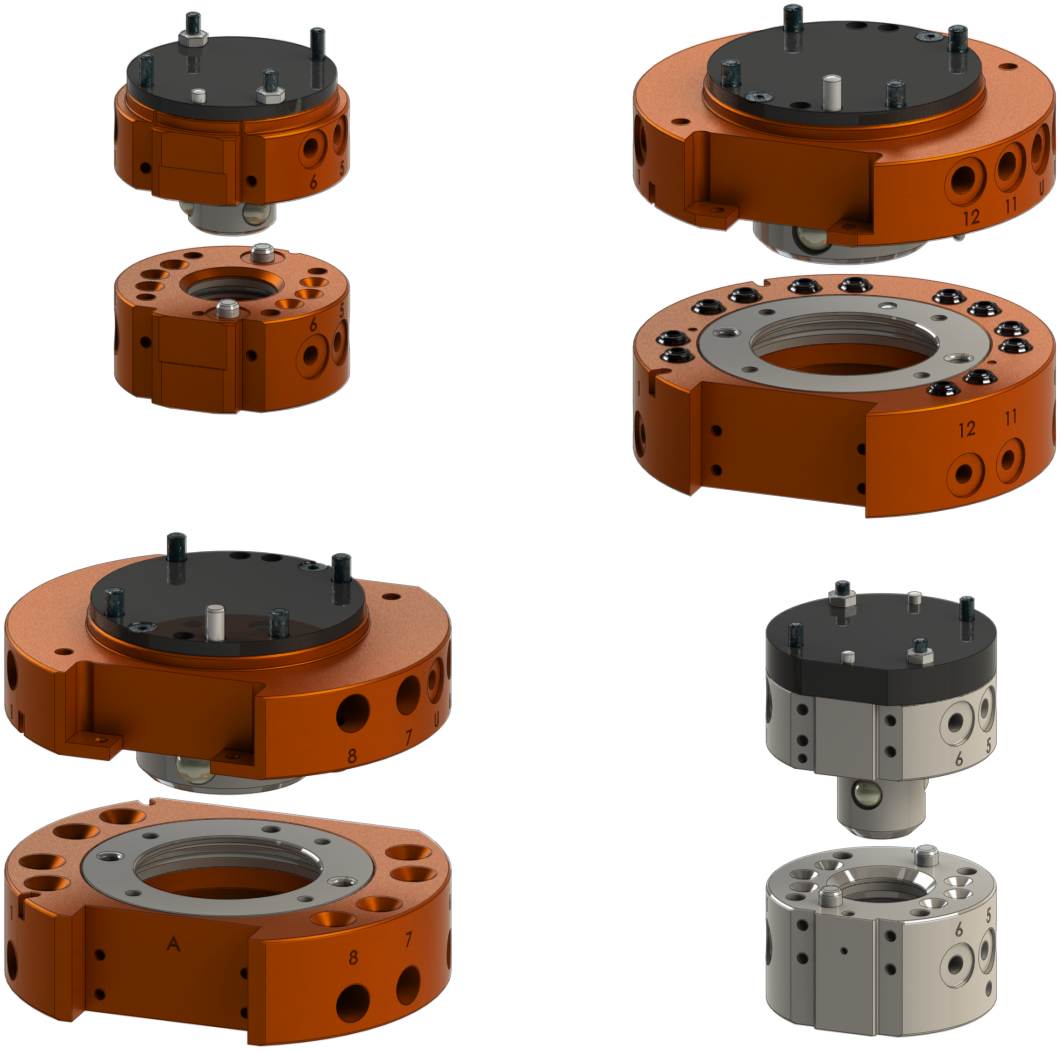
ATI INDUSTRIAL AUTOMATION

A Novanta Company

Robotic Tool Changers
QC-5 through QC-27

Manual



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Engineered Products for Robotic Productivity

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Foreword

This manual contains basic information applicable to all ATI robotic Tool Changers. Certain models have their own manuals that contain more detailed information. Also, additional information about electrical, pneumatic, fluid, high-power, and high-current modules and other options are available in other manuals and documents.

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



CAUTION: This manual describes the function, application, and safety considerations of this product. This manual must be read and understood before any attempt is made to install or operate the product, otherwise damage to the product or unsafe conditions may occur.

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Glossary

Table 1.1—Tool Changer and Module Glossary	
Term	**Definition**
Bearing Race	A steel ring in the Tool plate that is engaged by the locking balls during the coupling of the Tool Changer.
Cam	A multi tapered sliding cylinder attached to the piston that forces the locking balls outward during the locking process.
Coupling	The physical action of the locking the Master and Tool plates together. See Lock.
Cover Plate	A protective closure plate on the standard Master assemblies which closes the pneumatic chamber.
Detection Shaft	A threaded stem inserted into the robot side of the piston and functions as a target to actuate the Lock/Unlock sensors.
Electrical Module	Utility modules that pass electrical power and signals through the Master and Tool modules to the end-effector.
End-Effector	Tool used by the robot to perform a particular operation or function.
Fluid Module	Utility modules that pass fluids through the Master and Tool modules to the end-effector.
High Current Module	Utility modules that pass electrical power through the Master and Tool modules to the end-effector.
Interface Plate (IP)	An optional customized component that is used to adapt a Tool Changer to the user's robot or tooling.
Lock	The lock air pressure that is provided to the Master plate locking mechanism to force the cam to press the locking balls against the bearing race and lock the Master and Tool plates together.
Lock Port	A pneumatic port on the Master plate through which air pressure is supplied to Lock the Master plate to the Tool plate.
Lock Sensor	A proximity sensor that detects the position of the pneumatically actuated piston when it is in the locked or missed tool position.
Locked	An output signal provided by a proximity sensor that indicates the coupling mechanism is in the Locked position.
Locking Balls	Hardened steel ball bearings used in the fail-safe locking mechanism. The locking balls are forced outward by the cam against the bearing race to pull the Master and Tool plates together.
Locking Mechanism	A manual, pneumatic or electrical driven device that draws the Master and Tool plates together and secures them in a fail-safe locked condition until the mechanism is unlocked. The locking mechanism consists of locking balls, cam, ball cage, bearing race, and either an lever, pneumatic cylinder, or an electric motor.
L/U	Lock/*U*nlock sensing capability that allows the customer to determine the state of the Master assembly locking mechanism.
Master plate	The half of the Tool Changer that is mounted to a robot. The Master plate contains the locking mechanism.
Moment	The applied force multiplied by the distance it is from a point.
No-Touch™	A design feature of all ATI Tool Changer products that allows the Master plate and Tool plate to couple without physical contact prior to locking.
Piston	A cylinder located in the Master plate that actuates the locking mechanism.

Table 1.1—Tool Changer and Module Glossary	
Term	**Definition**
Pneumatic Module	Utility modules that pass air or vacuum through the Master and Tool modules to the end-effector.
Sensor Plate	A cover plate for the back side of the Master plate that seals the pneumatic chamber and provides mounting points for the Lock/Unlock switches.
Servo Module	Utility modules that pass electrical power and servo signals through the Master and Tool modules to the end-effector equipped with a servo motor.
Sensor Interface Plate SIP (SIP)	Used to adapt the Tool Changer Master to the customer-supplied robot. An interface plate that contains sensors that determine the state (Locked/Unlocked/ No Tool) of the Master plate.
Tool plate	The half of the Tool Changer to which various tools or end-effectors are mounted.
Tool Stand	A stand that holds the Tools not being used by the robot.
Trip Dog	A physical device used to activate a mechanical switch, which is used in the tool stand Interlock circuit.
Uncoupling	The physical action of the unlocking the Master and Tool plates. See Unlock.
Unlatch	The output supplied to the ATI Master module to uncouple the Tool Changer.
Unlock	The unlock air pressure provided to the Master plate locking mechanism that forces the cam to release the locking balls from the bearing race and allows the Master and Tool plates to be separated.
Unlocked	An output signal provided by a proximity sensor, indicating that the coupling mechanism is in the Unlocked position.
Unlock Port	Pneumatic port on the Master plate through which air pressure is supplied to Unlock the Master plate from the Tool plate.
Unlock Sensor	A proximity sensor that detects the position of the pneumatically actuated piston when it is in the unlocked position.

1. Safety

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

1.1 Explanation of Notifications

These notifications are used in all of ATI manuals and are not specific to this product. The user should heed all notifications from the robot manufacturer and/or the manufacturers of other components used in the installation.



DANGER: Notification of information or instructions that if not followed will result in death or serious injury. The notification provides information about the nature of the hazardous situation, the consequences of not avoiding the hazard, and the method for avoiding the situation.



WARNING: Notification of information or instructions that if not followed could result in death or serious injury. The notification provides information about the nature of the hazardous situation, the consequences of not avoiding the hazard, and the method for avoiding the situation.



CAUTION: Notification of information or instructions that if not followed could result in moderate injury or will cause damage to equipment. The notification provides information about the nature of the hazardous situation, the consequences of not avoiding the hazard, and the method for avoiding the situation.

NOTICE: Notification of specific information or instructions about maintaining, operating, installing, or setting up the product that if not followed could result in damage to equipment. The notification can emphasize, but is not limited to: specific grease types, best operating practices, and maintenance tips.

1.2 General Safety Guidelines

Prior to purchase and installation, the customer should verify that the Tool Changer selected is rated for the maximum loads and moments expected during operation. Particular attention should be paid to dynamic loads caused by robot acceleration and deceleration. These forces can be (exponentially) greater than the value of static forces in high acceleration or deceleration situations. To verify an ATI product is rated for a particular application, refer to the product specifications section and/or drawing section for each component in this manual or contact ATI for assistance.

The customer is responsible for ensuring that the area between the Master and Tool sides is clear of foreign objects during mating and subsequent coupling. Failure to do so may result in serious injury to personnel.



DANGER: The gap between the Master and Tool sides is a pinch point. All personnel should abstain from placing any part of their body or clothing in the gap, especially during actuation of the locking mechanism.

The customer is responsible for understanding the function of the Tool Changer and implementing the proper fasteners and/or software to operate the Tool Changer safely. The Tool Changer should be controlled such that there is no chance of locking or unlocking in a position that would endanger personnel and/or equipment. If Lock/Unlock (L/U) and Ready-to-Lock (RTL) sensing capability are used, monitor the status and apply interlocks to prevent injury and damage to personnel and equipment.

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. Functional failure of electrical, pneumatic, or fluid lines may result in injury and damage to personnel and equipment.

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

1.3 Safety Precautions

WARNING: Remove all temporary protective materials (caps, plugs, tape, etc.) on locking face of Tool Changer and modules prior to operation. Failure to do so will result in damage to Tool Changers, modules, and end-of-arm tooling and could cause injury to personnel.



WARNING: Do not perform maintenance or repair(s) on the Tool Changer or modules unless the Tool is safely supported or placed in the tool stand, all energized circuits (for example: electrical, air, water, etc.) are turned off, pressurized connections are purged and power is discharged from circuits in accordance with the customer safety practices and policies. Injury or equipment damage can occur with the Tool not placed and energized circuits on. Place the Tool in the tool stand, turn off and discharge all energized circuits, purge all pressurized connections, and verify all circuits are de-energized before performing maintenance or repair(s) on the Tool Changer or modules.

WARNING: During operation, the area between the Master and Tool must be kept clear. Failure to keep area clear will result in damage to Tool Changer, modules, or end-of-arm tooling and could cause injury to personnel.

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

CAUTION: The Master plate locking mechanism must not be actuated without being mounted to the interface plate. Damage to the Cover Plate and O-ring may result. Always attach the Master plate to the Interface plate prior to attempting any operations.

2. Product Overview

ATI Tool Changers enhance the versatility of a robot by enabling the use of multiple customer tools, such as: grippers, vacuum cup tooling, pneumatic and electric motors, weld guns, and more.

The Tool Changer consists of a Master plate, which is attached to the robot arm, and a Tool plate, which is attached to customer tooling. When the robot picks up the customer tooling, a pneumatically-driven locking mechanism couples the two plates. The patented, fail-safe locking mechanism utilizes a multi-tapered cam with ball locking technology to ensure the Tool Changer does not uncouple if air pressure falls below 60 psi (4.1 bar) during operation.

The robot can be programmed to select the desired customer tooling by coupling the Master plate to the Tool plate. Electricity, fluid, and other forces of energy transfer to the customer tooling through optional modules that are attached to the Master and Tool plates. Refer to the ATI website for compatible modules or contact an ATI sales representative for more details.

QC models are available with different anodizing, pneumatic port sizes, and quantities. Refer to *Table 2.1* for specific part numbers. Other custom models are available with features for specific applications such as food grade, wash down, etc. For more information on custom models, contact an ATI sales representative.

Table 2.1—QC Tool Changer Models and Features

Model	Payload	Flats	Plate	Pneumatic Ports	Part No.
QC-5	18 lbs	(1) Flat	Master	(6) M5 X 0.8 Pass through ports (2) M5 X 0.8 Lock/Unlock air ports	9120-005M-000-000[1]
			Tool	(6) M5 X 0.8 Pass through ports	9120-005T-000-000[1]
QC-11	35 lbs	(1) Flat	Master	(6) M5 X 0.8 Pass through ports (2) M5 X 0.8 Lock/Unlock air ports	9120-011M-000-000-SQx-yyyy[2,5,6] 9120-011M-000-000-SQx-yyyy-B[3,5,6]
			Tool	(6) M5 X 0.8 Pass through ports	9120-011T-000-000[2] 9120-011T-000-000-B[3]
QC-20	55 lbs	(1) Flat for K series modules	Master	(12) M5 X 0.8 Pass through ports (2) M5 X 0.8 Lock/Unlock air ports	9120-020M-000-PM5-SQx-yyyy[2,5,6] 9120-020M-000-PM5-SQx-yyyy-B[3,5,6] 9120-020M-000-PM5-C[4]
			Tool	(12) M5 X 0.8 Pass through ports	9120-020T-000-PM5[2] 9120-020T-000-PM5-B[3] 9120-020T-000-PM5-C[4]
			Master	(16) M5 X 0.8 Pass through ports (2) M5 X 0.8 Lock/Unlock air ports	9120-020M-000-P16-SQx-yyyy[2,5,6] 9120-020M-000-P16-SQx-yyyy-B[3,5,6]
			Tool	(16) M5 X 0.8 Pass through ports	9120-020T-000-P16[2] 9120-020T-000-P16-B[3]

Notes:

1. QC-5 Tool Changers have stainless steel bodies.
2. All standard QC Tool Changers have orange anodized bodies.
3. QC Tool Changer Master and Tool plate Assemblies with (-B or -E) Part Numbers have black anodized bodies.
4. QC Tool Changer Master and Tool plate Assemblies with (-C) Part Numbers have clear anodized bodies.
5. QC Tool Changer Master Assemblies can be ordered with a (SIP) sensor interface plate. The -SQx in the Part Number indicates the sensor type, SQ for PNP type sensors or SQN for NPN type sensors. If no SIP is ordered the -SQx will not exist in the part number (i.e. 9120-011M-000-000-B).
6. The -yyyy specifies the Interface plate model, contact ATI sales representative for custom interface plates available.

