

Assembly and operating manual

AGE-W

Angular Compensation Unit



Imprint

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Document number: 1007596

Version: 01.02 | 18/07/2017 | en

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Dear Customer,

thank you for trusting our products and our family-owned company, the leading technology supplier of robots and production machines.

Our team is always available to answer any questions on this product and other solutions. Ask us questions and challenge us. We will find a solution!

Best regards,

Your SCHUNK team

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Reg. No. 003496 QM08



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Glossar

Ball Cage

Hardened steel ring attached to the Compensator Body that contains the balls that are engaged by the cam during the locking process.

Ball Lock Cam

Circular disc attached to the piston that forces the locking balls inward during the locking process.

Ball Pivot

A ball end shaft that attaches to the Tool Mount Plate and is captive in the Compensator Body. Part of the mechanism that provides angular and rotational compliance about the Z axis.

Compensator Body

The part of the Ball Lock Compensator that is mounted to a robot. The body contains the locking mechanism.

Lock Port

Pneumatic port on the Compensator Body to which air is supplied to Lock the body to the lock plate.

Lock Sensing

Proximity sensor mounted in sensor fitting detects when Compensator is locked.

Pivot Cam

The Pivot Cam is part of the mechanism that provides angular and rotational compliance about the Z axis when the Compensator is in the Unlocked position. Is part of the mechanism that maintains the centered noncompliant position when the Compensator is in the Locked position.

Tool Mount Plate

The part of the Ball Lock Compensator that attaches to the End-effector.

Unlock Port

Pneumatic port on the Compensator Body to which air is supplied to Unlock the body from the lock plate.

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 where they apply.

1.1 Explanation of Warnings

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



⚠ DANGER

Danger for persons!

Non-observance will inevitably cause irreversible injury or death.



⚠ CAUTION

Dangers for persons!

Non-observance can cause minor injuries.



⚠ WARNING

Dangers for persons!

Non-observance can lead to irreversible injury and even death.

NOTICE

Material damage!

Information about avoiding material damage.

1.2 General Safety Guidelines

Prior to purchase and installation, the customer should verify that the AGE-W selected is rated for the maximum loads moments expected during operation. Refer to [Technical Data \[▶ 7\]](#) for specific ratings, or contact SCHUNK for assistance. Particular attention should be paid to dynamic loads caused by robot acceleration and deceleration. These forces can be many times the value of static forces in high acceleration or deceleration situations.

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

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

1.3 Safety Preauctions



⚠ WARNING

Injury or equipment damage can occur with power or air on.

- Do not perform maintenance or repair on the AGE-W with power or air on.
- Turn off power and air before performing maintenance or repair on the AGE-W.



⚠ CAUTION

The AGE-W is only to be used for intended applications and applications approved by the manufacturer.

Using the AGE-W in applications other than intended will result in damage to AGE-W or end-of-arm tooling and could cause injury to personnel.

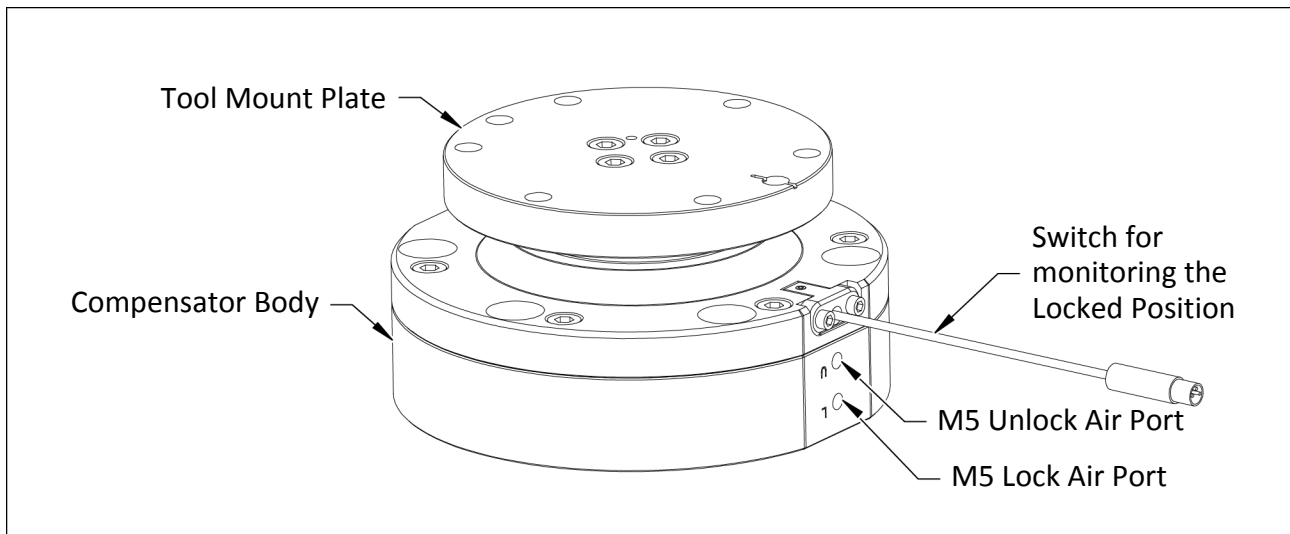
2 Technical Data

Specifications such as payload, moment capacity, repeatability, and weight for each model may be found in the product catalog and on our website. Drawings may also be found in the product catalog and on our website.

3-D models are also available on our website. Contact SCHUNK for specific information and drawings regarding your installation. We encourage you to use our applications department to review your designs and answer your questions.

