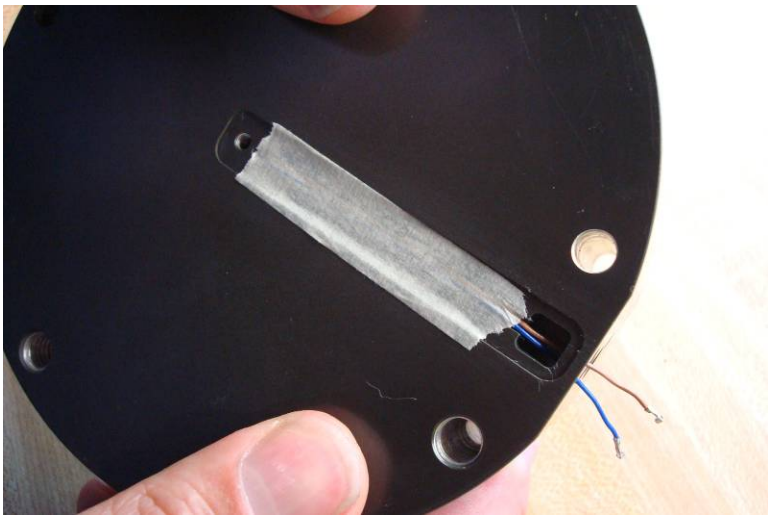
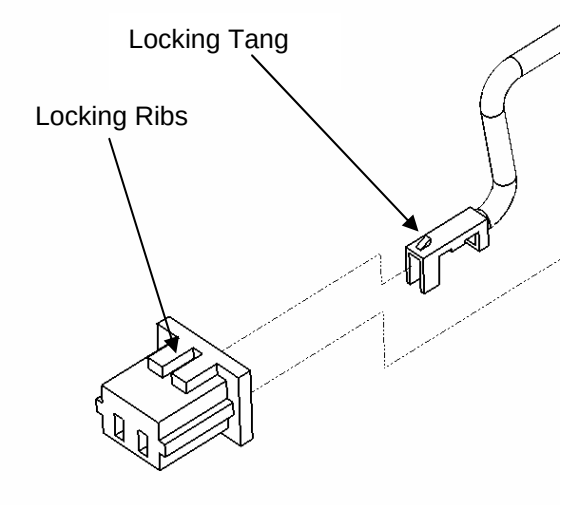


Figure 3.3—Wire Routing

3. Insert the Wire Connectors into the Micro Header Socket with the Locking Tang of the Wire connectors facing the Locking Ribs on the Micro Header Socket. Grip each wire with needle-nose pliers just behind the Wire Connector and push it firmly into the Micro Header Socket. Check to be sure that the Wire Connectors are locked into place and will not pull out accidentally.



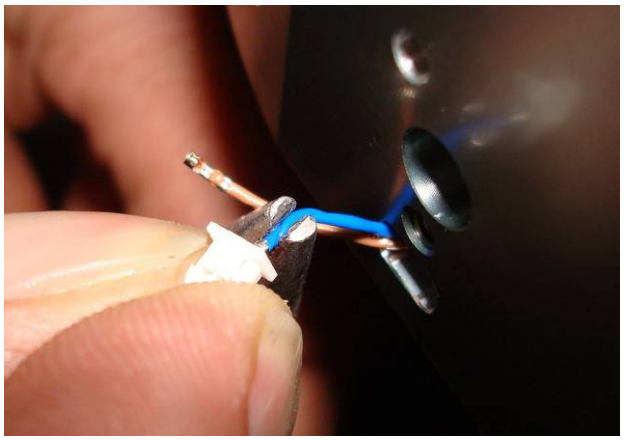


Figure 3.4—Inserting Wire Connectors

4. Place the Switch Carrier Spring into the Body Post on top of the Switch Assembly.
5. Apply 222MS Loctite to the two (2) M2.5 x 6mm Flat Head Screws and fasten the Spring Stop to the Body Post. Tighten the screws to 64 in-ozs.