Table 2.1—QC Tool Changer Models and Features					
Model	**Payload**	**Flats**	**Plate**	**Pneumatic Ports**	**Part No.**
QC-21	55 lbs	(2) Flats: (1) Flat for K series modules (1) Flat for J16 mounting pattern (with adapter plate)	Master	(8) 1/8 NPT Pass through ports (2) M5 X 0.8 Lock/Unlock air ports	9120-021M-000-000-SQx-yyyy[2,5,6]
			Tool	(8) 1/8 NPT Pass through ports	9120-021T-000-000[2]
			Master	(8) G 1/8 (BSPP) Pass through ports (2) M5 X 0.8 Lock/Unlock air ports	9120-021M-000-000-SQx-yyyy-E[3,5,6]
			Tool	(8) G 1/8 (BSPP) Pass through ports	9120-021T-000-000-E[3]
QC-27	83 lbs	(1) Flat for K series modules	Master	(8) 1/8 NPT Pass through ports (2) M5 X 0.8 Lock/Unlock air ports	9120-027M-000-000-SQx-yyyy[2,5,6]
			Master	(8) G 1/8 (BSPP) Pass through ports (2) M5 X 0.8 Lock/Unlock air ports	9120-027M-000-000-SQx-yyyy-E[3,5,6]
			Tool	(8) G 1/8 (BSPP) Pass through Ports	9120-027T-000-000-E[3]

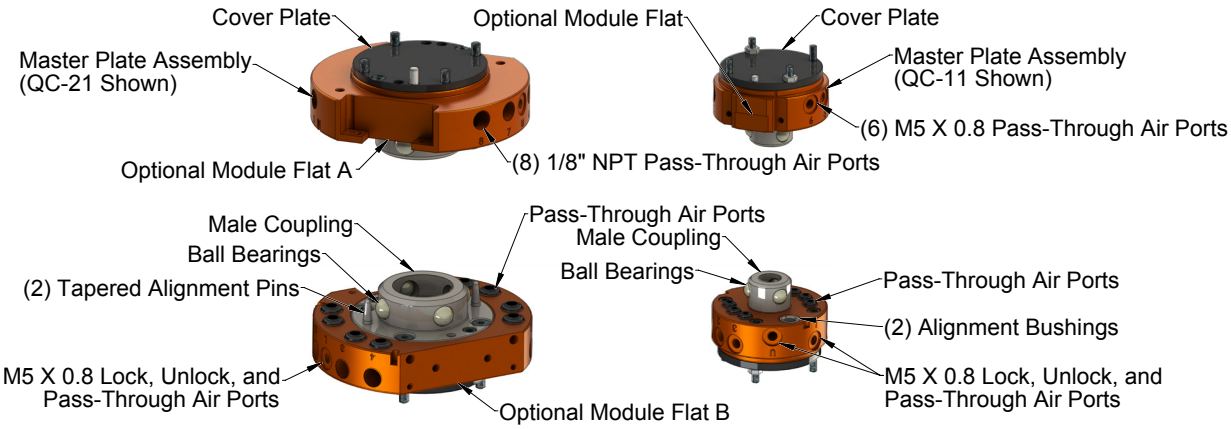
Notes:

1. QC-5 Tool Changers have stainless steel bodies.
2. All standard QC Tool Changers have orange anodized bodies.
3. QC Tool Changer Master and Tool plate Assemblies with (-B or -E) Part Numbers have black anodized bodies.
4. QC Tool Changer Master and Tool plate Assemblies with (-C) Part Numbers have clear anodized bodies.
5. QC Tool Changer Master Assemblies can be ordered with a (SIP) sensor interface plate. The -SQx in the Part Number indicates the sensor type, SQ for PNP type sensors or SQN for NPN type sensors. If no SIP is ordered the -SQx will not exist in the part number (i.e. 9120-011M-000-000-B).
6. The -yyyy specifies the Interface plate model, contact ATI sales representative for custom interface plates available.

2.1 Master Plate Assembly

The Master plate assembly includes an anodized aluminum body, a hardened stainless-steel locking mechanism, and hardened steel alignment pins. The locking mechanism consists of a cam, a male coupling, and chrome-steel ball bearings. The Master plate provides (1) or (2) flat sides for mounting optional modules. Optional modules can be arranged to suit the application.

Figure 2.1—Master Plate Assemblies



The air ports provide Lock and Unlock air for the locking mechanism and pass-through air for the end of arm tooling. An adapter plate assembly provides a standoff for the air ports and a mounting pattern to attach to the robot arm.

Alignment pins mate with bushings to ensure repeatable alignment during the coupling process. An extreme pressure grease is applied to the cam, male coupling, ball bearings, and pins to enhance performance and maximize the life of the Master plate assembly. In some models, the Master plate has tapered alignment pins, and in the other models, such as the QC-11, the Master plate has hardened stainless steel alignment bushings.

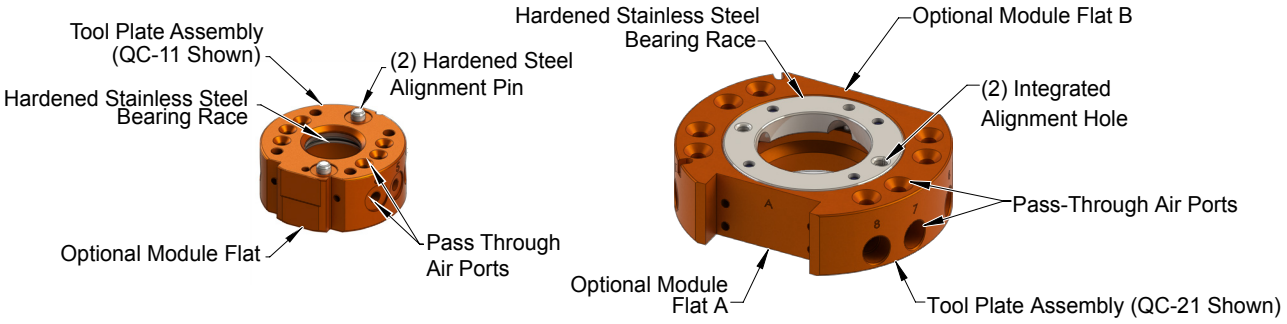
A cover plate that attaches to the Master protects the internal locking mechanism during shipment. This cover plate can be removed during installation if replaced by an interface plate. Refer to *Section 3—Installation* for details.

2.2 Tool Plate Assembly

The Tool plate assembly includes an anodized aluminum body and a hardened stainless-steel bearing race. The Tool plate provides (1) or (2) flat sides for mounting of optional modules. Optional modules can be arranged to suit the application. In some models, the bearing race or Tool plate body has integrated alignment holes or bushings, and in other models, such as the QC-11, the Tool plate has hardened steel alignment pins.

The Tool plate is equipped with pass through air ports to supply air to the end of arm tooling.

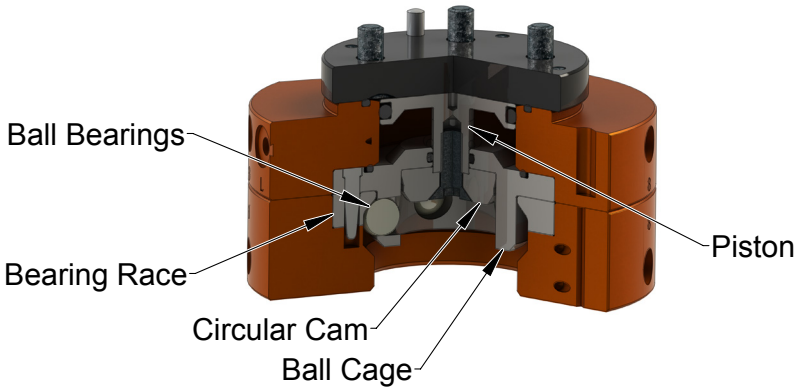
Figure 2.2—Tool Plate Assemblies



2.3 Master Plate/Tool Plate Locking Mechanism

The coupling of the Master plate and the Tool plate is achieved through a patented, high-strength, and stainless steel mechanism. During locking, steel balls in the Master plate are driven outward by a circular cam attached to a pneumatically actuated piston. The cam profile has (3) features: A lead-in angle (conical), a flat (cylindrical) area, and a secondary angle (conical). The lead-in angle initiates the coupling process, the flat area assures the coupling will not be compromised in case of air loss (fail-safe feature), and the secondary angle provides rigid coupling during normal operation. The balls engage a bearing race (or "locking ring") in the Tool plate and lock the Master plate and Tool plate tightly together.

Figure 2.3—Locking Mechanism



2.4 Optional Sensor Interface Plate (SIP)

The sensor interface plate (SIP) system provides locking mechanism position signals to the customer process controller. These signals indicate (2) possible conditions for the Tool Changer Master plate: unlocked or locked.

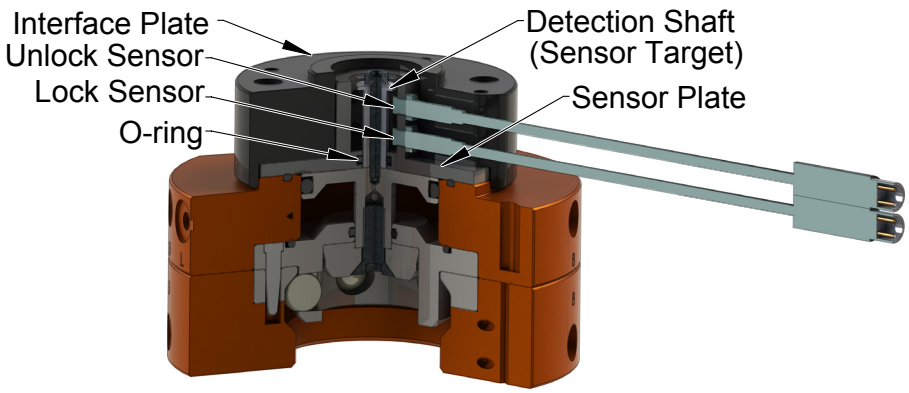
The SIP system utilizes sensors to detect the position of the pneumatically-actuated piston in the Master plate. These sensors are available in PNP, NPN, and other options upon request, contact ATI for more information.

The SIP system consists of a SIP plate, a detection shaft, a sensor plate, proximity switches, and an O-ring.

The sensor plate (which is the interface plate between the Master plate and the robot) will replace the cover plate on the back of the Tool Changer Master. The sensor plate provides mounting locations for the proximity sensors and closes the pneumatic chamber of the Master. The SIP provides mounting holes for attaching the Master to the customer application and retains the sensor plate.

The QC-27 is equipped with a SIP system and is required to provide the Lock air port. Optional interface plates are available to adapt to specific robots, contact an ATI sales representative.

Figure 2.4—The SIP System



2.5 Optional Modules

Tool Changers have (1) or (2) flats depending on the model. Optional modules support the pass-through of various utilities, such as signal, fluid/air, and power, etc. Refer to *Table 2.2* for more information. Some modules require an adapter plate.

For assistance in choosing the right modules for a particular application, visit the ATI website or contact an ATI Sales Representative.

Table 2.2—Tool Changer Models and Features

Model	For the most current list, information, and specifications for compatible Optional Modules click the link below
QC-5	*QC-5 Web Page* and select the Compatible modules tab
QC-11	*QC-11 Web Page* and select the Compatible modules tab
QC-20	*QC-20 Web Page* and select the Compatible modules tab
QC-21	*QC-21 Web Page* and select the Compatible modules tab
QC-27	*QC-27 Web Page* and select the Compatible modules tab
Note: The ATI website provides information on the standard compatible modules additional custom modules are available, contact an ATI Sales Representative.	

3. Installation

The Master plate of the Tool Changer mounts to the robot arm using an interface plate. Custom interface plates are available from ATI upon request. Refer to *Section 3.1—Robot Interface Plates* or *Section 2.4—Optional Sensor Interface Plate (SIP)* for more information.

The end-effector is typically attached to the Tool plate with an interface plate,standard and custom tool interface plates are available from ATI upon request. Refer to *Section 3.4—Tool Interface Plate* for more information.

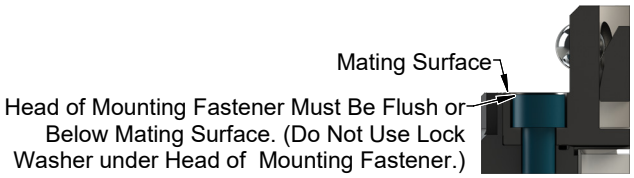
All fasteners used to mount the Tool Changer to the robot and to customer's tooling should have pre-applied adhesive or be applied with removable (blue) Loctite and tightened to a torque value as indicated in *Table 3.1*, which contains recommended torque values based on engineering standards. Because custom Tool Changers may use different mounting fasteners, the specifications for torque and thread locker may vary; contact an ATI sales representative for more information.

Pneumatic lines and electrical cables are attached, bundled, and must be strain-relieved in a manner that allows for freedom of movement during operation.

WARNING: Do not perform maintenance or repair(s) on the Tool Changer or modules unless the Tool is safely supported or placed in the tool stand, all energized circuits (for example: electrical, air, water, etc.) are turned off, pressurized connections are purged and power is discharged from circuits in accordance with the customer specific safety practices and policies. Injury or equipment damage can occur with the Tool not placed and energized circuits on. Place the Tool in the tool stand, turn off and discharge all energized circuits, purge all pressurized connections, and verify all circuits are de-energized before performing maintenance or repair(s) on the Tool Changer or modules.

WARNING: All pneumatic fittings and tubing must be capable of withstanding the repetitive motions of the application without failing. The routing of electrical and pneumatic lines must minimize the possibility of over stressing, pullout, or kinking the lines. Failure to do so can cause some critical electrical and/or pneumatic lines not to function properly and may result in injury to personnel or damage to equipment.

WARNING: Do not use lock washers under the head of the mounting fasteners or allow the mounting fasteners to protrude above the mating surfaces of the Master and Tool plates. Allowing fasteners to protrude above the mating surface will create a gap between the Master and Tool plates and not allow the locking mechanism to fully engage, this can cause damage to equipment or personal injury. The mounting fasteners must be flush or below the mating surfaces of the Master and Tool plates.



CAUTION: Do not apply Lock or Unlock air pressure to the Tool Changer prior to installing an interface plate. Applying air pressure before the installation of an interface plate can damage the cover plate, O-ring, or may cause injury to personnel from flying debris. Always install an appropriate interface plate and mount the Tool Changer securely to the robot before applying air pressure. Refer to *Section 3.1—Robot Interface Plates* and *Section 3.2—Master Plate Installation* for more information.

CAUTION: Thread locker applied to fasteners must not be used more than once. Fasteners might become loose and cause equipment damage. Always apply new thread locker when reusing fasteners.

CAUTION: Do not use fasteners that exceed the thread depth in the Tool Changer's robot or tool side. Refer to *Section 9—Drawings* for details on the mounting hole thread depth. Secure the Tool Changer with the proper length fasteners.

CAUTION: Failure to follow the interface plate design considerations in *Section 3.1—Robot Interface Plates* and *Section 3.4—Tool Interface Plate* may result in damage to the cover plate or O-ring or loose mounting between the interface plate and Tool Changer. Guidelines for the interface plate design(s) should be followed.