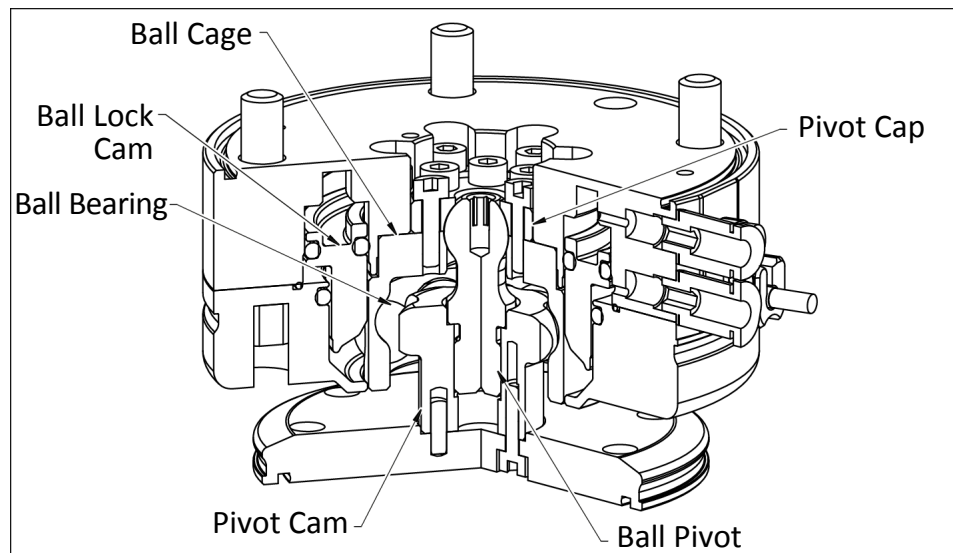
Designation	value	Description
Compliance X and Y (angular)	$\pm 13^\circ$	Unit complies laterally about X-Y axis and rotates about the Z axis simultaneously.
Compliance Z (rotatory)	$\pm 19^\circ$	
Moment Breakaway [Nm]	68	At 5.5 bar
Max. Number of compensatory movements	1 Million	Compliance Cycles
Positional Repeatability [mm]	0.1	Repeatability tested at rated load at one million cycles.
Weight [kg]	2.66	Compensator without Sensors
Operating Pressure Range [bar]	4.5 – 5.5	Locking mechanism supply pressure operating range. Supply clean, dry, and filtered to 50 micron or better.
	4.5 – 5.5	Position Hold supply pressure operating range. Supply clean, dry, and filtered to 50 micron or better.
Air Supply Port Size	M5	For Lock, and Unlock
Pattern robot side	125 mm (6x) M10 (2x) M10	\emptyset of the circle of mounting screws mounting screws Dowel pin
Pattern tool side	100 mm (6x) M8 (2x) M8	\emptyset of the circle of mounting screws mounting screws Dowel pin Custom tooling plates available upon request.
Monitoring	Center Position Lock	Sensor options SG – 3 wire DC PNP, M8 Quick Connect SE – 3 wire DC NPN, M8 Quick Connect
Material / Design	Anodized Aluminum	Housing and Tool plate
	Hardened Stainless Steel	Internal compliance components

3 Product Overview



angular compensator

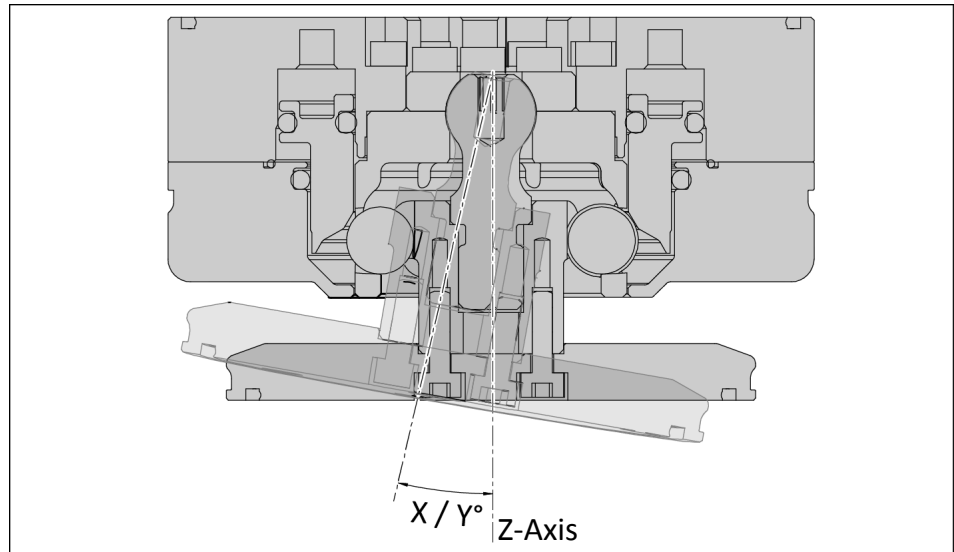
The angular compensator is a compliance device that enhances the flexibility and reliability of a robot or assembly machine. Compensators are used in automated assembly applications to provide compliance for misalignment during assembly. The compensator allows for angular offset for the assembling a pin into a bore in an approximate location without twisting or tilting the work piece. The AGE-W consists of two main components, an Compensator Body assembly and an Tool Mount Plate assembly. The Compensator Body assembly contains a hardened steel ball lock cam, ball bearings, and ball cage that is part of the locking mechanism. The Tool Mount Plate assembly provides angular and rotational compliancy using a ball pivot and pivot cam. When the locking mechanism is actuated the Tool Mount Plate assembly will return to the centered and locked position. Respectively pressure grease is applied to the ball pivot and ball bearings to enhance performance and maximize the life of the assemblies.



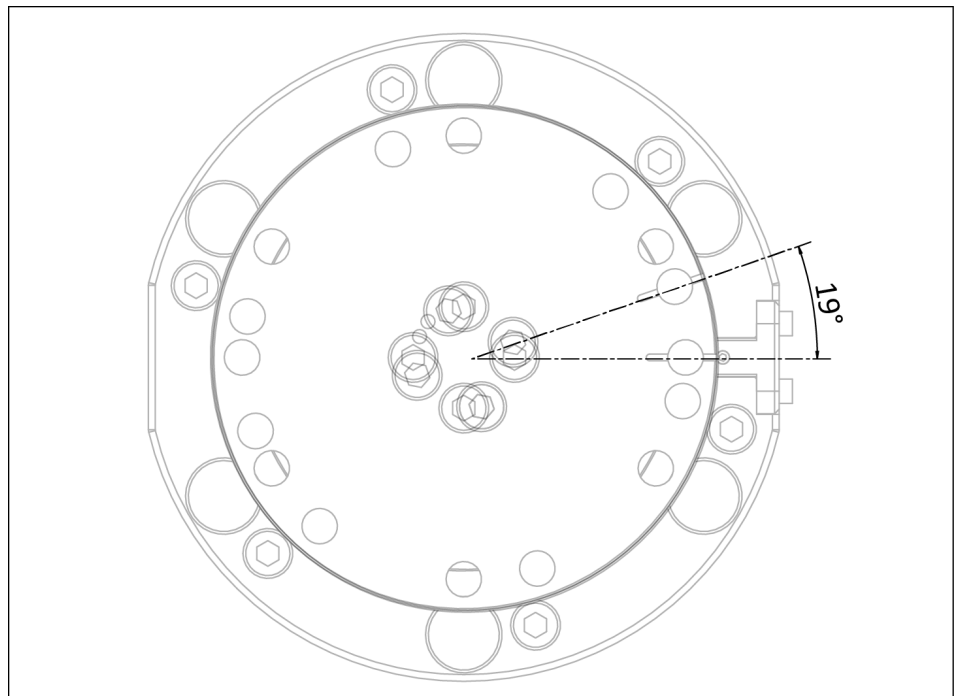
Section View

The body is equipped with a mounting pattern and two locating dowel holes used to mount the compensator to the robot. The body has Lock and Unlock M5 air ports. The compensator can also be equipped with Locked position PNP Sensor. The Tool Plate assembly has a mounting pattern and two locating dowel pin holes for mounting the tool.