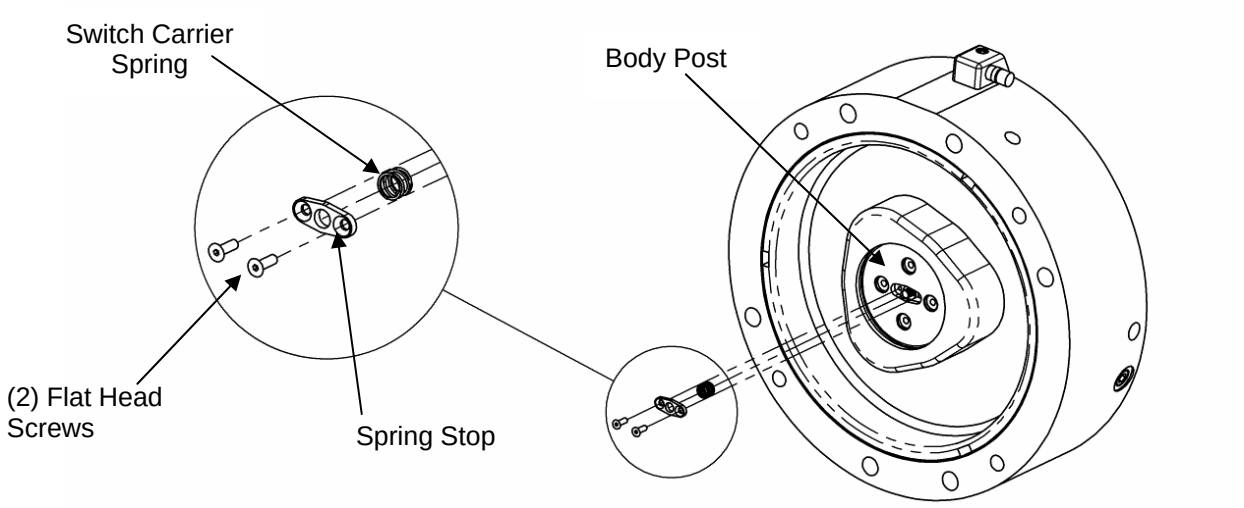


Figure 3.5—Reinstallation of Switch

3.2 Reassembly of Switch Actuator Mechanism

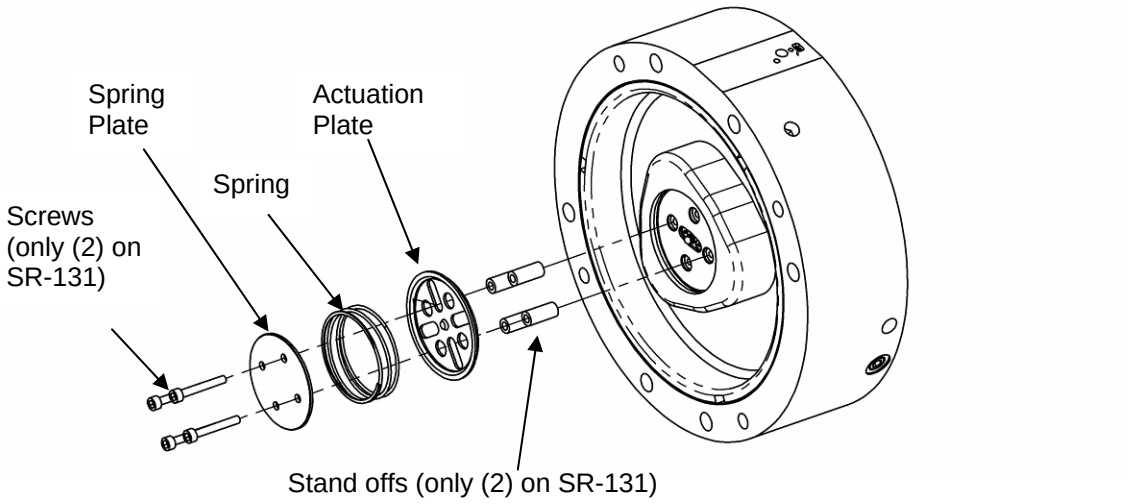


Figure 3.6—Reassembly of Switch Actuator Mechanism

1. Insert the Stand offs into the counterbores in the Body Post.
2. Place the Actuation Plate over the Stand offs. Must be oriented per Figure 3.7.

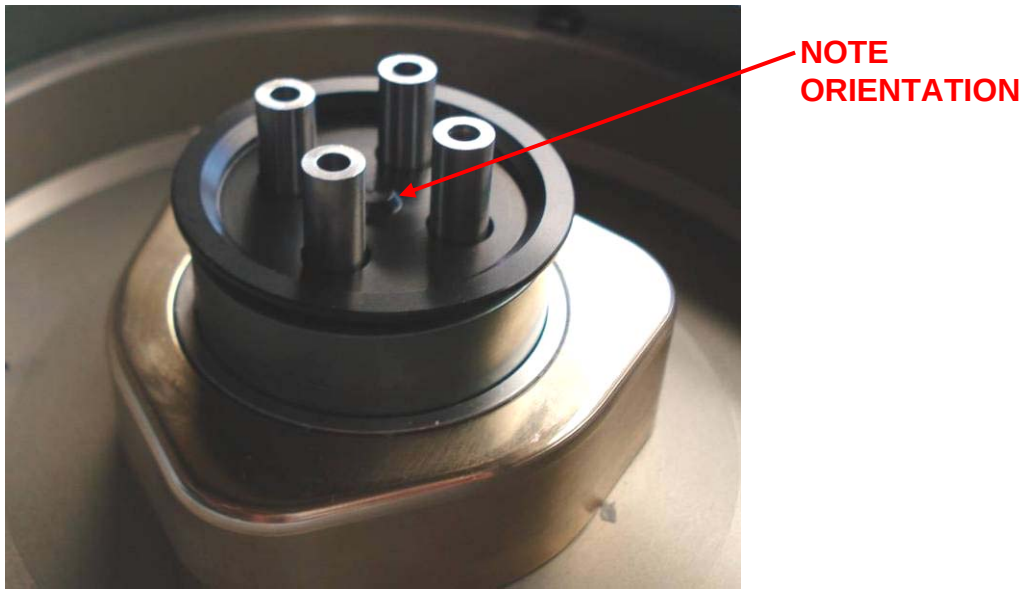


Figure 3.7—Orientation of Actuator Plate

3. Place the Actuation Spring into the Actuation Plate.
4. Place the Spring Plate on top of the Stand offs while lining up the screw holes. Apply Loctite 222MS to the threads of the Screws. Slide the Screws through the Spring Plate and Stand offs and screw into the Body Post. Tighten per the following chart:

Model	Screw Size / Type	Recommended Torque
SR-131	M3 x 20 SHCS	12 in-lbs
SR-176	M3 x 25 SHCS	12 in-lbs
SR-221	M4 x 30 SHCS	25 in-lbs

3.3 Reattaching the Connector Block

1. Plug the Micro Header Socket into the PCB Header in the Connector Block.

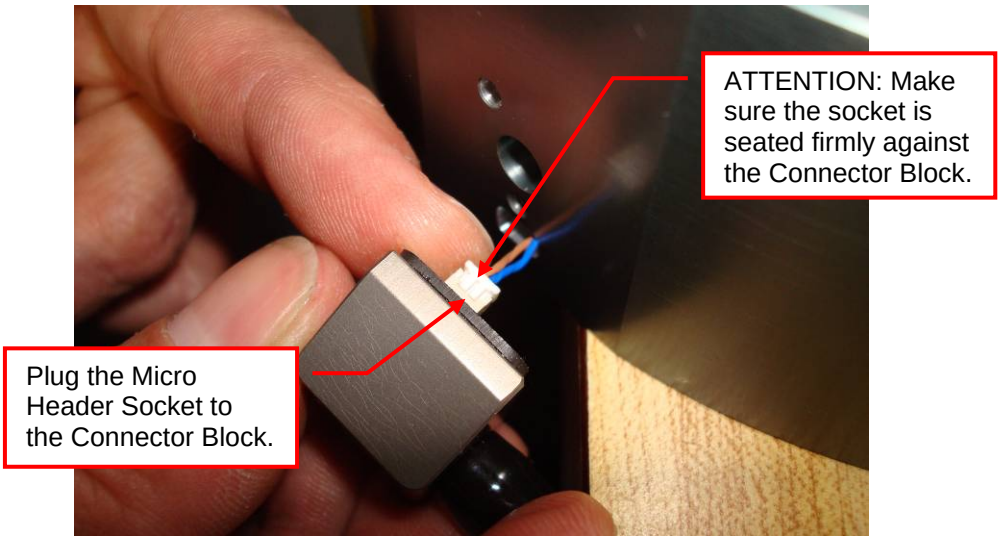


Figure 3.8—Reattaching the Connector Block

2. Place the Nylon Washer on M3. Apply Loctite 222MS to the Connector Block's M3 mounting screw and thread it into the Body and torque to 64 in-ozs. To avoid bunching of the wires in the channel, work any slack in the wires into the slot leading to the cavity on the side of the Body.