Table 3.1—Fastener Size, Class, and Torque Specifications

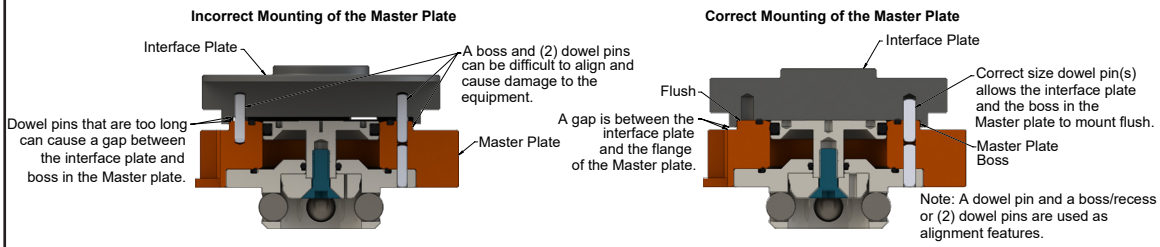
Mounting Conditions	Fastener Size, Property Class, and type	Recommended Torque	Thread Locker
QC-5 and QC-11 Master plate to Robot Interface Plate or Sensor Interface plate, Supplied Fasteners (M3 socket head cap screws)	M3-0.5 Class 12.9	10 in-lbs (1.13 Nm)	Pre-applied Adhesive or Loctite® 222
QC-20, QC-21, and QC-27 Master plate to Robot Interface Plate or Sensor Interface plate, Supplied Fasteners	M4-0.7 Class 12.9		
	Socket flat head cap	20 in-lbs (2.26 Nm)	
	Socket head cap	25 in-lbs (2.82 Nm)	
Tool Interface Plate to QC-5 and QC-11 Tool plate Minimum thread engagement of 7.5 mm [1.5X fastener Ø]. Do not exceed maximum available thread depth of 8 mm as shown in *Section 9—Drawings*.	M5-0.8 Class 12.9		
	Socket head cap	45 in-lbs (5.08 Nm)	
	Socket flat head cap	35 in-lbs (3.96 Nm)	
Tool Interface Plate to QC-20 and QC-21 Tool plate Minimum thread engagement of 9 mm [1.5X fastener Ø]. Do not exceed maximum available thread depth of 10 mm as shown in *Section 9—Drawings*.	M6-1.0 Class 12.9		Pre-applied Adhesive or Loctite® 242
	Socket head cap	90 in-lbs (10.2 Nm)	
	Socket flat head cap	60 in-lbs (6.78 Nm)	
QC-27 Tool Plate to Tool Interface Plate (6061-T6 aluminum) Minimum thread engagement of 6 mm (0.24") [1.5X fastener Ø].	M4-0.7 Class 12.9	25 in-lbs (2.82 Nm)	Pre-applied Adhesive or Loctite® 222
QC-27 Tool Plate to Tool Interface Plate (steel; US ≥ 90 KSI) Minimum thread engagement of 4 mm (0.16") [1.0X fastener Ø].	M4-0.7 Class 12.9	25 in-lbs (2.82 Nm)	

3.1 Robot Interface Plates

The Master plate is typically attached to the robot arm. An interface plate can adapt the Master plate to a specific robot arm. Alignment features (dowel holes and bosses) accurately position and bolt holes secure the Master plate to the robot arm or an interface plate. Custom interface plates are available from ATI upon request (Refer to the Drawing Section for technical information on mounting features.)

CAUTION: Do not use more than two alignment features when securing a Master plate to a robot interface plate. Using more than two alignment features can cause damage to equipment. Use either two dowel pins or a single dowel pin along with a boss/recess feature to align the Master plate with the robot interface plate.

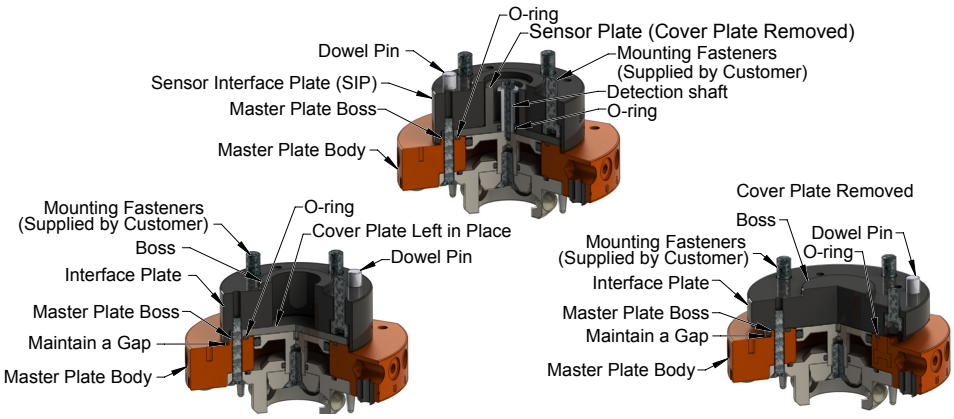
CAUTION: Do not use dowel pins that are too long that will not allow the interface plate and the Master body's boss to mate flush with each other. Using dowel pins that are too long will cause a gap between the interface plate and the Master body's boss causing damage to the equipment. Use the proper size dowel pins that will not extend further than allowed by the Master body.



If the customer chooses to design and build an interface plate, consider the following points:

- The interface plate should include bolt holes for mounting and either (2) dowel pins or (1) dowel pin and a boss for accurate positioning on the robot and Master plate. The dowel and boss features prevent unwanted rotation. Refer to the robot manual for robot mounting features.
- The thickness of the interface plate must be sufficient to provide the necessary thread engagement for the mounting bolts.
- Dowel pins must not extend out from the surface of the interface farther than the depth of the dowel holes in the boss of the Master plate.
- A recess of proper depth and diameter must be machined into the interface plate to correspond with the boss on the Master plate.
- Mounting bolts that are too long can create a gap between the interface plate and the Master plate, which can damage the equipment.
- The interface plate must provide rigid mounting to the Master plate.
- The interface plate design must account clearances required for Tool Changer module attachments and accessories.

Figure 3.1—Configurations for a Master with an Interface Plate



3.2 Master Plate Installation

The Tool Changer Master plate mounts to the robot flange using an interface plate. A cover plate that attaches to the Master plate protects the internal locking mechanism during shipment. Depending on the Master and interface plate configuration, remove the cover plate or install an interface plate to the cover plate.

Refer to *Figure 3.2*

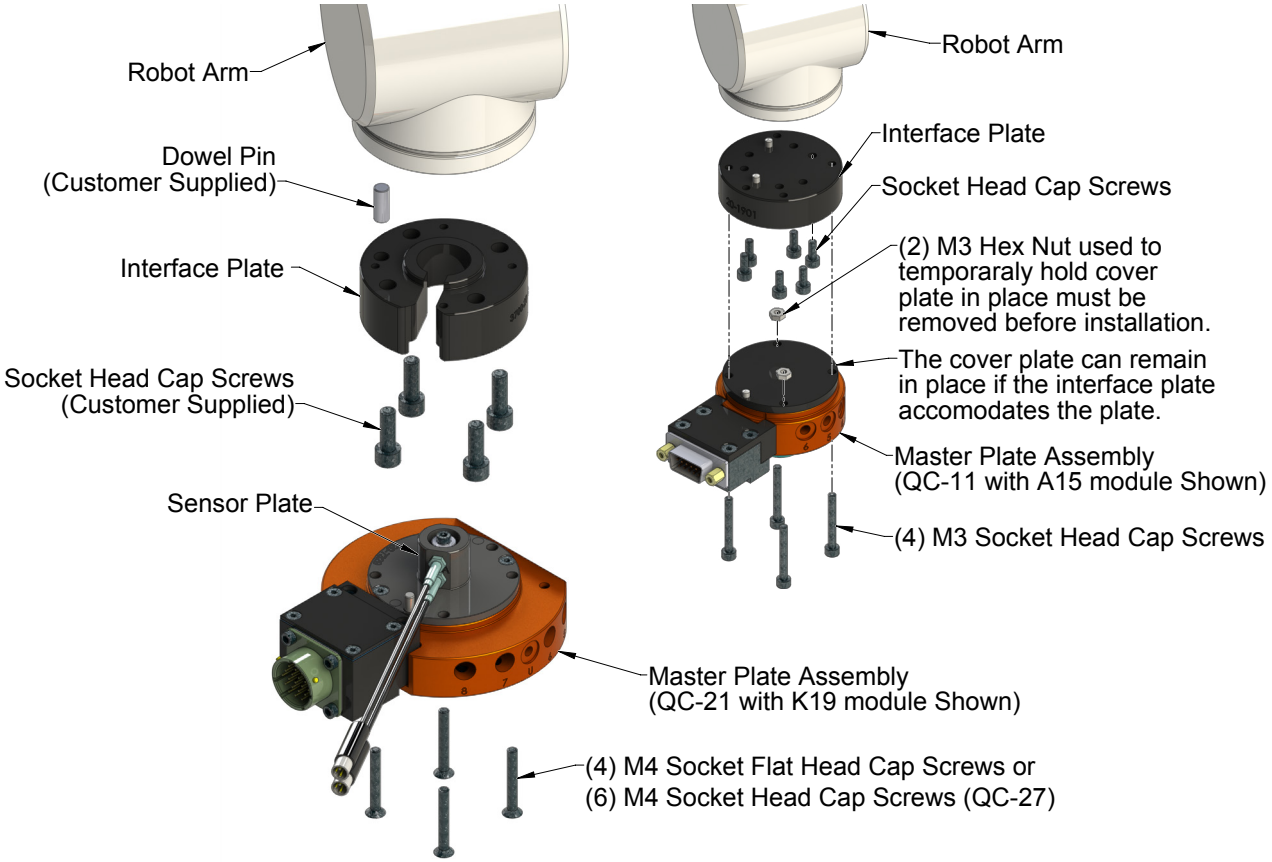
Tools required: *2 mm, 2.5 mm, and/or 3 mm hex key wrench(es), torque wrench*

Supplies required: *Clean rag, Loctite® 222*

1. Clean the mounting surfaces.
2. Position the interface plate to the robot arm and secure with the supplied or customer supplied fasteners, refer to *Figure 3.2*. Refer to *Table 3.1* for proper fasteners and torque.
3. Determine the Master and interface plate configuration:
   - The interface plate replaces the cover plate. Go to step *4*.
   - The interface plate incorporates the cover plate. Go to step *5*.
4. Remove the cover plate.
   - For the QC-5 or QC-11, remove the (2) M3 hex nuts securing the cover plate to the Master plate.
   - For a QC-20 and QC-21, remove the (2) M3 socket flat head screws using a 2 mm hex key that secure the cover plate to the Master plate.

> **CAUTION:** Make sure the O-ring is properly seated in the Master plate's groove, or the seal could leak because of a cut or damage from improper installation. Properly seat O-ring into groove in Master plate.

Figure 3.2—Typical Master Plate Installation



5. If equipped, connect the Lock and Unlock sensor cables.
6. Position and install the Master plate to the interface plate. Refer to *Figure 3.2*. Refer to *Table 3.1* for proper fasteners and torque.
   - For the QC-5 or QC-11 secure the Master plate to the interface plate with the (4) M3 socket head screws using a 2.5 mm hex key.
   - For the QC-20 and QC-21 secure the Master plate to the interface plate with the (4) M4 socket flat head screws using a 2.5 mm hex key.
   - For the QC-27 secure the Master plate to the interface plate with the (6) M4 socket head screws using a 3 mm hex key.
7. Connect all Lock / Unlock and pass-through air connections to the ports on the Master plate. For Lock and Unlock air, refer to *Section 3.9—Lock and Unlock Pneumatic and Valve Requirements.*
8. Connect other utilities to the optional modules on the Master plate.
9. Safely resume normal operation.

3.3 Master Plate Removal

Refer to *Figure 3.2* for Master module removal instructions.

Tools required: *2.5 mm or 3 mm hex key*

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits (e.g. electrical, air, water, etc.).
4. Disconnect all utilities (e.g. electrical, air, water, etc.).
5. Disconnect the Lock and Unlock sensor cables.
6. Remove the Master plate from the interface plate.

- For a QC-5 or QC-11, remove the (4) M3 socket head cap screws securing the Master plate to the interface plate.
- For a QC-20 or QC-21, remove the (4) M4 socket flat head cap screws securing the Master plate to the interface plate.
- For a QC-27 remove the (6) M4 socket head cap screws securing the Master plate to the interface plate.

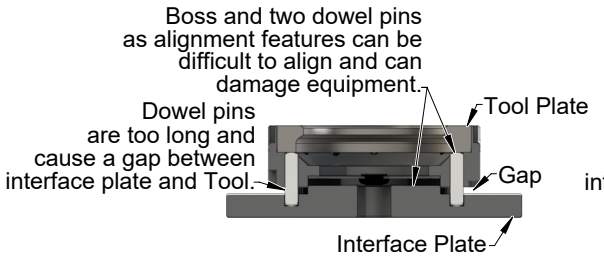
3.4 Tool Interface Plate

The Tool plate is attached to the customer's tooling. An interface plate can adapt the Tool plate to customer tooling. Alignment features (dowel holes and a recess) accurately position and bolt holes to secure the Tool plate to customer tooling. Custom interface plates can be supplied by ATI (refer to the application drawing).

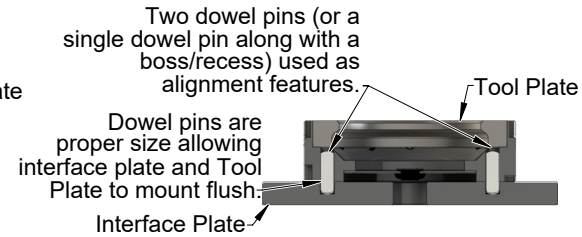
CAUTION: Do not use more than two alignment features when securing a Tool plate to an interface plate. Using more than two alignment features can cause damage to equipment. Use either two dowel pins or a single dowel pin, along with a boss/recess feature to align the Tool plate with the interface plate.

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

Incorrect Mounting of Tool Plate



Correct Mounting of Tool Plate



If the customer chooses to design and build a tool interface plate, consider the following points:

- The interface plate should include bolt holes for mounting and either two dowel pins or a dowel pin and a boss for accurate positioning on the customer tooling and Tool plate. The dowel and boss features prevent unwanted rotation.
- Dowel pins must not extend out from the surface of the interface plate farther than the depth of the dowel holes in the Tool plate.
- The thickness of the interface plate must be sufficient to provide the necessary thread engagement for the mounting bolts. Fasteners should meet minimum recommended engagement lengths while not exceeding the maximum available thread depth. Use of bolts that are too long can cause damage to the tool side changer.
- The plate design must account for clearances required for Tool Changer module attachments and accessories.
- If a boss is to be used on the interface plate, a boss of proper height and diameter must be machined into the interface plate to correspond with the recess in the Tool plate.
- The interface plate must have a hole in its center for manually returning the locking mechanism to the unlocked position under adverse conditions (i.e. unintended loss of power and/or air pressure). The center access hole with a minimum diameter of 1" (25.4 mm) prevents debris from contaminating the locking mechanism. Greater protection is provided by leaving the race cover and grommet in place.