3.1 Compliance movement



Compliance X and Y axis



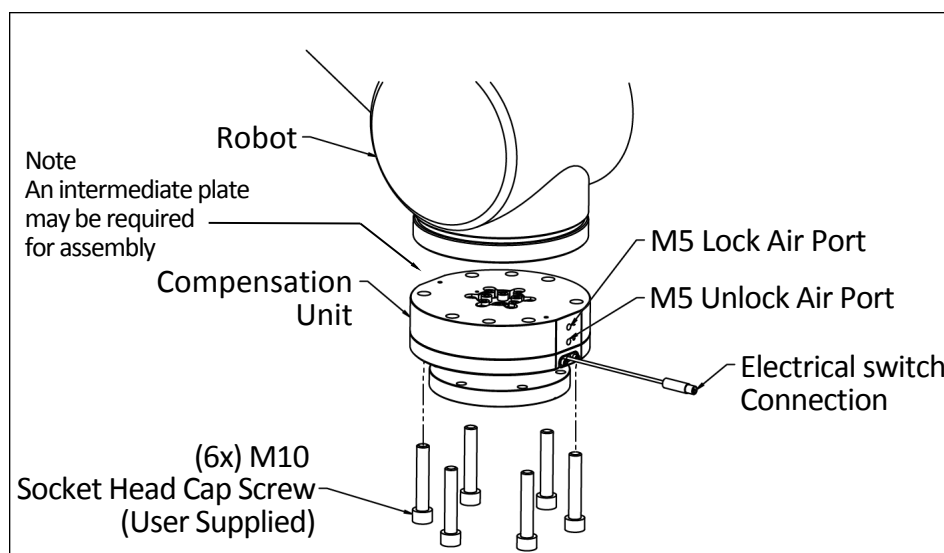
Compliance Z axis

The compensator is designed to provide compliance in the X / Y Planes and rotational compliance about the Z axis. The Tool Plate can rotate providing a 13° angular compliance in the X / Y planes and can rotate 19° about the Z axis (rotatory).

4 Installation

The AGE-W is mounted to the robot wrist (refer to following figure). The AGE-W is attached by using the tapped hole pattern. Pneumatic lines and electrical cables are attached, bundled, and must be strain-relieved in a manner that allows for freedom of movement during operation.

4.1 Installing the Compensation Unit to the Robot



Installing the Compensation Unit to the Robot

- It may be necessary to clean the mounting surfaces of the robot and the compensator.
- Apply Loctite 242® to the six user supplied mounting screws and attach the compensator to the robot.
- Sensor cables and pneumatic hosing can be connected after attaching the compensator to the robot.

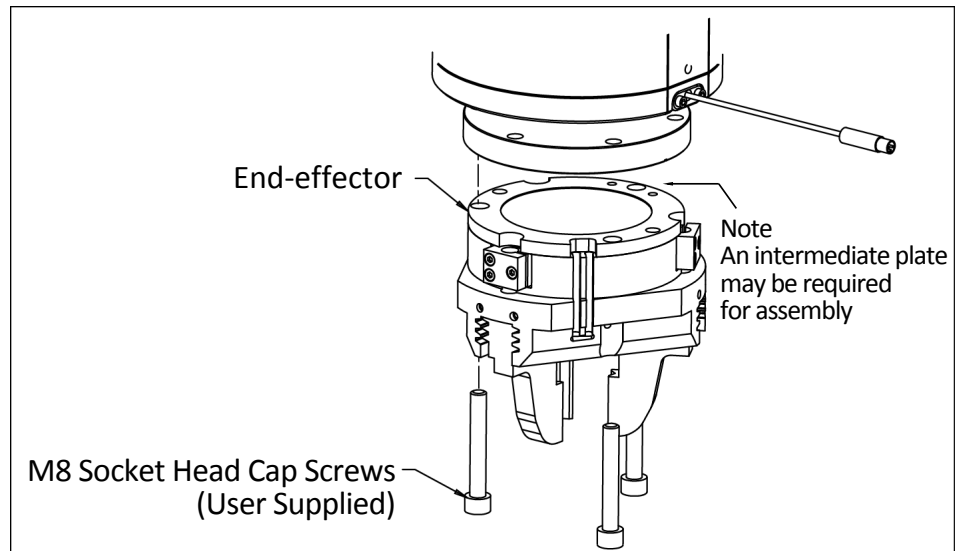


⚠ CAUTION

The routing of electrical and pneumatic lines must minimize the possibility of over stressing, pullout, or kinking the lines.

Failure to do so can cause some critical electrical and/or pneumatic lines not to function properly and may result in injury to personnel or damage to equipment.

- All pneumatic fittings and tubing must be capable of withstanding the repetitive motions of the application without failing.



Installing the End-effector to the compensator

- Once the compensator is attached to the Robot the end-effector can be attached to the compensator. With the user supplied mounting screw attach the end-effector on the Tool Mount Plate.

4.2 Removing the Compensator from the Robot

- Remove the screws securing the end-effector to the compensator, and remove the end-effector.
- Depending on the application, the electrical sensor and pneumatic connections may have to be removed.
- Remove the six fasteners securing the compensator to the robot and remove the compensator.

4.3 Lock/Unlock Pneumatic Connections and Valve



⚠ CAUTION

The locking mechanism will not function properly when connected to a single 3-way valve as this type of valve is incapable of venting trapped air pressure from within the compensator.

This could result in damage to the product, attached tooling, or personnel.

- Connect the Lock and Unlock supply air to a single 2-position 4-way or 5-way valve