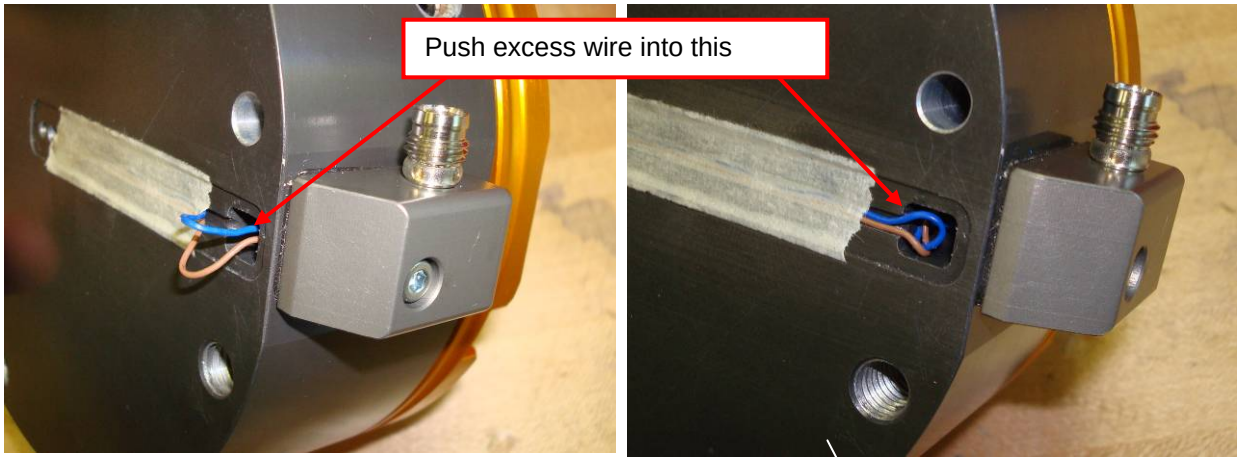


Figure 3.9—Reattaching the Connector Block

3. To avoid bunching of the wires in the channel, work any slack in the wires into the Body cavity indicated above.

3.4 Reassembly of Stem, Cover Plate, and Cover O-ring

1. Apply Magnalube to the o-ring Cover Seal and insert into the groove in the Cover Plate.

Figure 3.10—O-ring in Cover

2. With the Stem assembly upright, set the Cover Plate assembly onto it. Make certain that the alignment grooves are properly aligned.

Figure 3.11—Orientation of Stem in Cover

3. 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.
4. Press the Cover Plate down onto the Body. Apply Loctite 222MS to the four (4) screws and thread them into the Body.

   Note: On units with the Spring Assist Option it is necessary to use two opposing screws to evenly pull the Cover Plate down against the Body. Tighten the screws per the following table:

Model	Screw Size / Type	Recommended Torque
SR-131	M6 X 25 SFHCS	70 in-lbs
SR-176	M8 x 40 SFHCS	175 in-lbs
SR-221	M10 x 30 SHCS	420 in-lbs

3.5 Switch Adjustment

1. Provide 20 psi to the air supply port (not required if equipped with preload springs) and insure that the Protector™ 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. Set a volt-ohm meter to ohms or continuity and connect it between the black and brown wires of the cord (see wiring diagrams below) connected to the Nano connector on the switch housing.

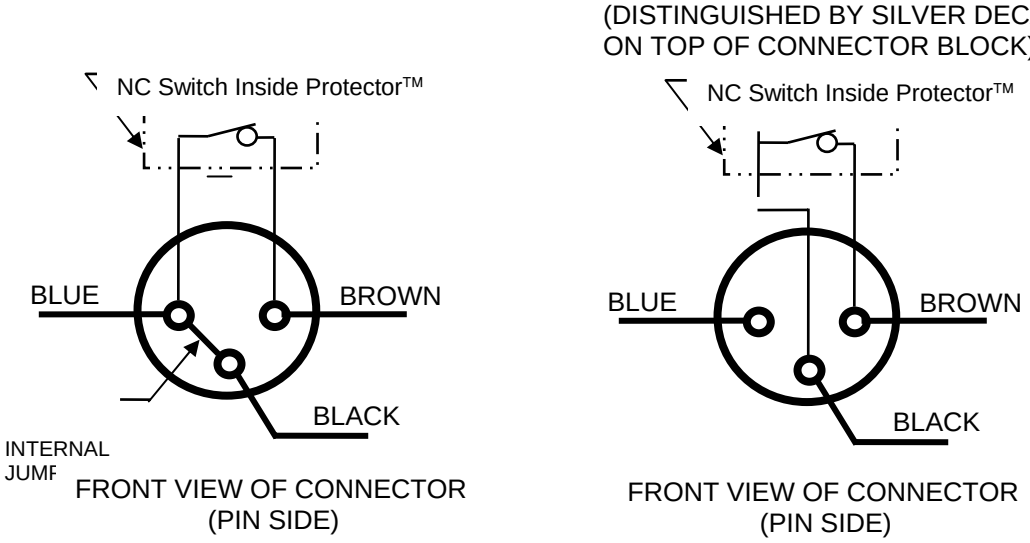


Figure 3.12—Protector™ Wiring

3. Attach an Interface Plate to the stem of the Protector™.
4. Center the Protector™ under the Press Ram of an Arbor Press (see Figure 3.13).

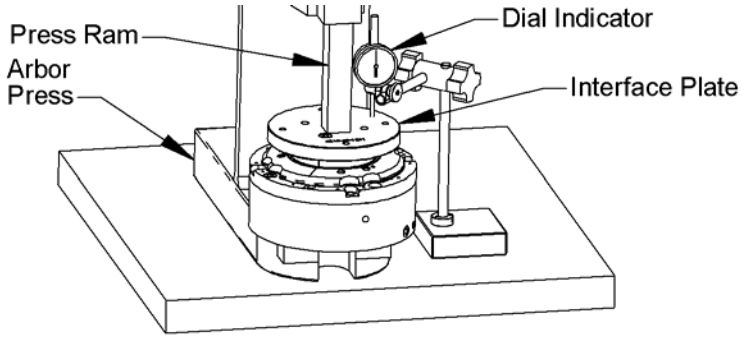


Figure 3.13—Checking Switch Height Adjustment

5. Set a Dial Indicator in contact with the Interface Plate and adjust it so that the probe is vertical. Set the Dial Indicator height so that it can read at least 0.10" stroke. Set the dial ring to zero. Factory default setting is 0.020".
6. Push on the press handle until the switch circuit opens and check the distance traveled on the Dial Indicator.
7. If the distance traveled before the switch turns off is greater than desired, turn the Adjusting Screw clockwise. If the distance traveled is less, turn the Adjusting Screw counterclockwise. (Use a 1.5mm hex key.)