3.5 Tool Plate Installation

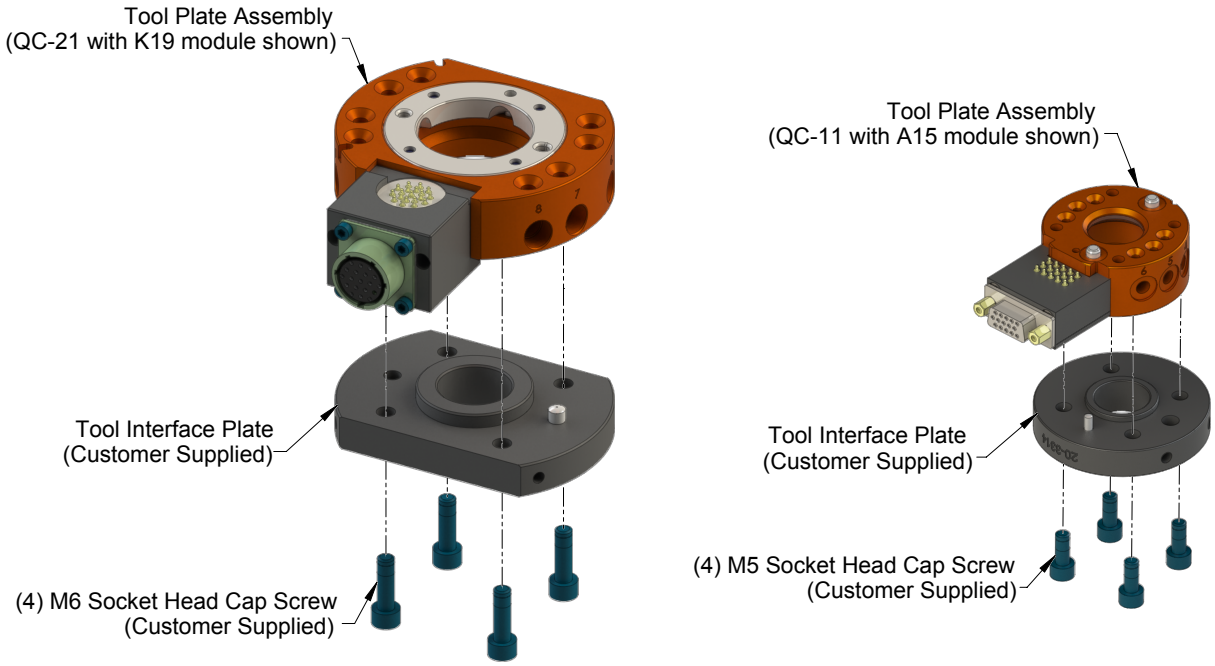
In most applications, the customer end-effector attaches to the Tool plate with a custom interface plate. Refer to *Section 3.4—Tool Interface Plate* for design considerations.

Tools required: *5 mm, 4 mm, or 3 mm hex key, torque wrench*

Supplies required: *Clean rag, Loctite 222 or 242*

1. Clean the mounting surfaces.
2. Position the interface plate or customer tooling to the Tool plate and secure with the customer supplied mounting fasteners. Apply Loctite to threads or use fasteners with pre-applied adhesive, refer to *Table 3.1* for proper thread engagement, torque, and thread locker. (Note: Mounting fasteners are supplied with ATI custom tool interface plates).
3. Connect utilities to the modules and Tool plate connections.
4. Safely resume normal operation.

Figure 3.3—Tool Plate Installation



3.6 Tool Plate Removal

Tools required: *5 mm, 4 mm, or 3 mm hex key*

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits (e.g. electrical, air, water, etc.).
4. Remove the fasteners securing the Tool plate to the interface plate.
5. Remove the Tool plate.

3.7 Optional Module Installation

Tool Changers are compatible with many different types of modules. Some modules require an adapter plate to be installed to the Tool Changer. The optional modules are typically installed on Tool Changers by ATI prior to shipment. The following steps outline field installation or removal.

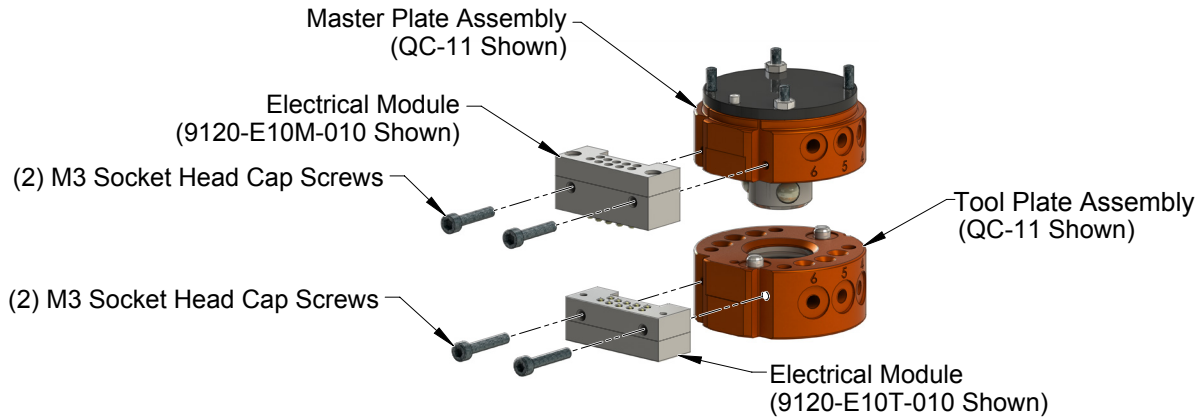
3.7.1 QC-5 and QC-11 Simple Electrical Module Installation

Tools required: *2.5 mm hex key, torque wrench*

Supplies required: *Clean rag, Loctite 222*

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits (e.g. electrical, air, water, etc.).
4. Make all soldered connections to the simple electrical module as desired.
5. Clean the mounting surfaces.
6. Align the module to the flat of the Master or Tool plate assembly.
7. Apply Loctite 222 to M3 socket head cap screws.
8. Secure the module with (2) M3 socket head cap screws using a 2.5 mm hex key. Tighten to 24 in-oz (0.17 Nm).
9. Remove all protective caps, plugs, tape, etc from the module prior to operation.
10. Connect the utility cable(s).
11. Safely resume normal operation.

Figure 3.4—QC-11 Simple Electrical Module Installation



3.7.2 QC-5 and QC-11 Simple Electrical Module Removal

Tools required: *2.5 mm hex key*

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits (e.g. electrical, air, water, etc.)
4. Disconnect the utility cable(s).
5. Remove the (2) M3 socket head cap screws using a 2.5 mm hex key.
6. Remove the module from the Master or Tool plate.

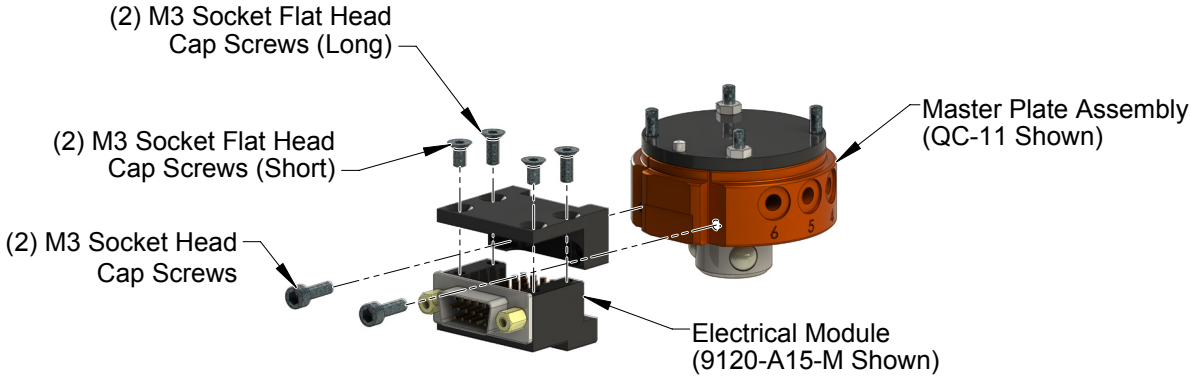
3.7.3 QC-5 and QC-11 Master Electrical Module Installation

Tools required: *2.5 mm and 2 mm hex key, torque wrench*

Supplies required: *Clean rag, Loctite 222*

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits (e.g. electrical, air, water, etc.).
4. Clean the mounting surfaces.
5. Remove the (4) M3 socket head cap screws that secure the cover to the module using a 2 mm hex key.
6. Align the cover to the Master plate.
7. Apply Loctite 222 to the M3 socket head cap screws.
8. Secure the cover with (2) M3 socket head cap screws using a 2.5 mm hex key. Tighten to 48 in-oz (0.34 Nm).
9. Apply Loctite 222 to the (4) M3 socket flat head cap screws.
10. Attach the module to the cover using the (2) long and (2) short M3 socket flat head cap screws using a 2.5 mm hex key. Tighten to 48 in-oz (0.34 Nm).
11. Remove all protective caps, plugs, tape, etc from the module prior to operation.
12. Connect the utility cable(s).
13. Safely resume normal operation.

Figure 3.5—QC-11 Master Electrical Module Installation



3.7.4 QC-5 and QC-11 Master Electrical Module Removal

Tools required: *2.5 mm and 2 mm hex key*

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits (e.g. electrical, air, water, etc.).
4. Disconnect the utility cable(s).
5. Remove the (4) M3 socket flat head cap screws holding the module to the cover using a 2.5 mm hex key.
6. Remove the module from the cover.
7. Support the cover, while removing the (2) M3 socket head cap screws using a 2.5 mm hex key.
8. Remove the cover from the Master plate.

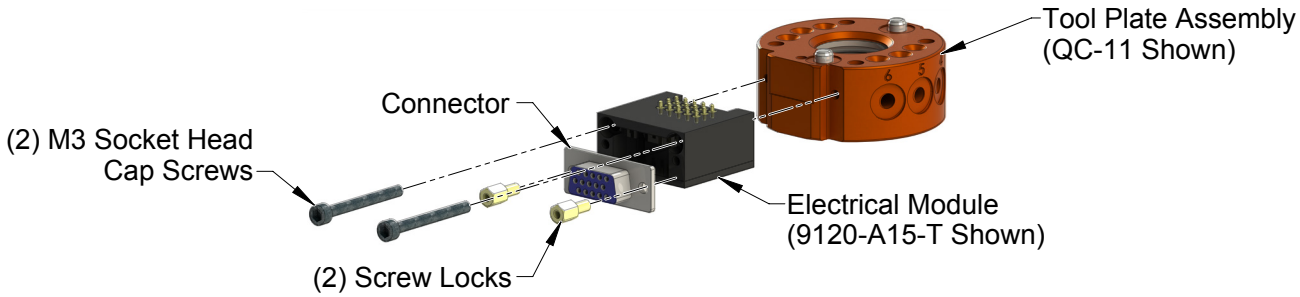
3.7.5 QC-5 and QC-11 Tool Electrical Module Installation

Tools required: *2.5 mm hex key, 3/16" wrench, torque wrench*

Supplies required: *Clean rag, Loctite 222 (if fasteners do not have pre-applied adhesive)*

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits (e.g. electrical, air, water, etc.).
4. Clean the mounting surfaces.
5. Remove the (2) screw locks that secure the connector to the module.
6. Carefully remove the connector to expose the mounting screws.
7. Align the module to the Tool plate.
8. Apply Loctite 222 to M3 socket head cap screws.
9. Secure the module with (2) M3 socket head cap screws using a 2.5 mm hex key. Tighten to 24 in-oz (0.17 Nm).
10. Apply Loctite 222 to the (2) screw locks.
11. Attach the connector to the module using the (2) screw locks using a 3/16" wrench. Tighten to 24 in-oz (0.17 Nm).
12. Remove all protective caps, plugs, tape, etc from the module prior to operation.
13. Connect the utility cable(s).
14. Safely resume normal operation.

Figure 3.6—QC-11 Tool Electrical Module Installation



3.7.6 QC-5 and QC-11 Tool Electrical Module Removal

Tools required: *2.5 mm hex key, 3/16" wrench*

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energized all energized circuits (e.g. electrical, air, water, etc.).
4. Disconnect the utility cable(s).
5. Remove the (2) screw locks that secure the connector to the module using a 3/16" wrench.
6. Carefully remove the connector to expose the mounting screws.
7. Remove the (2) M3 socket head cap screws that attach the module to the Tool plate using a 2.5 mm hex key.
8. Remove the module from the Tool plate.

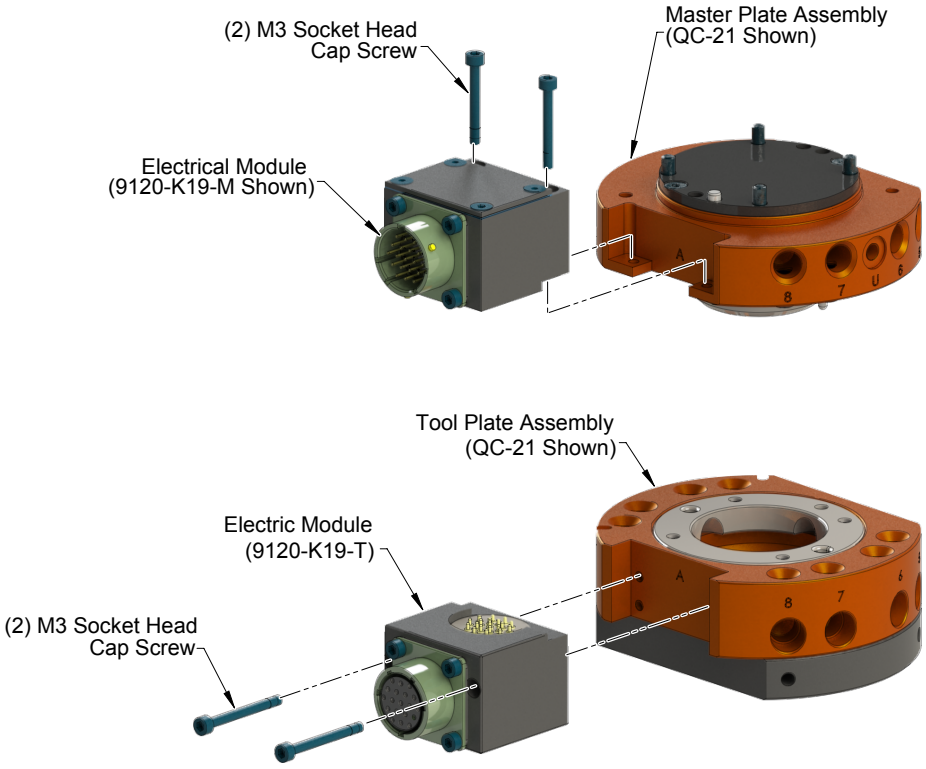
3.7.7 QC-20, QC-21, and QC-27 Flat A Optional K Series Module Installation

Tools required: *2.5 mm hex key, torque wrench*

Supplies required: *Clean rag, Loctite 222*

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits (e.g. electrical, air, water, etc.).
4. Ensure that the mounting surface is clean.
5. Align the optional module on flat A of Master or Tool plate assembly.
6. Apply Loctite 222 to the M3 socket head cap screws.
7. Secure the module with (2) M3 socket head cap screws using a 2.5 mm hex key. Tighten to 10 in-lbs (1.13 Nm).
8. Remove all protective caps, plugs, tape, etc from the module prior to operation.
9. Connect the utility cable(s).
10. Safely resume normal operation.

Figure 3.7—QC-20 and QC-21 Flat A Optional K Series Module Installation



3.7.8 QC-20, QC-21, and QC-27 Flat A Optional K Series Module Removal

Tools required: *2.5 mm hex key*

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits (e.g. electrical, air, water, etc.).
4. Disconnect the utility cable(s).