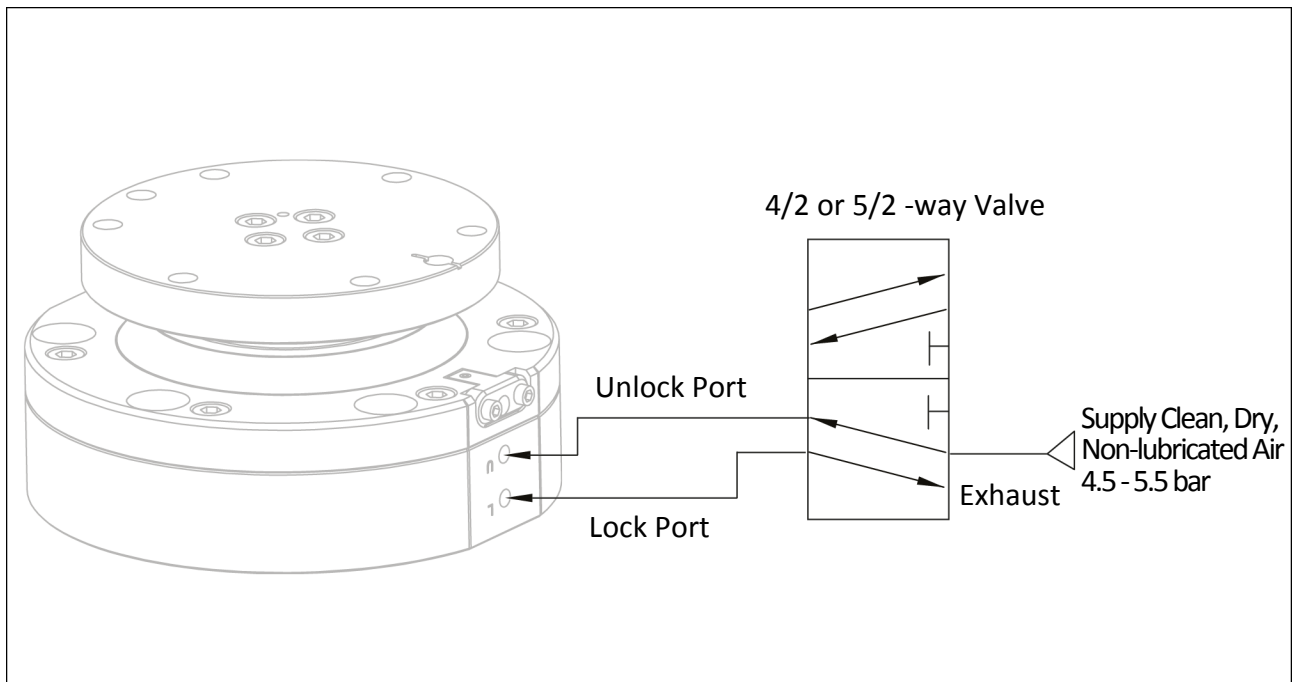
Air must be supplied to the “Lock” air port on the compensator body to move the internal piston, which moves the cam, and forces the locking balls inward. The locking balls move inward until they contact the machined surface of the Pivot Cam. This will rigidly engage the compensator body and lock plate centering and locking the compensator.

To unlock the lock plate from the compensator body, lock air must be vented and air supplied to the “Unlock” air port on the compensator body.

4.3.1 Air Requirements

For proper operation of the compensator, the air ports on the body must be supplied with clean, dry, non-lubricated air supplied between 4.5 – 5.5 bar and filtered at 20 microns or better.

4.3.2 Valve Requirements and Connections



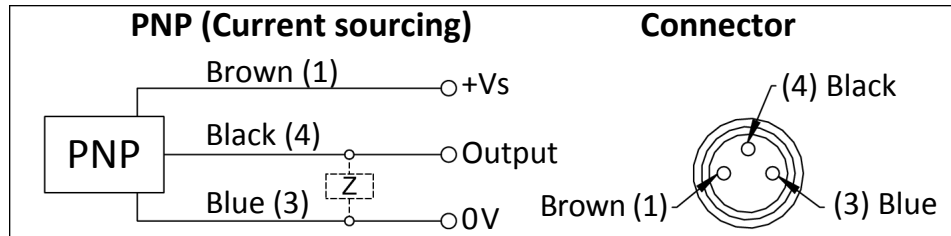
Pneumatic diagram for AGE-W

It is recommended that a single 4/2-way or 5/2-way valve be used to actuate the locking mechanism in the Compensator Body. It is imperative that when air is supplied to the Lock or Unlock Port on the compensator body, that the opposite port be vented to 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 compensator mechanism. The Lock and Unlock Ports are threaded for M5 x 0.8 connections.

4.4 Electrical Connections

The Compensator Body has optional available proximity sensors to query the central locking.

4.4.1 PNP Type Lock Sensors



PNP Type Lock and Unlock Sensors

PNP (Current Sourcing)

Description	Value
Voltage Supply Range	10-30 VDC
Output Current	< 100 mA
Nominal Sensing Distance S_n	0.8 mm
Function	PNP make function (NO)

5 Operation

The compensator locking mechanism is pneumatically driven and requires a continuous supply of clean, dry nonlubricated air 4.5 – 5.5 Bar and filtered to 20 microns or better.



⚠ CAUTION

Safe, reliable operation of the Compensators locking mechanism is dependent on a continuous supply of compressed air at a pressure of 4.5 – 5.5 Bar.

- Robot motion should be halted if the air supply pressure drops below 4.1 Bar for any reason.

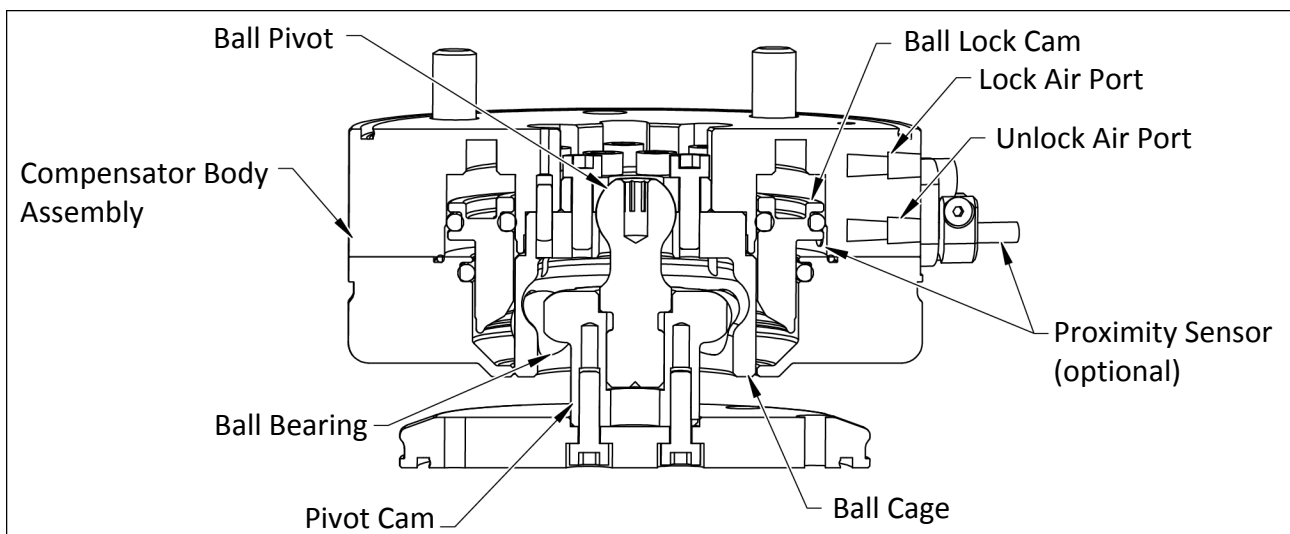
5.1 Lock Position

To lock the compensator in the centered position air must be supplied to the “Lock” air port on the compensator body to move the internal piston, which moves the Ball Lock Cam, and forces the locking balls inward. This will rigidly engage the compensator body and tool mounting plate assemblies centering and locking the compensator. Air from the unlock port must be exhausted to the atmosphere. The compensator is not compliant in the locked position.