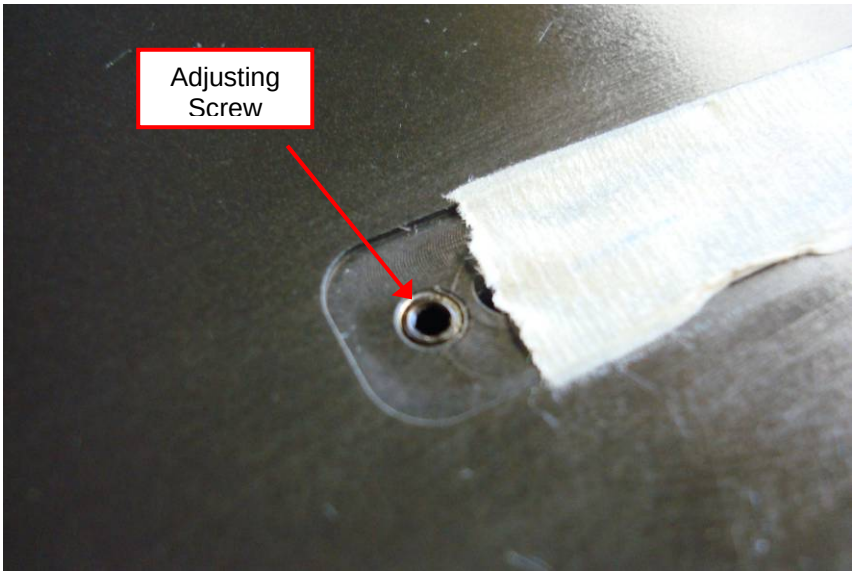


Figure 3.14— Location of Adjusting Screw

3.6 Wire Channel Gasket

Remove the masking tape covering the Wire Channel. Peel the paper backing off of the Wire Channel Gasket and apply the gasket to the shallow recess straddling the wire channel. Be sure that the wires are laying side-by-side in the channel before smoothing the gasket into place. Also, be sure that the Gasket resides completely within the shallow recess and that the wires are not twisted or bunched up under the Gasket.

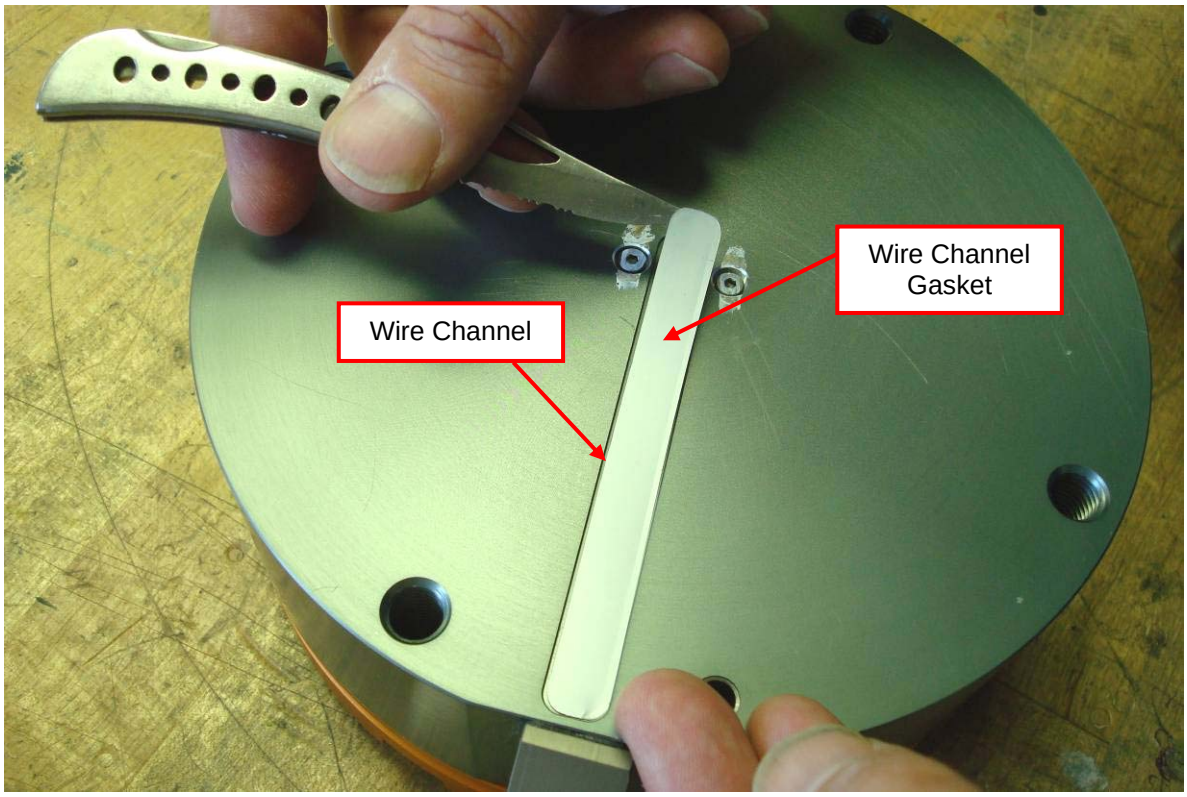
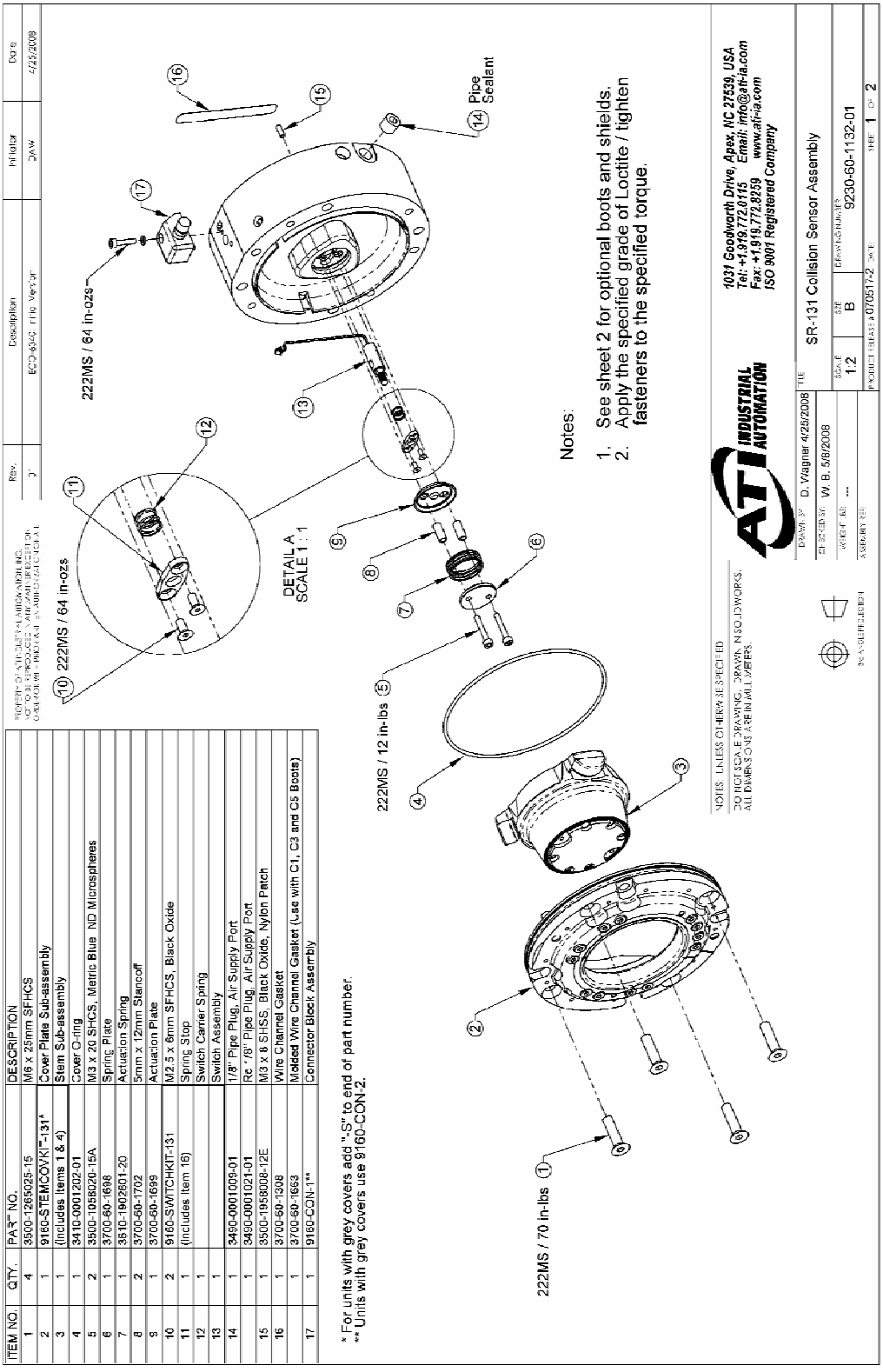