5. Remove the (2) M3 socket head cap screws securing the module to the Tool Changer using a 2.5 mm hex key. Note: For the module on the Master, the Master plate may have to be removed refer to *Section 3.3—Master Plate Removal*.
6. Remove the module from the Master or Tool plate.

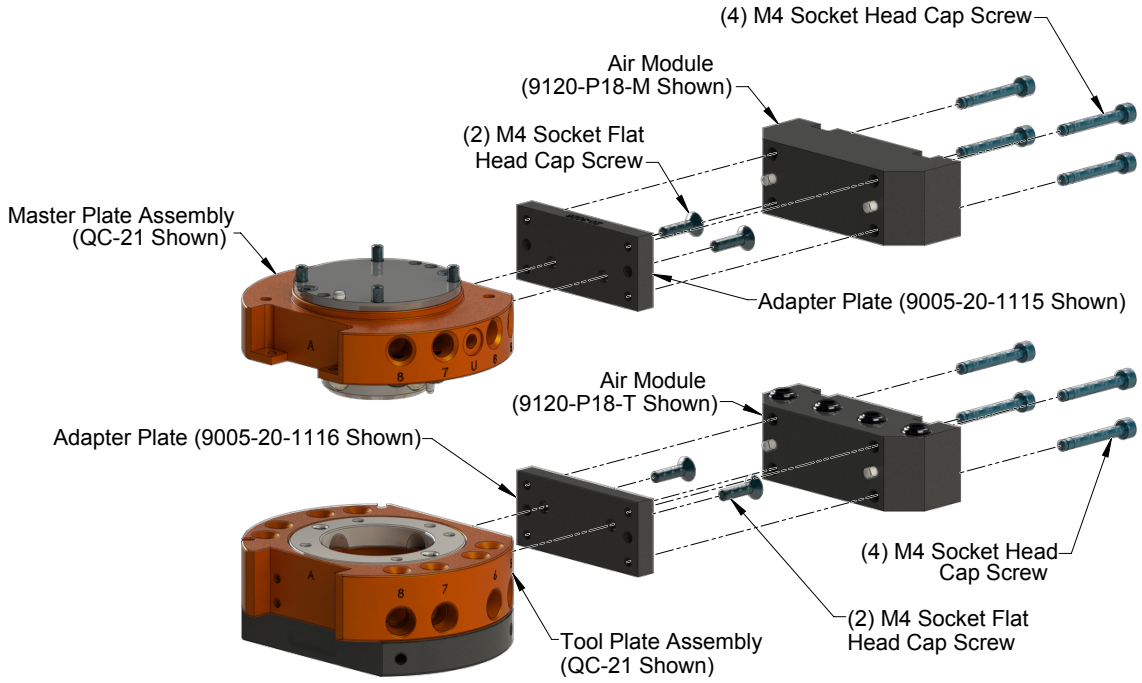
3.7.9 QC-21 Flat B Optional Module Installation

Tools required: *2.5 mm and 3 mm hex key, torque wrench*

Supplies required: *Clean rag, Loctite 222*

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits (e.g. electrical, air, water, etc.).
4. Clean the mounting surfaces.
5. Align the adapter plate to flat B of the QC-21 Master or Tool plate.
6. Apply Loctite 222 to the (2) M4 socket flat head cap screws.
7. Secure adapter plate to the Tool Changer with (2) M4 socket flat head cap screws using a 2.5 mm hex key. Tighten to 10 in-lbs (1.13 Nm).
8. Align the optional module on the adapter plate.
9. Apply Loctite 222 to the (4) M4 socket head cap screws.
10. Secure the module to the adapter plate with (4) M4 socket head cap screws using a 3 mm hex key. Tighten to 15 in-lbs (1.7 Nm).
11. Remove all protective caps, plugs, tape, etc from the module prior to operation.
12. Connect the utility cable(s).
13. Safely resume normal operation.

Figure 3.8—QC-21 Flat B Optional Module Installation



3.7.10 QC-21 Flat B Optional Module Removal

Tools required: *2.5 mm and 3 mm hex key*

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits (e.g. electrical, air, water, etc.).
4. Disconnect the utility cable(s).
5. Remove the (4) M4 socket head cap screws using a 3 mm hex key.
6. Remove the module from the adapter plate.
7. Remove the (2) M4 socket flat head cap screws securing the adapter plate to the Master or Tool plate using a 2.5 mm hex key.
8. Remove the adapter plate.

3.8 Installing an Optional SIP

The optional SIP is typically installed on Tool Changers by ATI prior to shipment. The following steps outline field installation. The SIP typically includes a custom interface plate that may replace the existing interface plate. For interface plate installation, refer to *Section 3.2—Master Plate Installation.*

The SIP assembly comes partially assembled, the Lock and Unlock sensors are assembled to the proper position in the sensor plate. Do not remove the sensors or adjust the position. The small detection shaft's O-ring is lubricated and installed in the sensor plate.

3.8.1 QC-11 SIP Assembly Installation

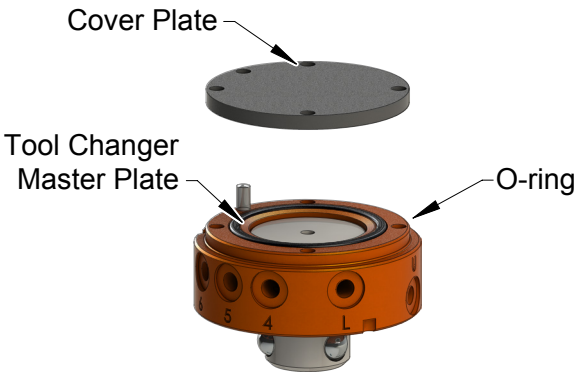
Tools required: *2.5 mm and 3 mm hex key, torque wrench*

Parts required: *9120-011M-SIP-xxxx (where xxxx is the custom SIP interface plate)*

Supplies required: *Magnalube (if necessary)*

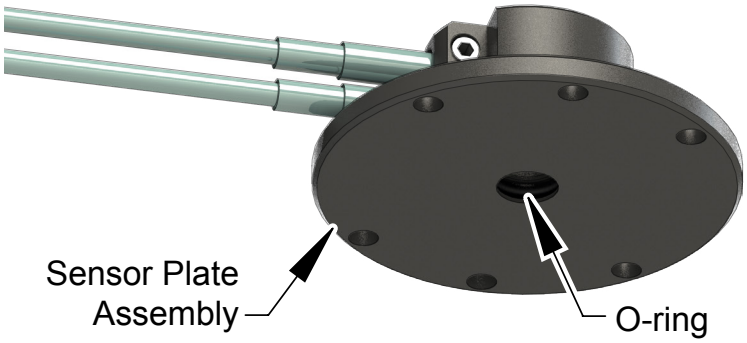
1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits (e.g. electrical, air, water, etc.).
4. Remove the Tool Changer Master plate from the robot and the interface plate, refer to *Section 3.3—Master Plate Removal.*
5. If the Tool Changer has a cover plate, remove the cover plate from the robot side of the Tool Changer.
6. Make sure the O-ring in the Master plate is present and in good condition, lubricate with Magnalube if needed.

Figure 3.9—QC-11 Cover Plate Removal



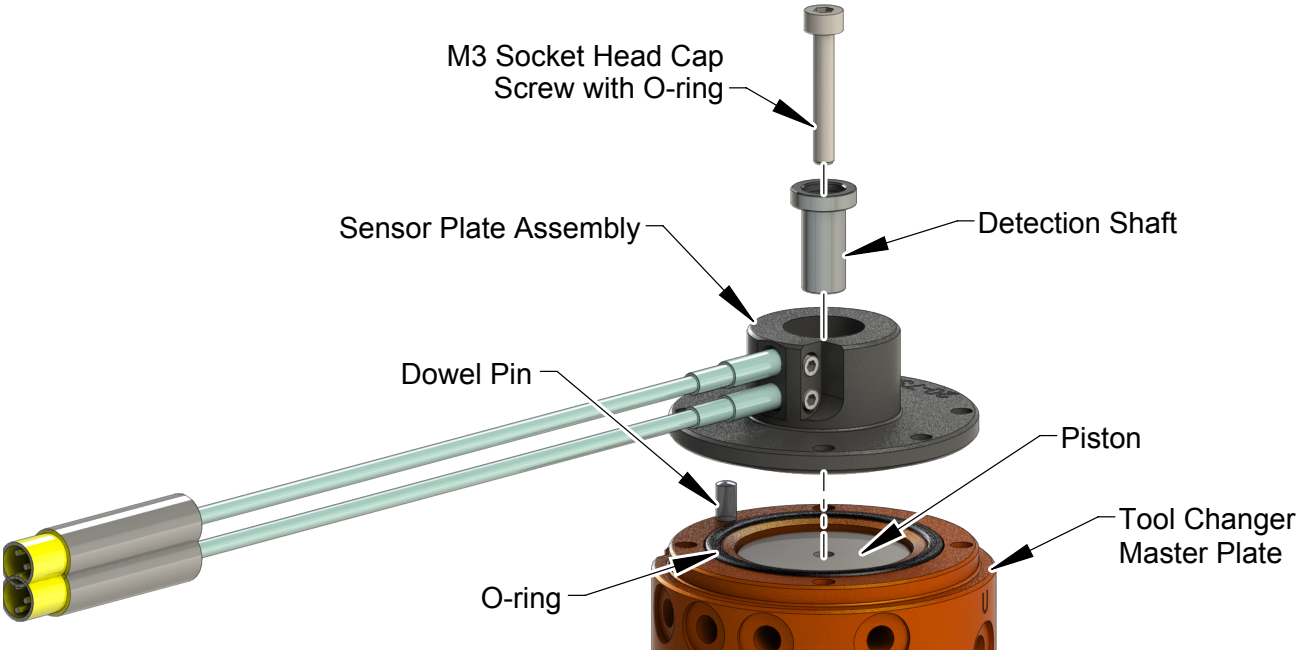
NOTICE: The sensor plate assembly comes assembled with the lock and unlock sensor installed. Do not remove the sensors, the sensors have been position properly from the factory. The sensor plate assembly has the detection shaft O-ring installed and lubricated, make sure it is present as shown in *Figure 3.10.*

Figure 3.10—QC-11 Sensor Plate Assembly with Lock/Unlock Sensors and O-ring



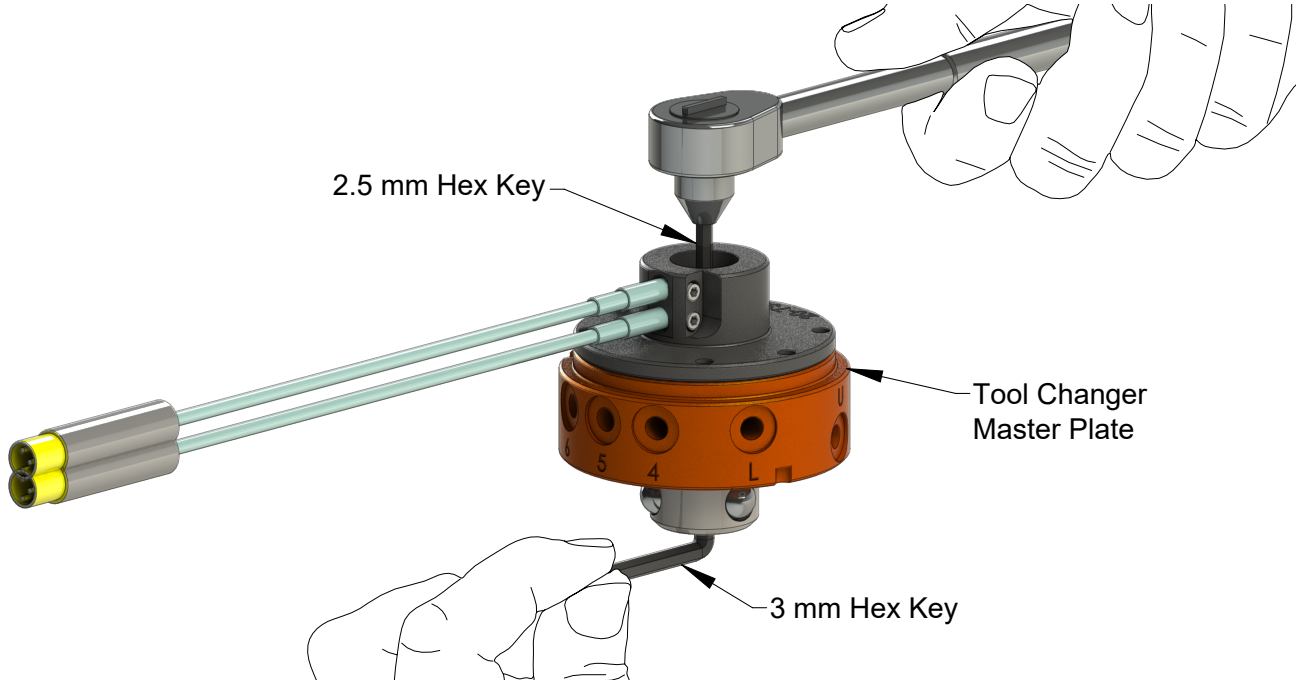
7. Press the detection shaft into the sensor plate assembly; push it all the way through until it stops.
8. Insert the M3 socket head cap screw with O-ring and pre-applied adhesive through the detection shaft.
9. Place the sensor plate assembly into the appropriate location on the Tool Changer Master plate.

Figure 3.11—QC-11 Sensor Plate Assembly Installation



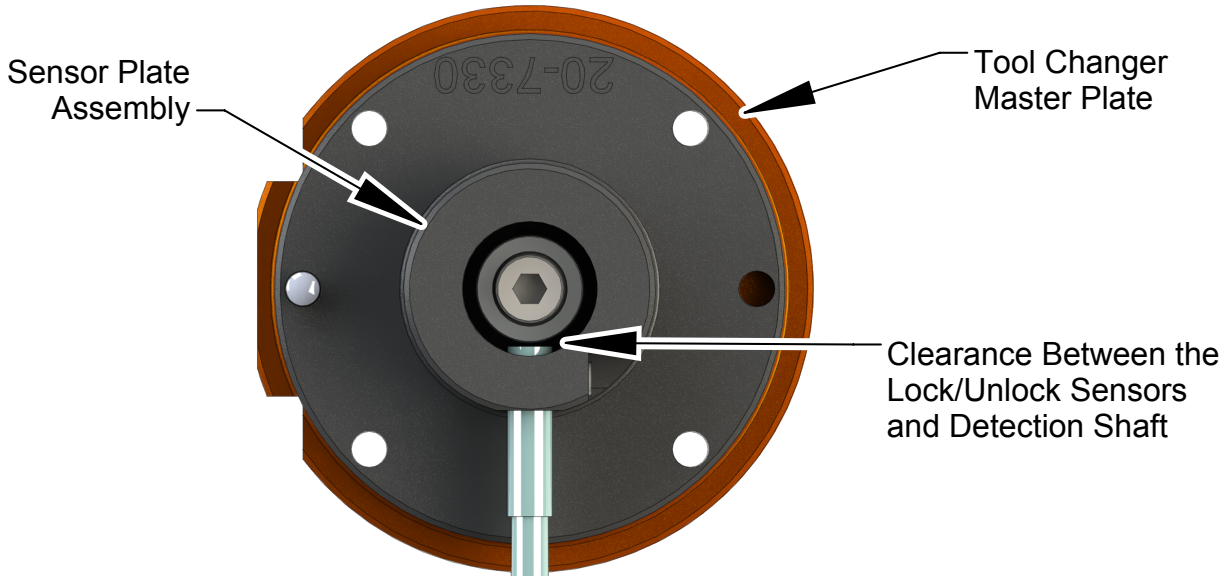
10. Insert a 3 mm hex key into the cam of the Tool Changer plate locking mechanism to hold the piston.
11. Using a 2.5 mm hex key, tighten the M3 socket head cap screw to 12 in-lbs (1.36 Nm).