5.2 Unlocked Position

To unlock the compensator air must be supplied to the “Unlock” air port on the compensator body to move the internal piston, which moves the ball lock cam, and releases the locking balls. The locking balls move outward. Air from the lock port must be exhausted to the atmosphere. The compensation unit can now be used to compensate inaccuracies.

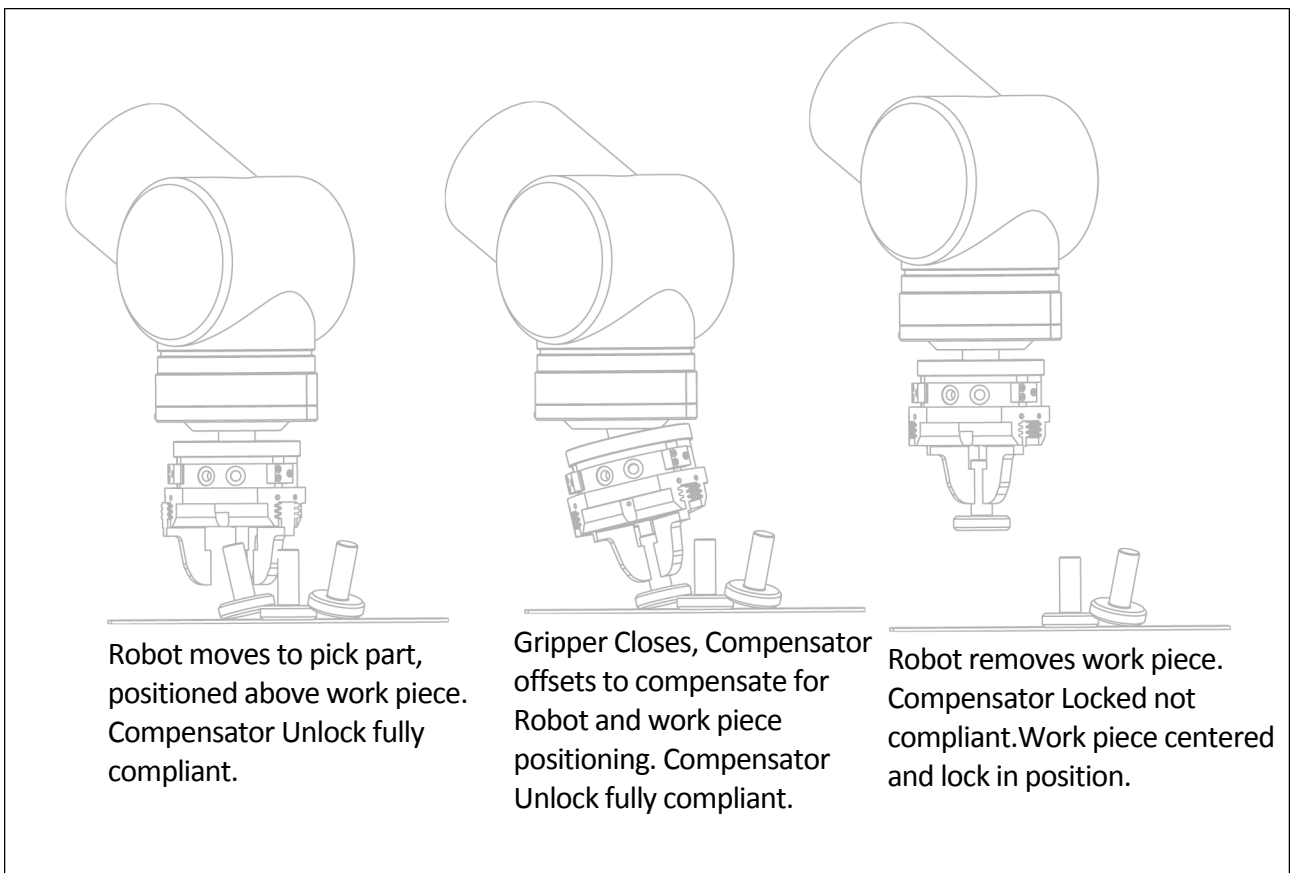
5.3 Locked Position Sensing (Optional)



Lock Position Sensor

The optional proximity sensor provides verification of the compensator's locked position. When the locking piston moves within the compensator body, the locked proximity sensor will detect when the locking piston enters the sensing range, sending a locked signal.

5.4 Operation of Pick Part



Pick Part Operation

The compensator can be used in a part picking operation. The compensator will allow for misalignment of the robot and work piece in the X-Y-Z and rotational directions. The compensator can center the work piece for placement.

6 Troubleshooting

If compensator is not operating properly check the following conditions prior to any further troubleshooting.

Possible Cause	Correction
Pneumatic connections incorrect or air supplied is insufficient.	Ensure that the compensator has proper pneumatic connections and air is supplied at a minimum of 4.5 bar. Lock/Unlock Pneumatic Connections and Valve [▶ 13]
Air or vacuum trapped in a de-energized lock or unlock port or incorrect valve type.	Ensure that no air or vacuum can be trapped in a deenergized Lock or Unlock Port and 4 way type valve is used (pressure must be vented to atmosphere) Lock/Unlock Pneumatic Connections and Valve [▶ 13].
O-ring seals are worn and leaking air.	Replace O-ring seals, O-ring seal replacement, Cleaning, & Lubrication of the Locking Mechanism [▶ 22].

Sensor not functioning, do not report Locked position

Possible Cause	Correction
Sensor cable damaged or loose connection	Inspect sensor cable for damage or loose connection, if loose re-connect, if damaged replace.
Sensor not functioning	Replace Sensor, Sensor Replacement [▶ 25].

7 Maintenance

Under normal conditions, no special maintenance is necessary, however it is recommended that periodic inspections be performed to assure long-lasting performance and to assure that unexpected damage has not occurred. Refer to [Preventive Maintenance](#) [► 21] for a schedule and items that should be visually inspected at regular intervals.

Spare parts are available from SCHUNK. Please call for recommendations.



⚠ WARNING

Injury or equipment damage can occur with AGE-W not supported or energized circuits on.

- Do not perform maintenance or repair on compensator unless the tool is safely supported or removed and all energized circuits (e.g. electrical, air, water, etc.) have been turned off.