Figure 3.15—Applying Wire Channel Gasket

4. Drawings

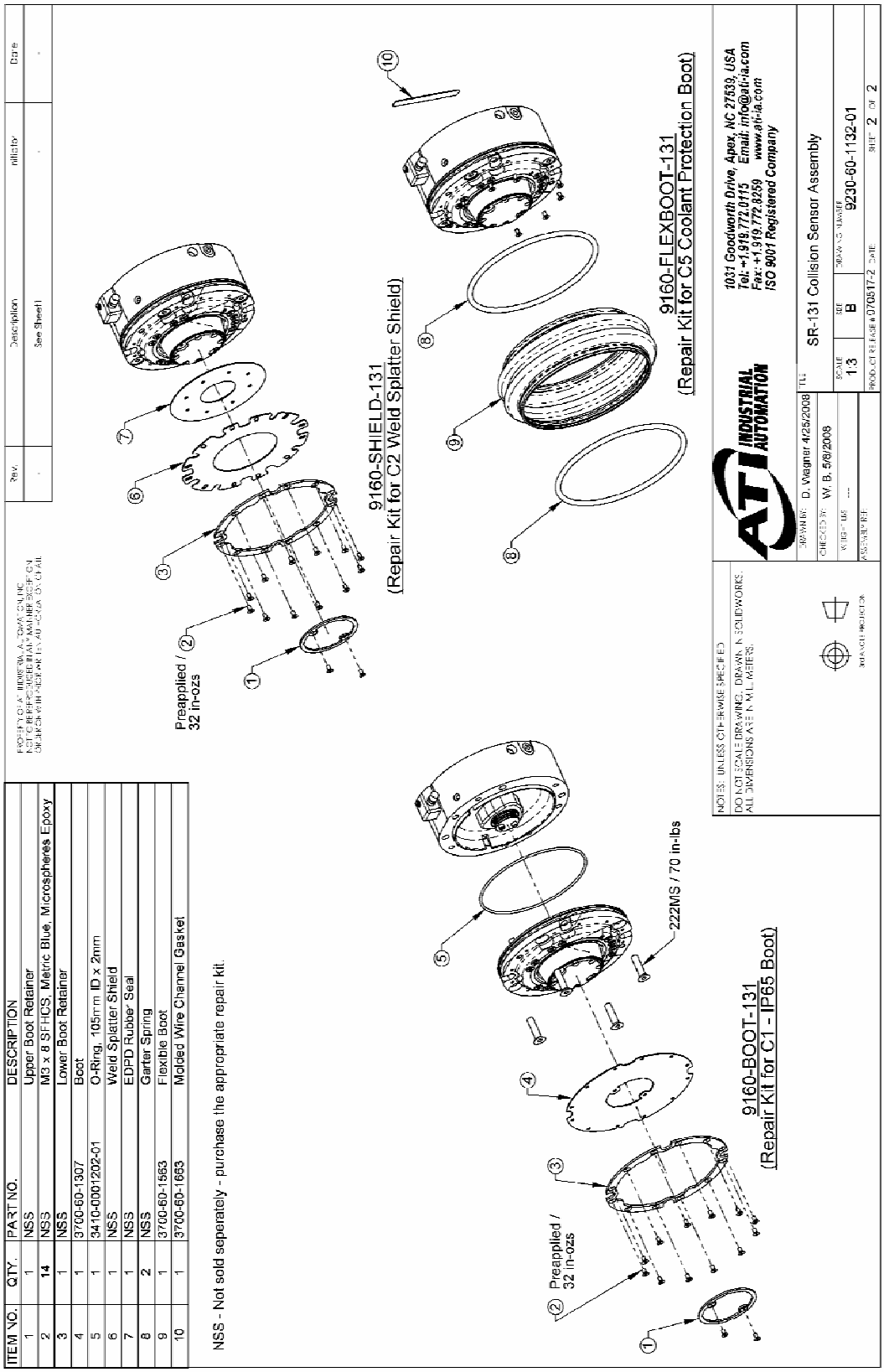
4.1 SR-131 Replacement Parts—General



ITEM NO.	QTY.	PART* NO.	DESCRIPTION
1	4	3500-1265025-15	M6 x 25mm SFHCS
2	1	9160-STEMCOVKIT*-131*	Cover Plate Sub-assembly
3	1	(includes Items 1 & 4)	Stem Sub-assembly
4	1	3410-0001202-01	Cover O-ring
5	2	3500-1058020-15A	M3 x 20 SHCS, Metric Blue ND Microspheres
6	1	3700-60-1698	Spring Plate
7	1	3610-1902601-20	Actuation Spring
8	2	3700-60-1702	5mm x 12mm Standoff
9	1	3700-60-1699	Actuation Plate
10	2	9160-SWITCHKIT-131	M2.5 x 6mm SFHCS, Black Oxide
11	1	(includes Item 16)	Spring Stop
12	1		Switch Carrier Spring
13	1		Switch Assembly
14	1	3490-0001009-01	1/8" Pipe Plug, Air Supply Port
	1	3490-0001021-01	Rc *1/8" Pipe Plug, Air Supply Port