Figure 3.12—QC-11 Sensor Plate Assembly Installation



12. Look straight into the sensor plate assembly and verify the detection shaft does not touch the Lock and Unlock sensors. If the sensors touch the shaft, adjust the sensor position. Refer to *Section 6.2.1—QC-11 and QC-27 Proximity Sensor Adjustment, Test, or Replacement.*

Figure 3.13—Verify Sensor and Detection Shaft Clearance



CAUTION: Do not apply Lock or Unlock air pressure to the Tool Changer prior to installing an interface plate. Applying air pressure can damage the cover plate, O-ring or may cause injury to personnel from flying debris. Always install an interface plate and have the Tool Changer mounted securely to the robot before applying air pressure. Refer to *Section 3.1—Robot Interface Plates* and *Section 3.2—Master Plate Installation* for more information.

13. Connect the Lock and Unlock sensor cables and manually move the Tool Changer piston to the locked and unlocked positions.
14. Verify the sensors properly work.
    a. Turn the power on to the sensor.
    b. Verify that the Locked signal turns ON and the sensor LED is illuminated when the Tool Changer is in the Locked position.
    c. Verify that the Unlocked signal turns ON and the sensor LED is illuminated when the Tool Changer is in the Unlocked position.
    d. If not, adjust and test the sensors. Refer to *Section 6.2.1—QC-11 and QC-27 Proximity Sensor Adjustment, Test, or Replacement.*
15. Install the new interface plate to the robot, and the Tool Changer Master plate to the interface plate, refer to *Section 3.2—Master Plate Installation.*
16. Safely resume normal operation.

3.8.2 QC-20 and QC-21 SIP Assembly Installation

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

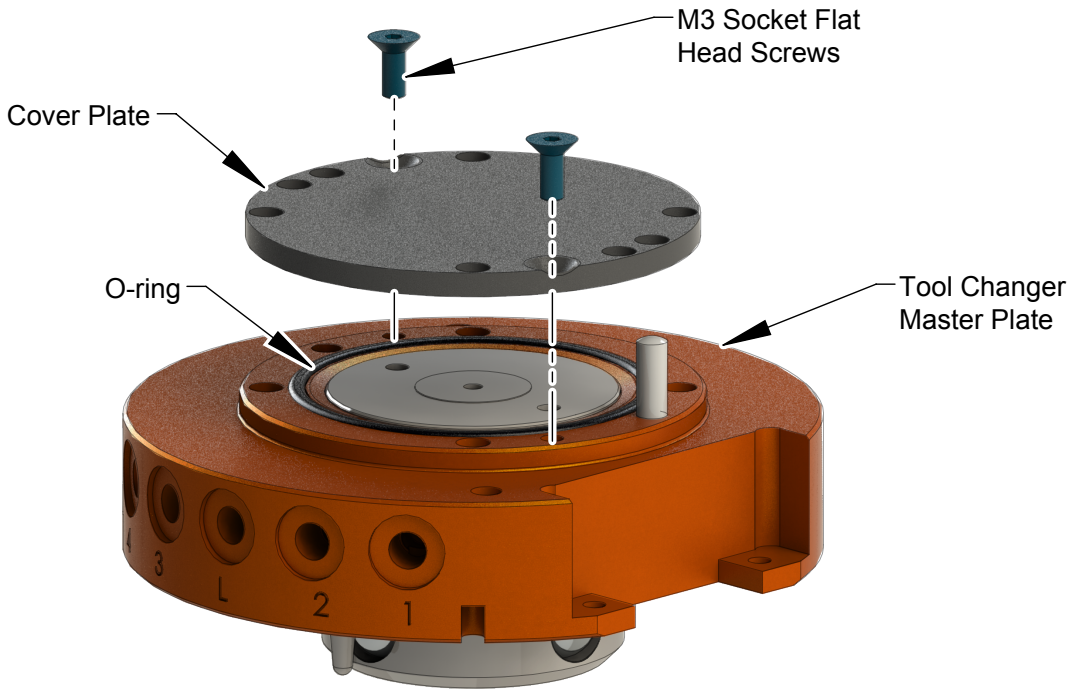
Parts required: *9120-020M-SIP-xxxx or 9120-021M-SIP-xxxx (where xxxx is the custom SIP interface plate)*

Supplies required: *Loctite 222 and Loctite Primer 7649 (if fasteners do not have pre-applied adhesive), magnalube (if necessary)*

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits (e.g. electrical, air, water, etc.).
4. Remove the Tool Changer Master plate from the robot and the interface plate; refer to *Section 3.3—Master Plate Removal.*

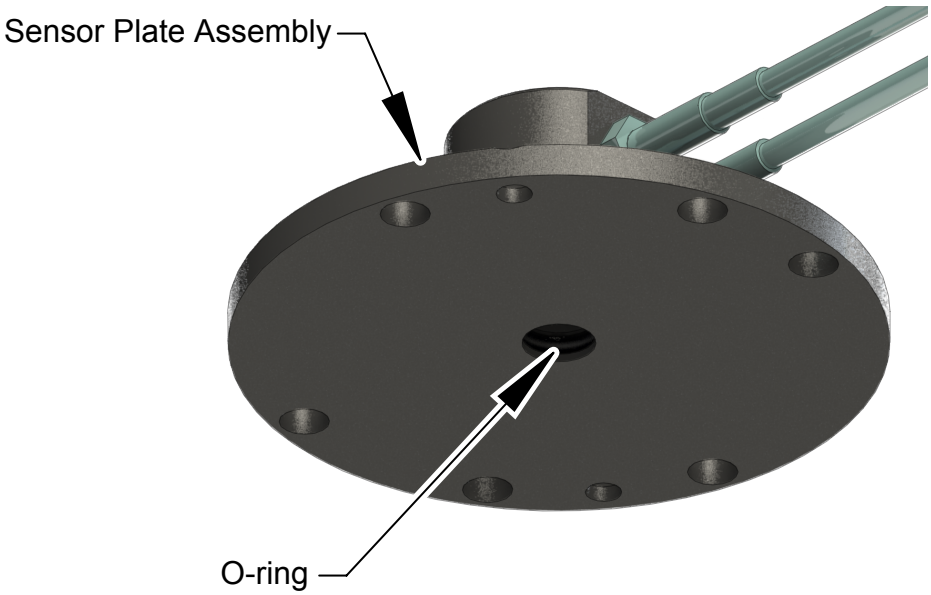
5. If the Tool Changer has a cover plate, remove the (2) M3 socket flat head screws that secure the cover plate to the Tool Changer Master plate using a 2 mm hex key.
6. Lift the cover plate off of the Tool Changer Master plate.
7. Make sure the O-ring in the Master plate is present and in good condition, lubricate with Magnalube if needed.

Figure 3.14—QC-20 and QC-21 Cover Plate Removal



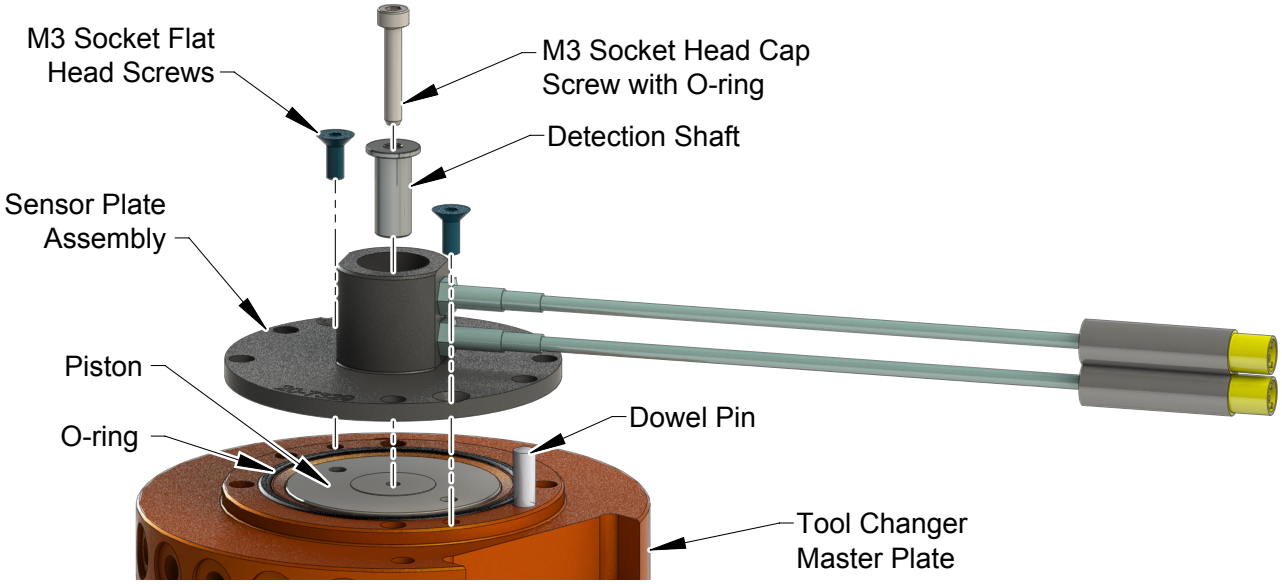
NOTICE: The sensor plate assembly comes assembled with the lock and unlock sensor installed. Do not remove the sensors. The sensors have been positioned properly from the factory. The sensor plate assembly has the detection shaft O-ring installed and lubricated, make sure it is present as shown in *Figure 3.15.*

Figure 3.15—QC-20 and QC-21 Sensor Plate Assembly with Lock/Unlock Sensors and O-ring



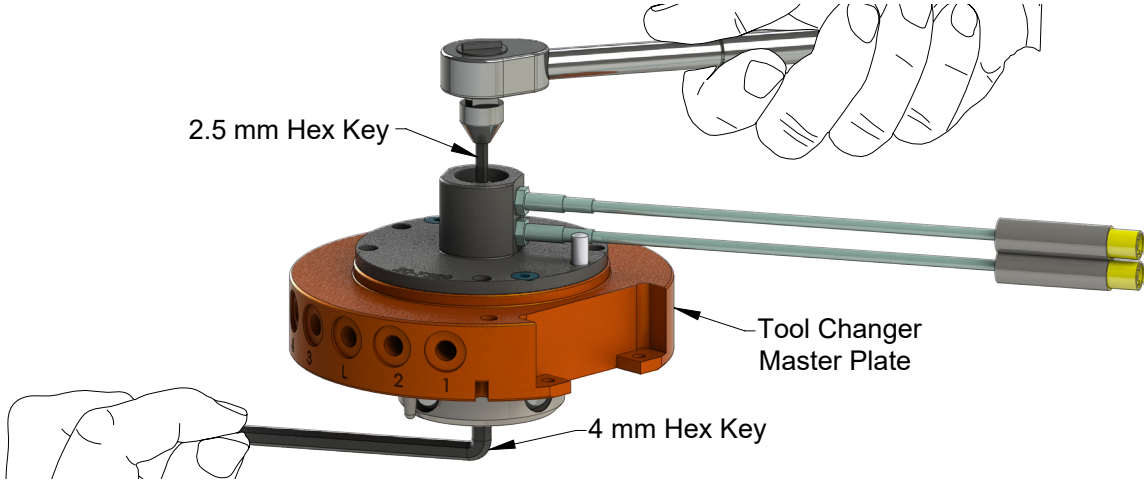
8. Press the detection shaft into the sensor plate assembly; push the shaft all the way through until it stops.
9. If the M3 socket head cap screw with O-ring does not have pre applied adhesive, apply Loctite primer 7649 to the threads of the M3 socket head cap screw and the internal threads of the piston. Allow the primer to dry.
10. If the M3 socket head cap screw does not have pre applied adhesive, apply Loctite 222 to the threads of the M3 socket head cap screw and the internal threads of the piston.
11. Insert the M3 socket head cap screw with O-ring through the detection shaft. Thread the M3 socket head cap screw into the piston.
12. Place the sensor plate assembly into the appropriate location on the Tool Changer Master plate.
13. Attach the sensor plate to the Tool Changer Master plate with the (2) M3 socket flat head screws using a 2 mm hex key. Tighten to 6 in lbs (0.68 Nm).

Figure 3.16—QC-20 and QC-21 Sensor Interface Plate Installation



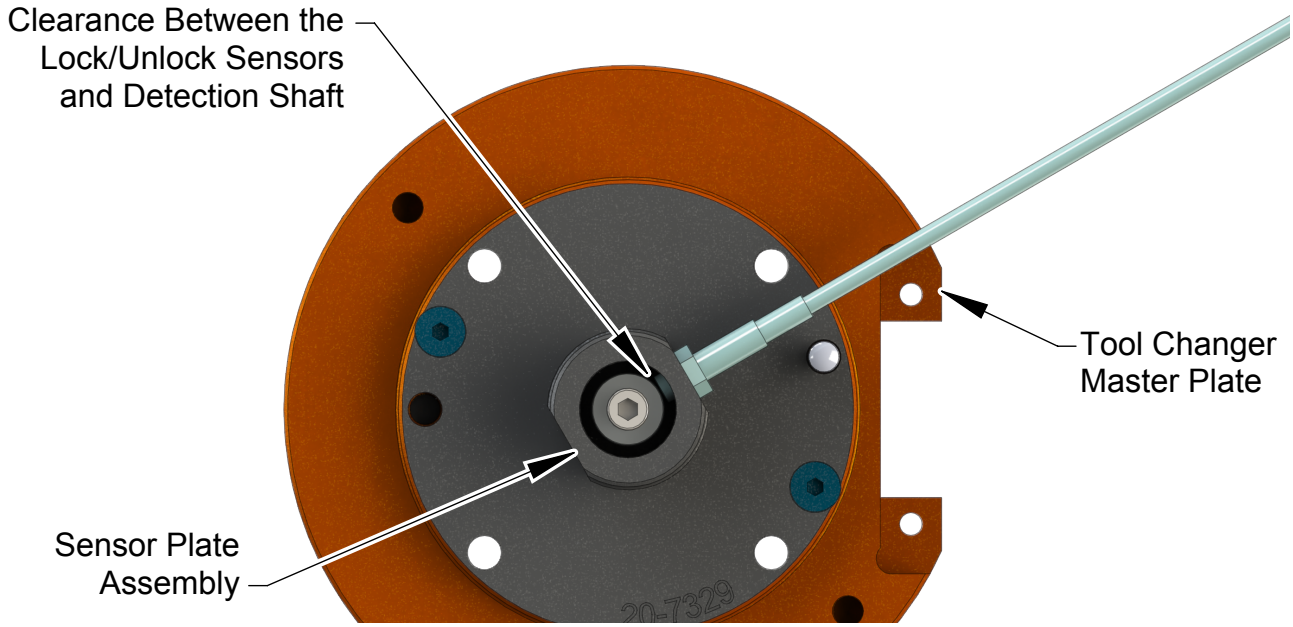
14. Insert a 4 mm hex key into the cam of the Tool Changer plate locking mechanism to hold the piston.
15. Using a 2.5 mm hex key tighten the M3 socket head cap screw to 12 in-lbs (1.36 Nm).