⚠ CAUTION

Fasteners used more than three times may come loose and cause equipment damage.

Discard fasteners used more than three times and install new fasteners with preapplied adhesive.

- It is recommended, not to use fasteners with pre-applied adhesive more than three times.

7.1 Preventive Maintenance

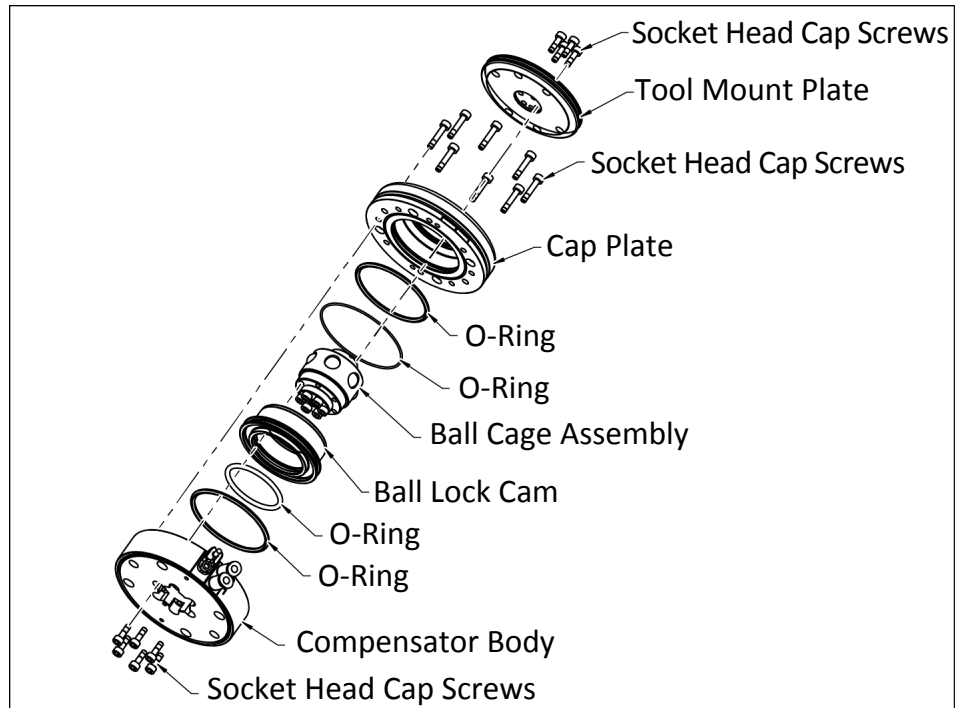
A visual inspection and preventive maintenance schedule is provided in the table below depending upon the application.

Preventive Maintenance Checklist

Application(s)	Cycle Frequency	Inspection Schedule
General Usage, Material Handling	More than 1 per minute	Weekly
	Less than 1 per minute	Monthly
Wet or Humid Environments	All	Weekly
Welding / Deburring, Foundry Operations (Dirty Environments)	All	Weekly
Mounting Fasteners		
<ul style="list-style-type: none"> Inspect mounting fasteners, verify they are tight and have the proper torque Installation [▶ 11]. 		
Interface Connections		
<ul style="list-style-type: none"> Inspect pneumatic connections for cuts in hoses, abrasions, or wear. If signs of wear are apparent, tighten connections and secure lines so that they allow freedom of movement during operation and do not rub or obstruct other components. Inspect electrical cables for cuts, abrasions, or wear. If signs of wear are apparent, check connections and secure cables so that they allow freedom of movement during operation and do not rub or obstruct other components. 		
O-rings seals -replace every 50.000 cycles.		
<ul style="list-style-type: none"> Inspect for wear, abrasion, and cuts. If worn or damaged, replace O-ring seal replacement, Cleaning, & Lubrication of the Locking Mechanism [▶ 22]. 		
Locking Mechanism - cleaned and lubricated every 500,000 cycles.		
<ul style="list-style-type: none"> Inspect and lubricate locking mechanism. Over time lubricants can become contaminated with process debris. Clean the mechanism of existing grease and relubricate. O-ring seal replacement, Cleaning, & Lubrication of the Locking Mechanism [▶ 22]. 		

7.2 O-ring seal replacement, Cleaning, & Lubrication of the Locking Mechanism

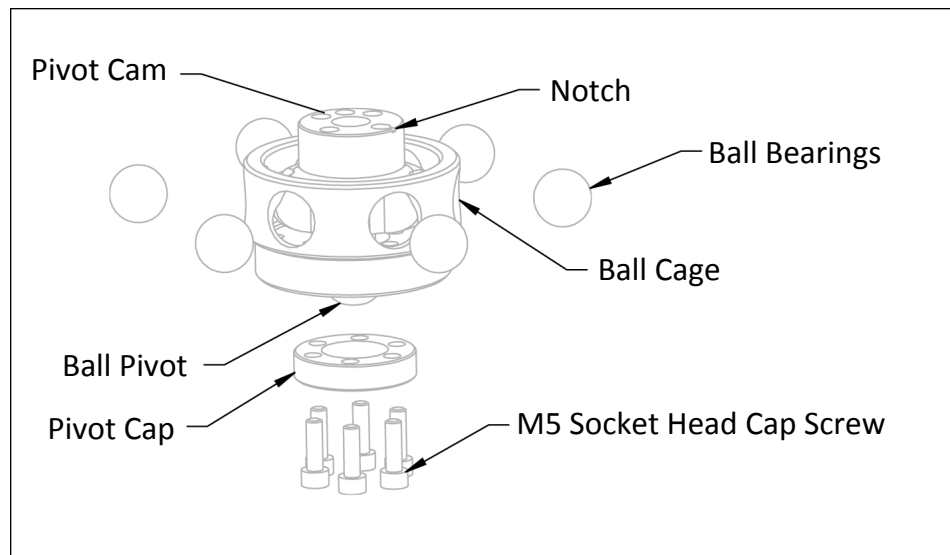
- Turn off and de-energize all energized circuits (e.g. electrical, air, water, etc.).
- Remove the end-effector from the compensator and remove the compensator from the robot. [Removing the Compensator from the Robot](#) [▶ 12].



Disassemble the Compensator for O-ring replacement and Cleaning

- Using an Allen wrench, remove the (4) M6 socket head cap screws that secure the tool mount plate to the ball cage assembly.
- Pull the tool mount plate straight up and off the pivot cam. This may be difficult due to the close fit of the dowel pins. Set aside.
- Using an Allen wrench, remove the (6) M6 socket head cap screws that secure the cap plate to the compensator body.
- Remove the cap plate by carefully pulling it straight up and off the compensator body. This may be difficult due to the close fit of the dowel pins.
- Remove the O-ring seal from the inner bore of the cap plate and discard O-ring seal.
- Remove the O-ring seal from the groove in the face of the cap plate and discard the O-ring seal.
- Set the cap plate aside.
- Using an Allen wrench, remove the (6) M5 socket head cap screws that secure the ball cage assembly to the compensator body.