15	1	3500-1958008-12E	M3 x 8 SHSS, Black Oxide, Nylon Patch
16	1	3700-60-1308	Wire Channel Gasket
	1	3700-60-1663	Molded Wire Channel Gasket (Use with C1, C3 and C5 Boots)
17	1	9160-CON-1**	Connector Block Assembly

* For units with grey covers add "-S" to end of part number.
** Units with grey covers use 9160-CON-2.

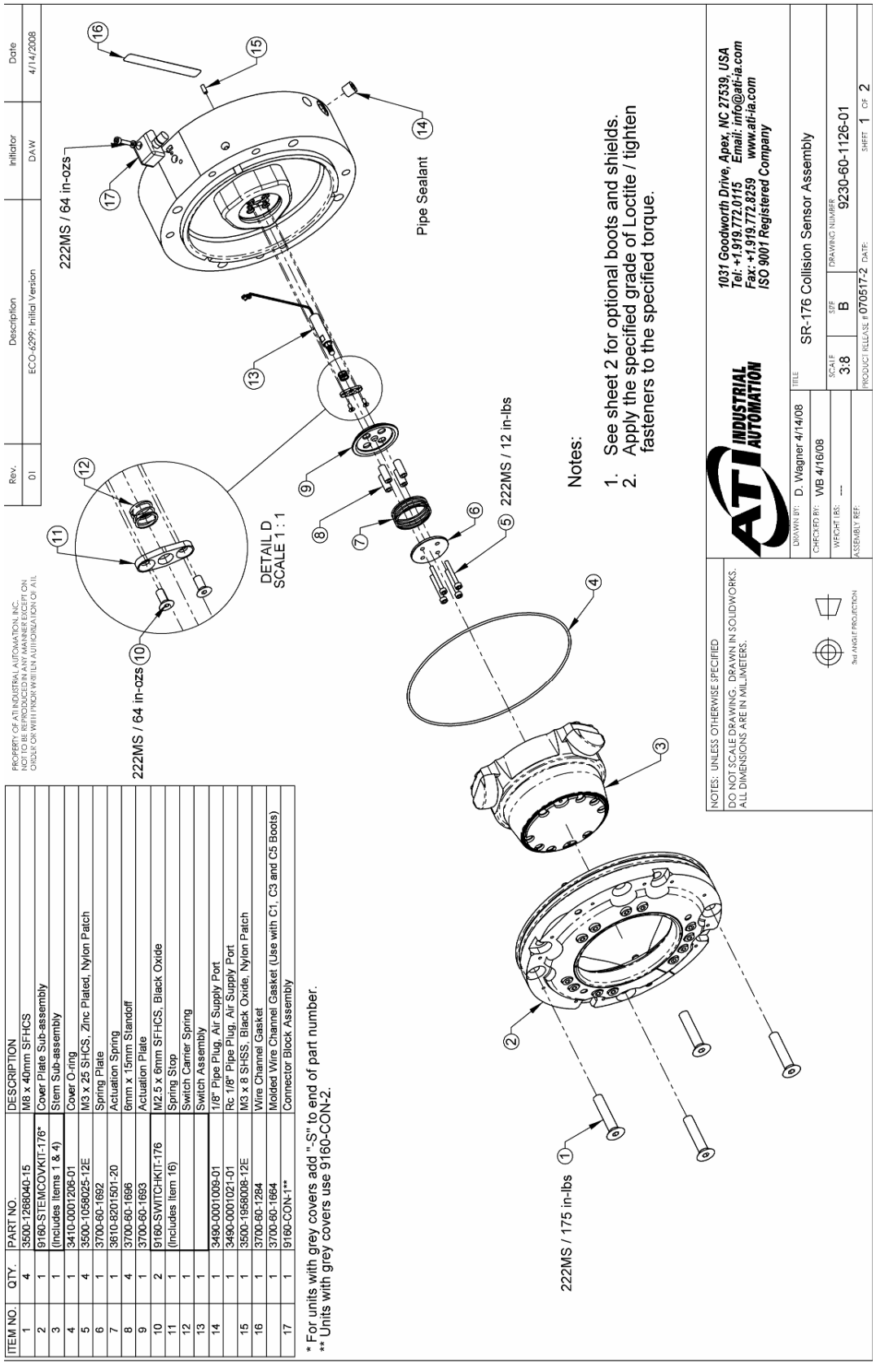
4.2 SR-131 Replacement Parts—Boots and Shields



ITEM NO.	QTY.	PART NO.	DESCRIPTION
1	1	NSS	Upper Boot Retainer
2	14	NSS	M3 x 8 SFHCS, Metric Blue, Microspheres Epoxy
3	1	NSS	Lower Boot Retainer
4	1	3700-60-1307	Boot
5	1	3410-0001202-01	O-Ring, 105mm ID x 2mm
6	1	NSS	Weld Splatter Shield
7	1	NSS	EDPD Rubber Seal
8	2	NSS	Garter Spring
9	1	3700-60-1563	Flexible Boot
10	1	3700-60-1663	Molded Wire Channel Gasket

NSS - Not sold separately - purchase the appropriate repair kit.