Figure 3.17—QC-20 and QC-21 Sensor Interface Plate Installation



16. Look straight into the sensor plate assembly and verify the detection shaft does not touch the Lock and Unlock sensors. If the sensors touch the shaft, adjust the sensor position. Refer to *Section 6.2.2—QC-20 and QC-21 Proximity Sensor Adjustment, Test, or Replacement.*

Figure 3.18—Verify Sensor and Detection Shaft Clearance



CAUTION: Do not apply Lock or Unlock air pressure to the Tool Changer prior to installing an interface plate. Applying air pressure can damage the cover plate, O-ring or may cause injury to personnel from flying debris. Always install an interface plate and have the Tool Changer mounted securely to the robot before applying air pressure. Refer to *Section 3.1—Robot Interface Plates* and *Section 3.2—Master Plate Installation* for more information.

17. Connect the Lock and Unlock sensor cables and manually move the Tool Changer piston to the locked and unlocked positions.
18. Verify the sensors properly work.
    a. Turn the power on to the sensor.
    b. Verify that the Locked signal turns ON and the sensor LED is illuminated when the Tool Changer is in the Locked position.
    c. Verify that the Unlocked signal turns ON and the sensor LED is illuminated when the Tool Changer is in the Unlocked position.
    d. If not, adjust and test the sensors. Refer to *Section 6.2.2—QC-20 and QC-21 Proximity Sensor Adjustment, Test, or Replacement.*
19. Install the new interface plate to the robot and the Tool Changer Master plate to the interface plate, refer to *Section 3.2—Master Plate Installation.*
20. Safely resume normal operation.

3.9 Lock and Unlock Pneumatic and Valve Requirements

To lock or unlock the Tool Changer, a constant supply of compressed air is required. If there is a loss of air pressure in the locked state, the cam profile prevents the Master plate and Tool plate from unlocking, and the Tool Changer goes into the fail-safe condition.

CAUTION: Do not use or transport the Tool Changer in the fail-safe condition (a state where the Master plate is locked to a Tool plate with no air pressure supplied). Damage to the locking mechanism might occur. Restore proper air pressure before continuing to use the Tool Changer.

3.9.1 Air Requirements

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

- Pressure range: 60-100 psi (4.1–6.9 bar)
- Filter minimum: 40 microns
- Flow maximum: 1/3 CFM at 70 psi (4.8 bar), when cycled continuously

3.9.2 Valve Requirements and Connections

To lock the Tool Changer, air must be supplied to the lock port and freely vent to the atmosphere from the unlock port. Conversely, to unlock the Tool Changer, air must be supplied to the unlock port and freely vent to the atmosphere from the lock port. Therefore, a single, 2-position, 4-way or 5-way valve with either a 4-port or 5-port configuration is required.

CAUTION: Do not use a single, 3-way valve to supply air to the Tool Changer, as this type of valve can not vent trapped air. Improper venting might result in injury to personnel, or damage to the product and attached tooling. Connect the lock and unlock air supplies to a single, 2-position, 4-way or 5-way valve with either a 4-port or 5-port configuration.

Figure 3.19—QC-5 and QC-11 Lock and Unlock Pneumatic Connections

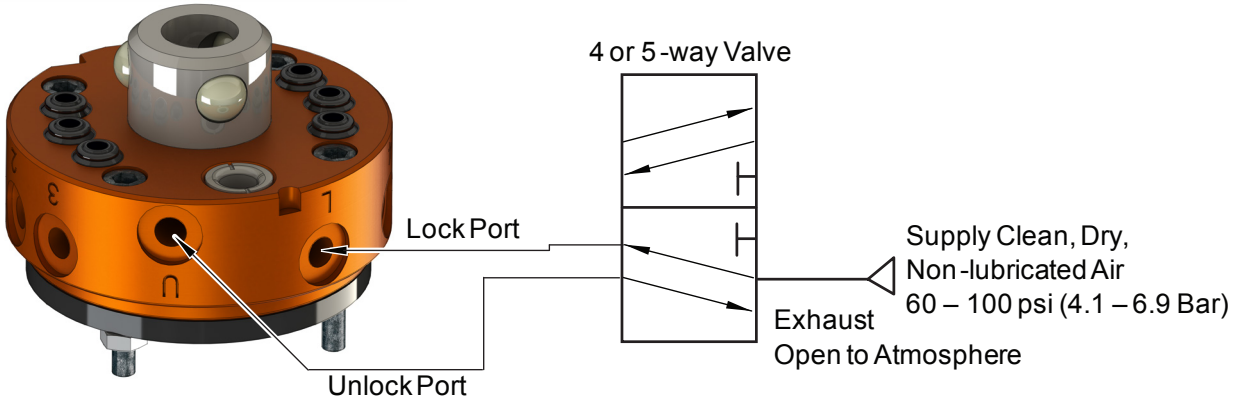


Figure 3.20—QC-20 and QC-21 Lock and Unlock Pneumatic Connections

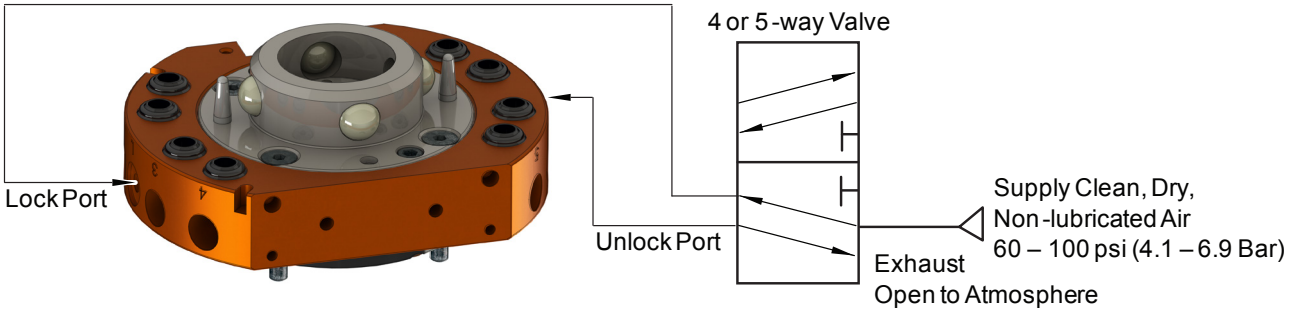
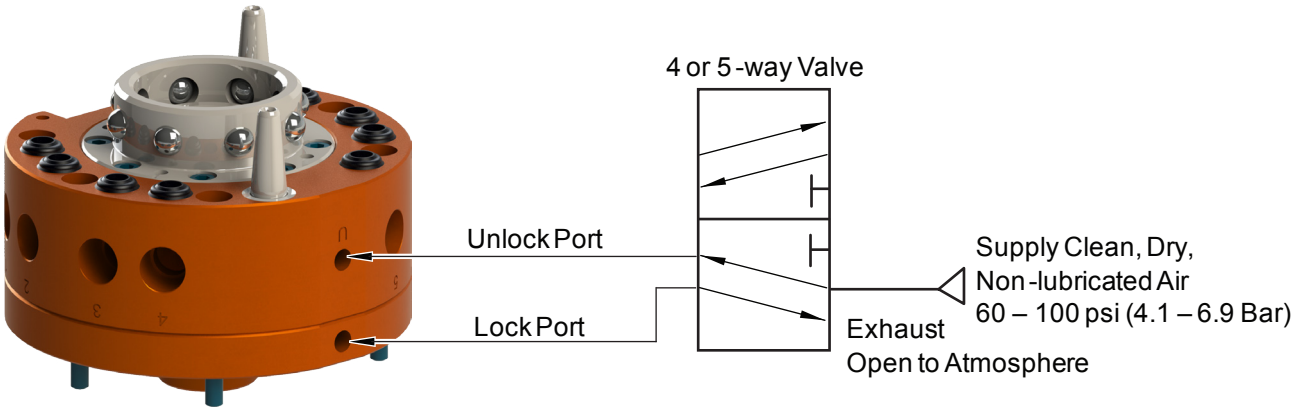


Figure 3.21—QC-27 Lock and Unlock Pneumatic Connections



3.10 Electrical Connections

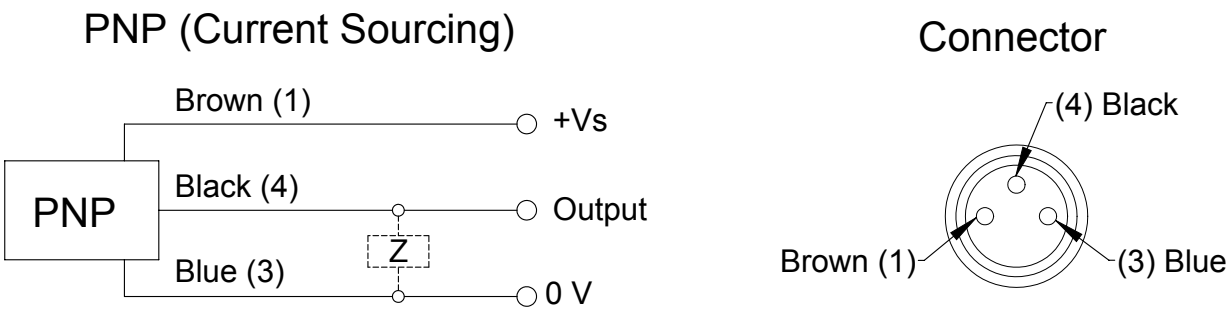
The optional Lock and Unlock sensors are available in PNP and NPN type.

3.10.1 PNP Type Lock and Unlock Sensors

The PNP Lock and Unlock sensors are 4 mm cylindrical inductive proximity sensor.

Table 3.2—PNP (Current Sourcing)	
Description	**Value**
Voltage Supply Range	10-30 VDC
Output Current	< 100 mA
Nominal Sensing Distance Sn	0.8 mm
Output Circuit	PNP make function (NO)

Figure 3.22—PNP Type Lock and Unlock Sensors

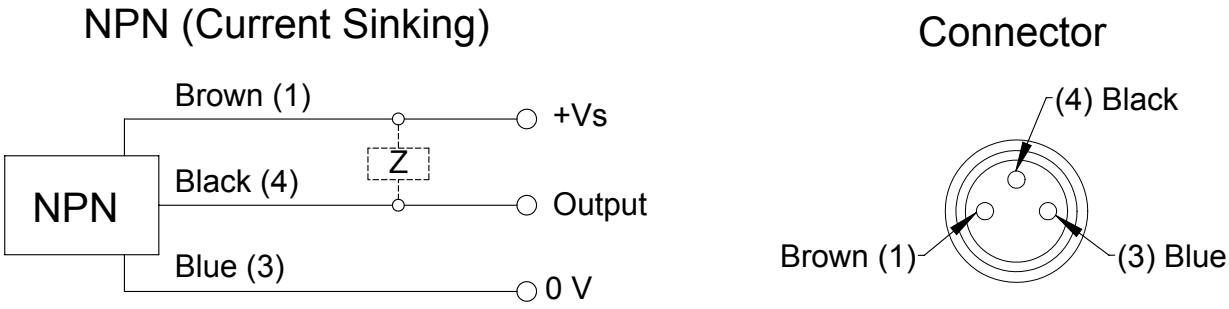


3.10.2 NPN Type Lock and Unlock Sensors

The NPN Lock and Unlock sensors are 4 mm cylindrical inductive proximity sensor.

Table 3.3—NPN (Current Sinking)	
Description	**Value**
Voltage Supply Range	10-30 VDC
Output Current	< 100 mA
Nominal Sensing Distance Sn	0.8 mm
Output Circuit	NPN make function (NO)

Figure 3.23—NPN Type Lock and Unlock Sensors



4. Operation

The Master locking mechanism is pneumatically driven to couple and uncouple with the bearing race on the Tool plate. The Master plate utilizes air ports to provide lock and unlock pressure to the locking mechanism.

CAUTION: Safe, reliable operation of the Tool Changer is dependent on a continuous supply of compressed air at a pressure of 60 to 100 psi (4.1 - 6.9 Bar). Robot motion should be halted if the air supply pressure drops below 60 psi (4.1 Bar) for any reason.

NOTICE: All standard Tool Changers are initially lubricated using MobilGrease® XHP222 Special grease. The end user must apply additional lubricant to the locking mechanism components and alignment pins prior to start of service (See *Section 5.2—Cleaning and Lubrication of the Locking Mechanism and Alignment Pins*). Tubes of lubricant for this purpose are shipped with every Tool Changer. Note: MobilGrease XHP222 Special is a NLGI #2 lithium complex grease with molybdenum disulfide. For custom Tool Changers lubricant may vary, contact an ATI Sales Representative for specific requirements for custom applications.

The robot should be programmed to minimize misalignment during coupling and uncoupling. Additionally, the tool stand should be durable and not allow deflection, under uncoupled Tool weight that will take alignment of the Tool Changer plates outside of accepted offsets. See *Figure 4.1* and *Table 4.1* for recommended maximum allowable offsets prior to coupling. In some cases, greater offsets than shown in *Table 4.1* can be accommodated by the Master and Tool plates but will increase wear.

Lock-up should occur with the Master plate in the No-Touch™ locking zone (see *Table 4.1*) but not touching the Tool plate. As locking occurs, the Master plate should draw the Tool plate into the locked position.

Figure 4.1— Offset Definitions

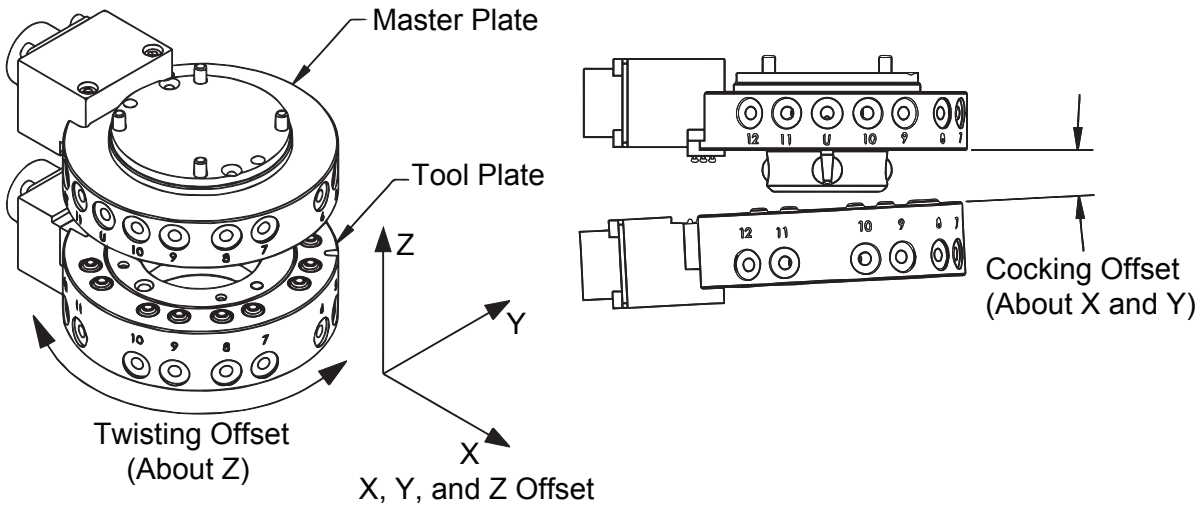


Table 4.1—Maximum Recommended Offsets Prior to Coupling

Model	No-Touch™ Zone Z Offset (Max)[1]	X and Y Offset (Max)[2]	Cocking Offset (Max) (degrees)	Twisting Offset (Max) (degrees)
QC-5	2 mm (0.08”)	±1 mm (0.039”)	±1.1	±2
QC-11	1.5 mm (0.06”)	±1 mm (0.039”)	±0.8	±2
QC-20 QC-21	2 mm (0.08”)	±1 mm (0.039”)	±0.8	±2
QC-27	3 mm (0.12”)	±2 mm (0.08”)	±1.0	±2

Notes:
1. Maximum values shown. Decreasing the actual values minimize wear during coupling and uncoupling.
2. Actual allowable values may be higher in some cases, but higher offsets increase wear during coupling.