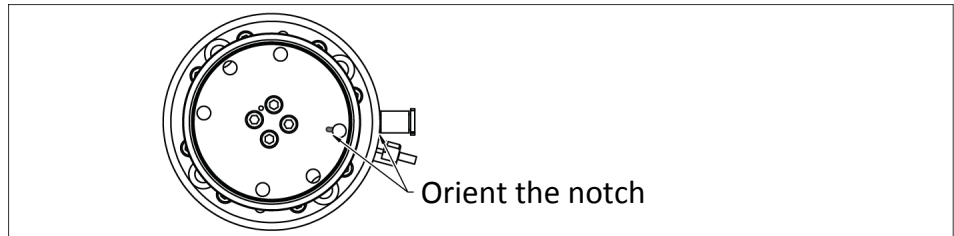
- **NOTICE! When removing the ball cage assembly, do not lose the ball bearings from the cage.**
Remove the ball cage assembly by carefully pulling it straight up and off the compensator body and set aside.
- Remove the ball lock cam by pulling it straight up out of the compensator body.
- Remove the O-ring seals from the outer diameter and inner bore of the ball lock cam and discard the O-ring seals.



Disassemble the Ball Cage Assembly for Cleaning

- Using a clean rag, remove lubrication from the ball lock cam.
- Using a clean rag, remove lubrication from the compensator body.
- Remove the (6) ball bearings from the ball cage assembly.
- Using a clean rag, remove the lubrication from all the ball bearings.
- Using an Allen wrench, remove the (6) M5 socket head cap screws that secure the pivot cap to the ball cage.
- Remove the pivot cap from the ball cage.
- Using a clean rag, remove the lubrication from the pivot cap, ball cage, pivot cam, and ball pivot. Set all parts aside.
- Apply Special grease to the new O-rings for the ball lock cam.
- Insert the O-ring seals in the grooves on the outer diameter and inner bore of the ball lock cam.
- Insert the ball lock cam into the compensator body.
- Apply Special grease to the spherical surface of the ball pivot.
- Using an Allen wrench, install the (6) M5 socket head cap screws that secure the pivot cap to the ball cage (Refer to Table "Screw specifications"). **NOTICE! Make sure the Pivot Cam moves freely; if not disassemble, clean, and reapply lubrication.**

- Apply Special grease to the spherical surface of the (8) ball bearings.
- Insert the ball bearings into the ball cage.
- Align the notch in the pivot cam to the Lock and Unlock ports in the compensator body.
- Using an Allen wrench, secure with the (6) M5 socket head cap screws (Refer to Table "Screw specifications").
- Apply Special grease to the (2) O-ring seals.
- Insert the O-ring seals in the grooves on the inner bore and face contacting the compensator body.
- Using an Allen wrench, secure the cap plate to the compensator body with the (6) M6 socket head cap screws (Refer to Table "Screw specifications").
- Place the tool mounting plate on the pivot cam.

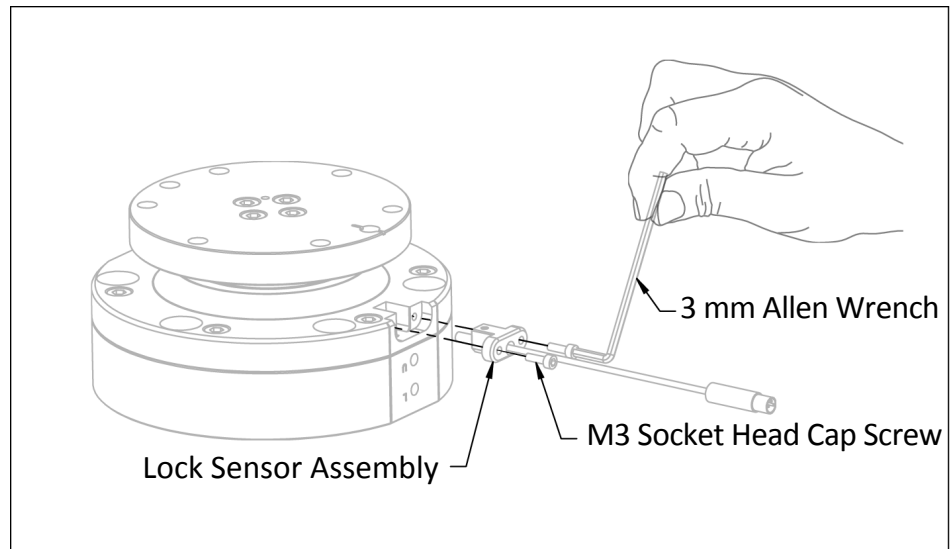


- Align the notch in the tool mounting plate to the sensor and air fittings.
- Secure using the (4) M6 socket head cap screws (Refer to Table "Screw specifications").
- Install Compensator to robot [Installing the Compensation Unit to the Robot](#) [▶ 11].

Screw specifications

Socket Head Cap Screw	Allen Wrench Size	Suggested Torque	Threadlocker
M5 0.8 x 16 mm 12.9	4.0 mm	5.9 Nm	Pre-applied
M6 1.0 x 16 mm 12.9	5.0 mm	10.1 Nm	Adhesive or Loctite 242

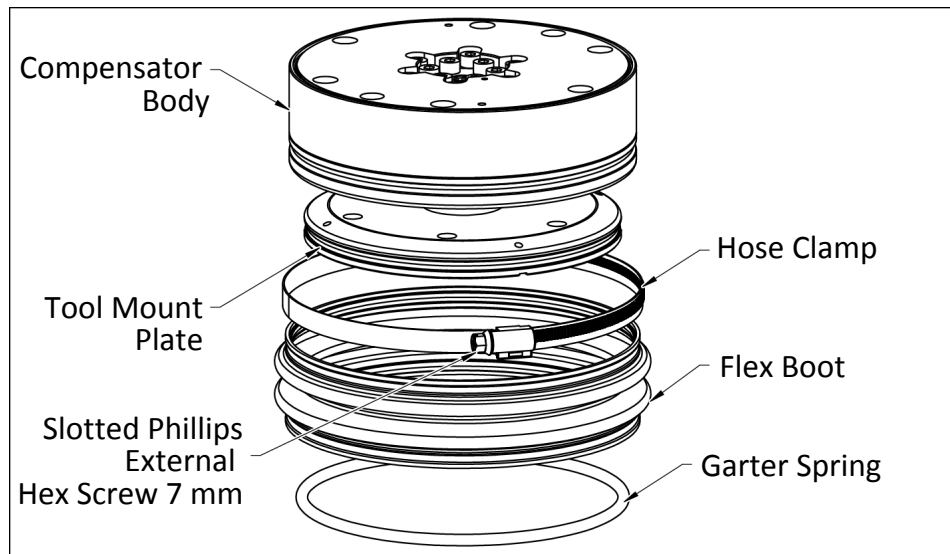
7.3 Sensor Replacement



- Turn off all energized circuits (e.g. electrical, air, water, etc.) before beginning maintenance.
- Disconnect the sensor cable.
- Using a 3 mm Allen wrench, remove the two M3 socket head cap screws.
- Pull the Sensor Assembly straight out and discard.
- Clean out sensor hole with compressed air.
- Insert new sensor and secure with the two M3 socket head cap screws. Tighten to 1.4 Nm.