4.3 SR-176 Replacement Parts—General

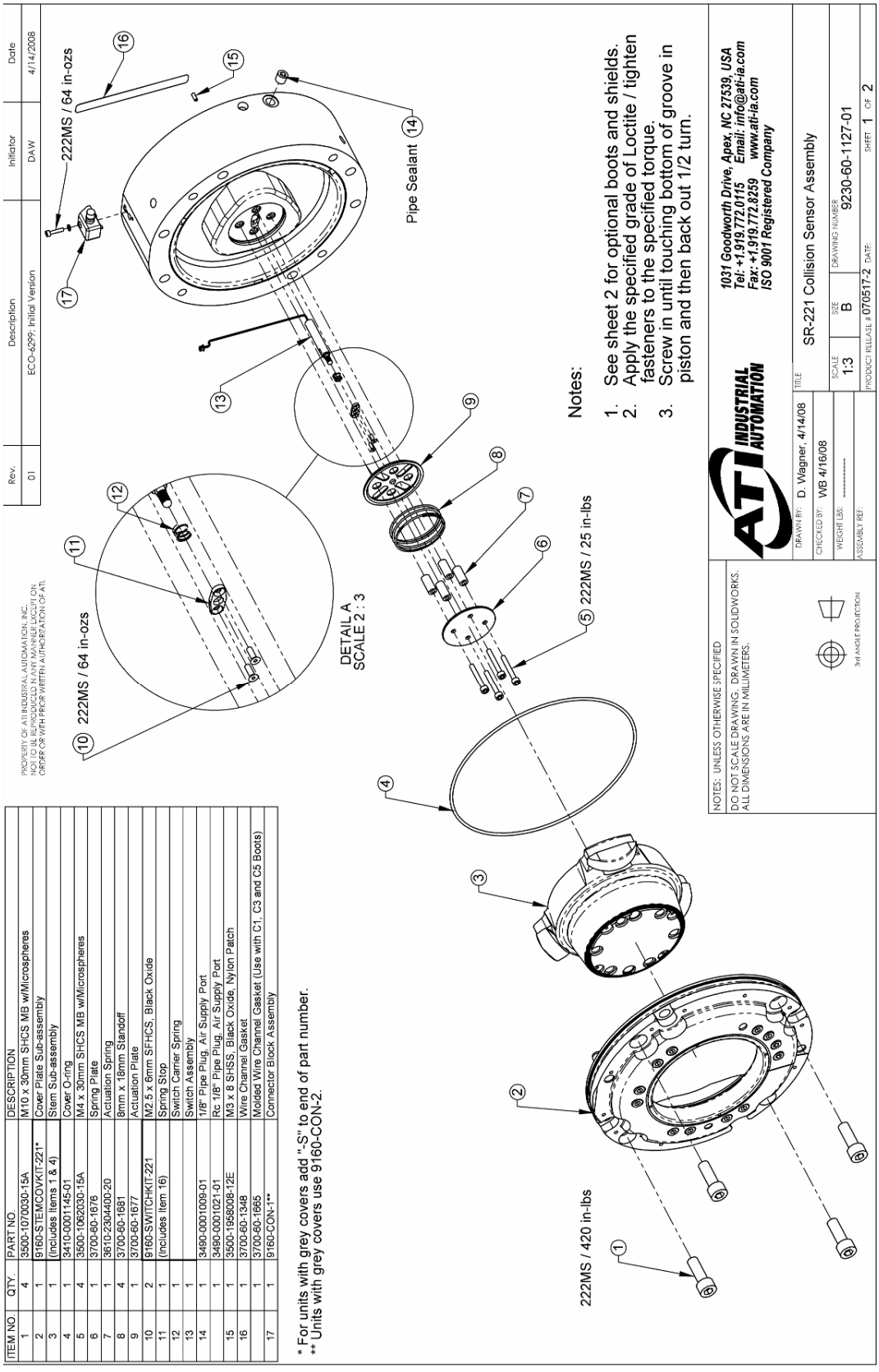


ITEM NO.	QTY.	PART NO.	DESCRIPTION
1	4	3500-1268040-15	M8 x 40mm SFHCS
2	1	9160-STEMCOVKIT-176*	Cover Plate Sub-assembly
3	1	(Includes Items 1 & 4)	Stem Sub-assembly
4	1	3410-0001206-01	Cover O-ring
5	4	3500-1058025-12E	M3 x 25 SHCS, Zinc Plated, Nylon Patch
6	1	3700-60-1692	Spring Plate
7	1	3610-8201501-20	Actuation Spring
8	4	3700-60-1696	6mm x 15mm Standoff
9	1	3700-60-1693	Actuation Plate
10	2	9160-SWITCHKIT-176	M2.5 x 6mm SFHCS, Black Oxide
11	1	(Includes Item 16)	Spring Stop
12	1		Switch Carrier Spring
13	1		Switch Assembly
14	1	3490-0001009-01	1/8" Pipe Plug, Air Supply Port
	1	3490-0001021-01	Rc 1/8" Pipe Plug, Air Supply Port
15	1	3500-1958008-12E	M3 x 8 SHSS, Black Oxide, Nylon Patch
16	1	3700-60-1284	Wire Channel Gasket
	1	3700-60-1664	Molded Wire Channel Gasket (Use with C1, C3 and C5 Boots)
17	1	9160-CON-1**	Connector Block Assembly

* For units with grey covers add "-S" to end of part number.
** Units with grey covers use 9160-CON-2.