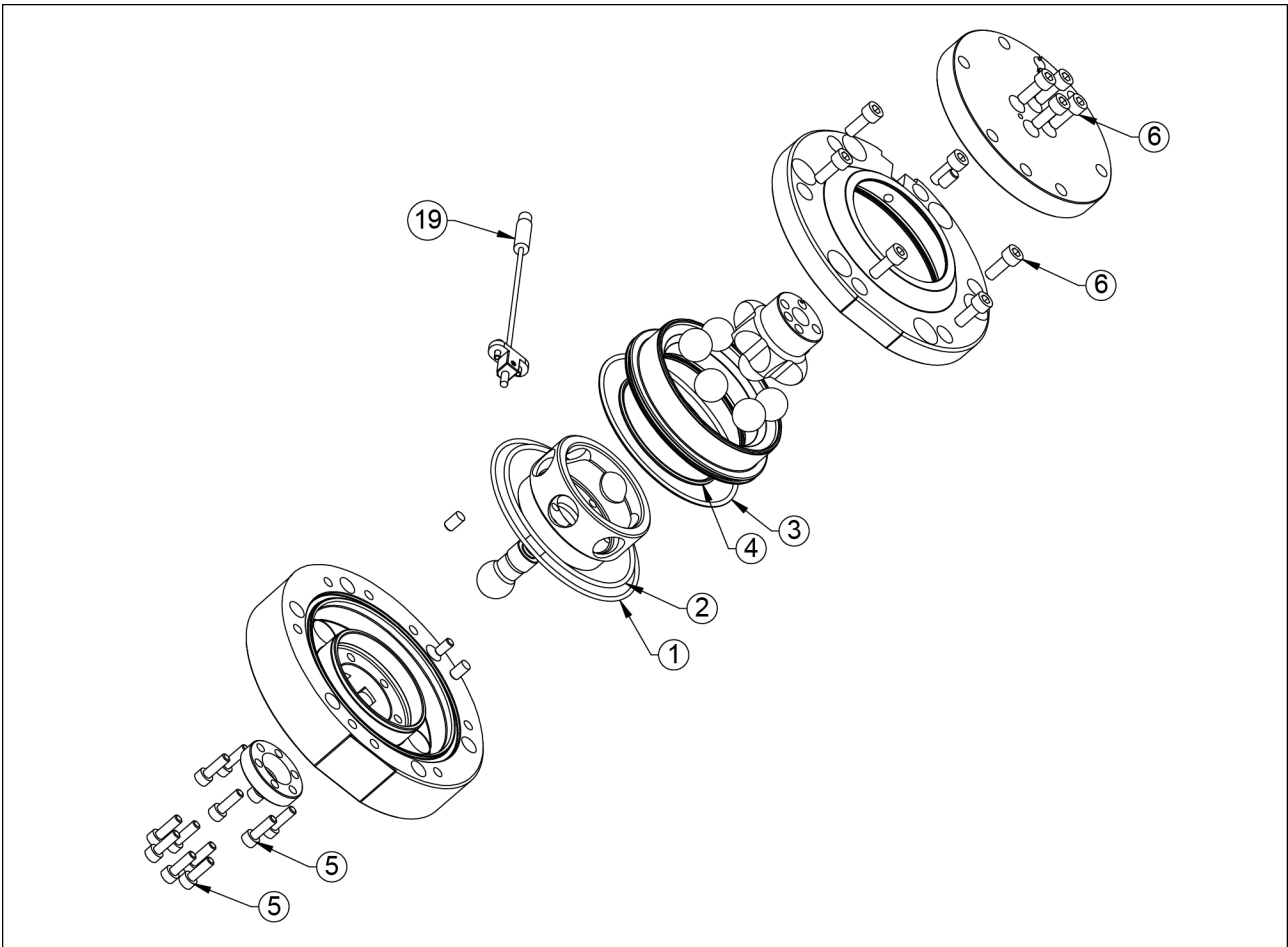
7.4 Optional Flex Boot Replacement

Parts required: Refer to [Recommended Spare Parts](#) [▶ 27]



- Turn off all energized circuits (e.g. electrical, air, water, etc.).
- Remove the garter spring from the tool mount plate.
- Either remove the garter spring, or using a Phillips head screw driver, loosen the hose clamp and remove it from the compensator body.
- Remove the flex boot
- Slide the new flex boot over the tool plate and onto the compensator.
- Slide the garter spring or hose clamp into the groove of the flex boot and Compensator body.
- Using a Phillips head screw driver, tighten the hose clamp to 2 Nm.
- Slide the garter spring in the groove of the flex boot and the tool mount plate.
- After the procedure is complete, resume normal operation.

7.5 Recommended Spare Parts



For more information about ordering spare parts, please contact the SCHUNK Technical Sales department.

8 Translation of original declaration of incorporation

in terms of the Directive 2006/42/EG, Annex II, Part 1.B of the European Parliament and of the Council on machinery.

Manufacturer/
Distributor

SCHUNK GmbH & Co. KG Spann- und Greiftechnik
Bahnhofstr. 106 – 134
D-74348 Lauffen/Neckar

We hereby declare that on the date of the declaration the following incomplete machine complied with all basic safety and health regulations found in the directive 2006/42/EC of the European Parliament and of the Council on machinery. The declaration is rendered invalid if modifications are made to the product.

Product designation: Pivoting Compliance Compensator / AGE-W /

The incomplete machine may not be put into operation until conformity of the machine into which the incomplete machine is to be installed with the provisions of the Machinery Directive (2006/42/EC) is confirmed.

The manufacturer agrees to forward on demand the relevant technical documentation for the partly completed machinery in electronic form to national authorities.

The relevant technical documentation according to Annex VII, Part B, belonging to the partly completed machinery, has been created.

Person authorized to compile the technical documentation:
Robert Leuthner, Address: see manufacturer's address

Signature: see original declaration

Lauffen/Neckar, June 2017

p.p. Ralf Winkler, Manager for development of gripping system components