4.4 SR-176 Replacement Parts—Boots and Shields

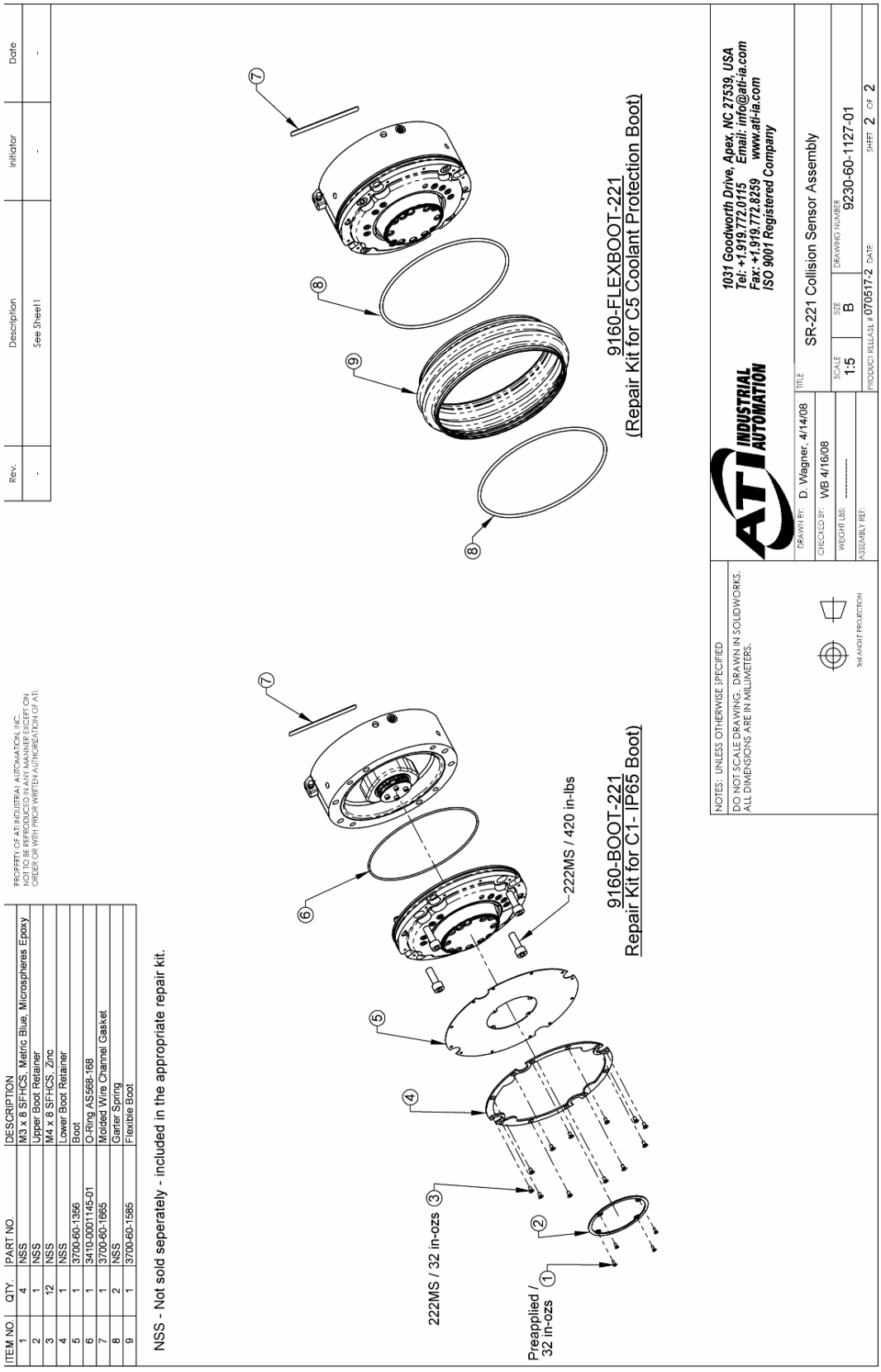
4.5 SR-221 Replacement Parts—General



ITEM NO.	QTY.	PART NO.	DESCRIPTION
1	4	3500-1070030-15A	M10 x 30mm SHCS MB w/Microspheres
2	1	9160-STEMCOVKIT-221*	Cover Plate Sub-assembly
3	1	(Includes Items 1 & 4)	Stem Sub-assembly
4	1	3410-0001145-01	Cover O-ring
5	4	3500-1062030-15A	M4 x 30mm SHCS MB w/Microspheres
6	1	3700-60-1676	Spring Plate
7	1	3610-2304400-20	Actuation Spring
8	4	3700-60-1681	8mm x 18mm Standoff
9	1	3700-60-1677	Actuation Plate
10	2	9160-SWITCHKIT-221	M2.5 x 6mm SFHCS, Black Oxide
11	1	(Includes Item 16)	Spring Stop
12	1		Switch Carrier Spring
13	1		Switch Assembly
14	1	3490-0001009-01	1/8" Pipe Plug, Air Supply Port
	1	3490-0001021-01	Rc 1/8" Pipe Plug, Air Supply Port
15	1	3500-1958008-12E	M3 x 8 SHSS, Black Oxide, Nylon Patch
16	1	3700-60-1348	Wire Channel Gasket
	1	3700-60-1665	Molded Wire Channel Gasket (Use with C1, C3 and C5 Boots)
17	1	9160-CON-1**	Connector Block Assembly

* For units with grey covers add "-S" to end of part number.
** Units with grey covers use 9160-CON-2.

4.6 SR-221 Replacement Parts—Boots



ITEM NO.	QTY.	PART NO.	DESCRIPTION
1	4	NSS	M3 x 8 SFHCS, Metric Blue, Microspheres Epoxy
2	1	NSS	Upper Boot Retainer
3	12	NSS	M4 x 8 SFHCS, Zinc
4	1	NSS	Lower Boot Retainer
5	1	3700-60-1356	Boot
6	1	3410-0001145-01	O-Ring AS568-168
7	1	3700-60-1665	Molded Wire Channel Gasket
8	2	NSS	Garter Spring
9	1	3700-60-1585	Flexible Boot

NSS - Not sold seperately - included in the appropriate repair kit.

5. 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 Protector™ products purchased hereunder will be free from defects in material and workmanship under normal use for a period of one (1) 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 any event not later than the last day of the warranty period; and (b) the defective item is received by ATI not later ten (10) days after the last day of the warranty period. ATI's entire liability and Purchaser's sole remedy under this warranty is limited to repair or replacement, at ATI's election, of the defective part or item or, at ATI's election, refund of the price paid for the item. The foregoing warranty does not apply to any defect or failure resulting from improper installation, operation, maintenance or repair by anyone other than ATI.

ATI will in no event be liable for incidental, consequential or special damages of any kind, even if ATI has been advised of the possibility of such damages. ATI's aggregate liability will in no event exceed the amount paid by purchaser for the item which is the subject of claim or dispute. ATI will have no liability of any kind for failure of any equipment or other items not supplied by ATI.
No action against ATI, regardless of form, arising out of or in any way connected with products or services supplied hereunder may be brought more than one (1) year after the cause of action 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.