4.1 Coupling Sequence

CAUTION: The locking mechanism must be in the unlock position when attempting to couple the Tool Changer. Failure to adhere to this condition may result in damage to the unit and/or the robot.

1. Position the Master plate above the Tool plate with the air supplied to the Unlock Port (if equipped, the Unlock sensor indicates the Tool Changer is Unlocked).
2. Move the Master plate toward the Tool plate so that the (2) alignment pins enter the alignment holes on the opposite plate. Program the robot so that the Master plate and Tool plate are aligned axially and are parallel to each other (as closely as possible). This will minimize Tool movement and subsequent wear during lock-up.

CAUTION: No-Touch™ locking technology allows the unit to couple with a separation distance between the Master and Tool. Direct contact of the Master and Tool mating surfaces is not suggested or required prior to coupling. Contact may result in damage to the unit and/or the robot.

3. When the (2) faces are within the specified No-Touch™ distance, release the pressure from the Unlock port and supply air to the Lock port. The Tool plate is drawn toward the Master plate and coupled. Air must be maintained on the Lock Port during operation to assure rigid coupling (if equipped, the Lock sensor indicates the Tool Changer is in the Locked position).
4. A sufficient delay must be programmed between locking valve actuation and robot motion so that the locking process is complete before moving the robot.

CAUTION: If air pressure is lost during operation, ATI's patented fail-safe design prevents the Tool plate from being released. Do not use the Tool Changer in a fail-safe condition. Re-establish air pressure and ensure the Tool Changer is in a secure lock position before returning to normal operations.

4.2 Fail-Safe Operation

A fail-safe condition occurs when there is an unintended loss of lock air pressure to the Master plate. When air pressure is lost, the Tool Changer relaxes and there may be a slight separation between the Master and Tool plates. The lock sensor may indicate that the unit is not locked. ATI's patented fail-safe feature utilizes a multi-tapered cam to trap the ball bearings and prevent an unintended release of the Tool plate. Positional accuracy of the tooling is not maintained during this fail-safe condition. Do not operate the Tool Changer in the fail-safe condition. If source air is lost to the unit, movement should be halted until air pressure is restored.

After air pressure is re-established to the Master plate, the locking mechanism will energize and securely lock the Master and Tool plates together. In some cases when the load on the tool changer is significantly off center, it may be necessary to position the load underneath the tool changer or return the tool to the tool storage location to ensure a secure lock condition. If equipped, make sure the lock sensor indicates the Tool Changer is in the locked position before resuming normal operations. Consult the Control/Signal Module Manual for specific error recovery information.

CAUTION: Do not use the Tool Changer in a fail-safe condition. Damage to the locking mechanism could occur. Re-establish air pressure and ensure the Tool Changer is in a secure lock position before returning to normal operations.

4.3 Uncoupling Sequence

1. Position the Tool plate in the tool stand so that there is little or no contact force between the Tool plate and tool stand.
2. Release air on the Lock port and apply air to the Unlock Port (if equipped, the Unlock sensor will indicate the Tool Changer is in the Unlocked position).

NOTICE: The air will cause the locking mechanism to be released and the weight of the Tool plate and attached tooling will assist in its removal. The Tool weight assists in uncoupling if the Tool is released in the vertical position only.

3. A sufficient delay must be programmed between unlocking valve actuation and robot motion, so that the unlocking process is complete and the Tool plate is fully released before moving the robot.
4. Move the Master plate axially away from the Tool plate.
5. In automated Tool change applications, it is recommended that a Tool presence sensor(s) be used in the tool stand to verify that the Tool is present and that the Tool remains in place as the robot moves away after the unlocking process.

4.4 Tool Identification

When using multiple Tools, it is good practice to implement a Tool-ID system that identifies each Tool with a unique code. Tool-ID can be used to verify that the robot has picked up the proper Tool. Modules with Tool-ID are available for purchase through the ATI website. Go to *http://www.ati-ia.com/products/toolchanger/tool_changer_modules.aspx* for products available or contact ATI for assistance.

4.5 Tool Storage Considerations

NOTICE: Tool stand design is critical to operation of the Tool Changer. Improperly designed tool stands can cause jamming and excessive wear of the Tool Changer components.

Tool plates with customer tooling attached may be stored in a tool stand. ATI provides compatible tool stands designed for durability, longevity, and maximum adaptability to fit most customers' applications. The ATI Tool Stand Small (TSS) system is compatible with ATI Tool Changer sizes QC-001 to QC-41. The TSS systems ystems can be configured in a variety of arrangements and are available with additional modular accessories such as covers and tool sensing. For products available, contact an ATI representative or refer to the following ATI webpage: *http://www.ati-ia.com/products/toolchanger/toolstand/small/SmallStand.aspx*. Another resource is the *ATI TSS manual*: *https://www.ati-ia.com/app_content/Documents/9610-20-1068.pdf*.

For some Tool Changers, ATI can provide a Teaching Aid to assist users with teaching the robot how to couple the Master with the Tool in a tool stand. For more information, refer to the *ATI Teaching Aid manual* or the ATI webpage for Teaching Aids: *https://www.ati-ia.com/products/toolchanger/TeachingAid.aspx*.

If the customer supplies the tool stand, the tool stand should include the following design considerations:

- Provide a fixed, repeatable, level, and stable position for tool pick-up and drop-off.
- Support the weight of the Tool Changer Tool plate, tool interface plate, optional modules, cables, hoses, and customer tooling without allowing deflection in excess of the offsets specified.
- (Preferred) the Tool should hang vertically in the tool stand so that gravity assists to uncouple the Tool plate from the Master plate during unlocking.
- It is possible to design tool stands that hold tools in the horizontal position, but the necessary compliance must be provided during coupling and uncoupling. In general, horizontally positioned tool stands cause more wear on the locking mechanism and locating features of the Tool Changer and tool stand. Furthermore, horizontal pick-up and drop-off of the Tool plate increases wear on the robot arm.
- A variety of methods may be used to position the Tool in the tool stand. A common method is to use tapered alignment pins and bushings. Robot programming and positional repeatability are critical aspects of successful Tool pick-up and drop-off.
- Install a debris shield to cover Tools and modules to protect them in dirty environments, such as grinding or welding. Alternatively, position tool stands in areas that are shielded from weld spatter, fluids, adhesives, or other debris.
- For proximity sensors, consider the following:
    - Install a proximity sensor that detects the presence of the Tool in the tool stand. The sensor may be used prior to coupling to ensure the Tool is seated in the stand. Sensors may also be used as the robot starts to move away after uncoupling. Sensors provide a safety measure if a Tool becomes jammed in the stand or if the Tool fails to release from the robot.
    - Position the proximity sensor so that the sensing face is vertical to prevent metal shavings, weld spatter, or other debris from falling on the sensor and creating false readings.

5. Maintenance

WARNING: Do not perform maintenance or repair(s) on the Tool Changer or modules unless the Tool is safely supported or placed in the tool stand, all energized circuits (for example: electrical, air, water, etc.) are turned off, pressurized connections are purged and power is discharged from circuits in accordance with the customer specific safety practices and policies. Injury or equipment damage can occur with the Tool not placed and energized circuits on. Place the Tool in the tool stand, turn off and discharge all energized circuits, purge all pressurized connections, and verify all circuits are de-energized before performing maintenance or repair(s) on the Tool Changer or modules.

NOTICE: The cleanliness of the work environment strongly influences the trouble free operation of the Tool Changer. The dirtier the environment, the greater the need for protection against debris. Protection of the entire EOAT, the Master, the Tool and all of the modules may be necessary. Protective measures include the following:

1) Placement of tool stands away from debris generators.
2) Covers incorporated into the tool stands.
3) Guards, deflectors, air curtains, and similar devices built into the EOAT and the tool stand.

5.1 Preventive Maintenance

The Tool Changer and optional modules provide a long life with regular maintenance. A maintenance schedule for an application and a maintenance checklist is provided in the following table. Detailed assembly drawings are provided in *Section 9—Drawings* of this manual.

Table 5.1—Maintenance

Application(s)	Tool Change Frequency	Inspection Schedule
General Usage Material Handling Docking Station	> 1 per minute	Weekly
	< 1 per minute	Monthly
Welding/Servo/Deburring, Foundry Operations (Dirty Environments)	All	Weekly

Checklist

Mounting Fasteners

- ☐ Inspect fasteners for proper torque, interferences, and wear. Tighten and correct as required. Refer to *Section 3—Installation.*

Ball Bearings/Alignment Pins/Bushings/Bearing Race

- ☐ Inspect for wear and proper lubrication. MobilGrease XHP222 Special a NLGI #2 lithium complex grease with molybdenum disulfide additive is suggested for locking mechanism and alignment pin lubrication. Over time, lubricants can become contaminated with debris. Therefore, it is recommended to thoroughly clean the existing grease and replace with new as needed. See *Section 5.2—Cleaning and Lubrication of the Locking Mechanism and Alignment Pins*.
- ☐ Inspect for excessive alignment pin/bushing wear that may be an indication of poor robot position during pickup/drop-off. Adjust robot position as needed. Check tool stand for wear and alignment problems. The QC-27M model has replaceable alignment pins, refer to *Section 6.2.4—QC-27M Alignment Pin Replacement.*
- ☐ Wear on the balls/bearing race could be an indication of excessive loading.

Sensors and Cables

- ☐ Inspect sensor cable connectors for tightness, and if loose, tighten the connections.
- ☐ Inspect sensor cables for any damage, cuts, and abrasion. Replace as necessary. Refer to *Section 6.2.1—QC-11 and QC-27 Proximity Sensor Adjustment, Test, or Replacement* or *Section 6.2.2—QC-20 and QC-21 Proximity Sensor Adjustment, Test, or Replacement*

Hoses

- ☐ Inspect the hose connection for tightness and leaks. If leaking or loose, secure the hose connection.
- ☐ Inspect hoses for interferences, abrasions, cuts, and leaks. Replace as required.

Electrical Contacts/Pin Block (Modules)

- ☐ Inspect for damage, debris, and stuck/burnt pins. Refer to *Section 5.3—Optional Electrical Module Pin Block Inspection and Cleaning.*

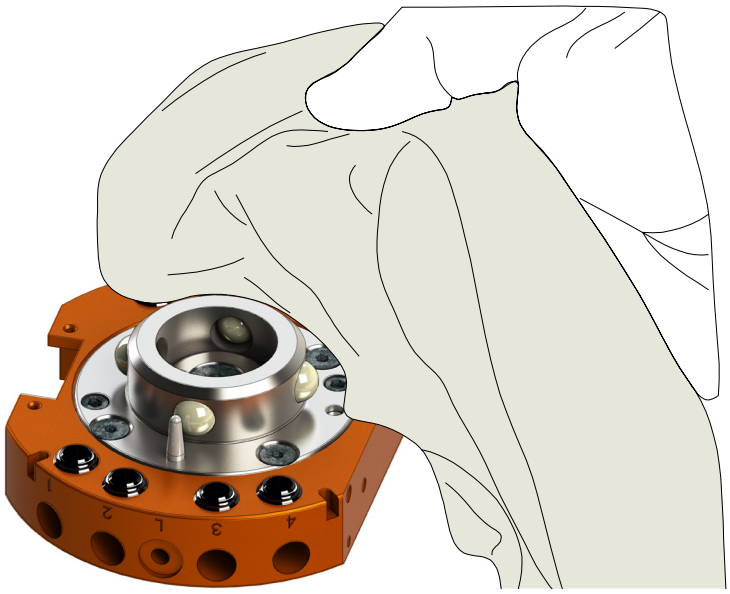
Seals Pass Through Air and Optional Modules

- ☐ Exposed seals and rubber bushings may damaged during normal operation. Inspect for wear, abrasion, and cuts. Replace damaged seals or rubber bushings as needed. Refer to *Section 6.2.3—Rubber Bushing Inspection and Replacement,* or *Section 6.2.5—Optional Electrical Module V-ring Seal Inspection and Replacement*

5.2 Cleaning and Lubrication of the Locking Mechanism and Alignment Pins

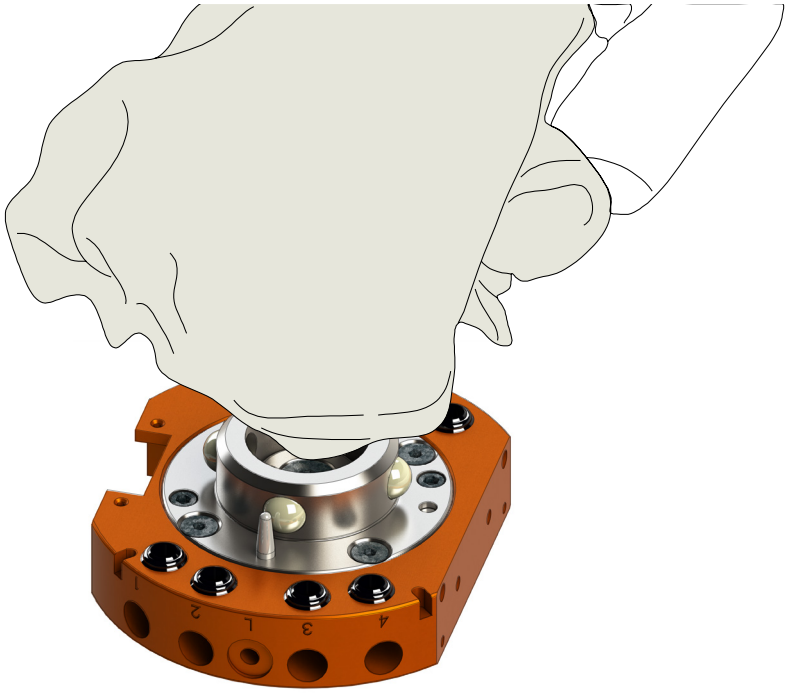
1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits (for example: electrical, pneumatic, and hydraulic circuits).
4. Use a clean rag to thoroughly remove any lubricant and debris from the ball bearings, male coupling, cam, and alignment pins.

Figure 5.1—Cleaning Ball Bearings and Outer Surfaces of Male Coupling



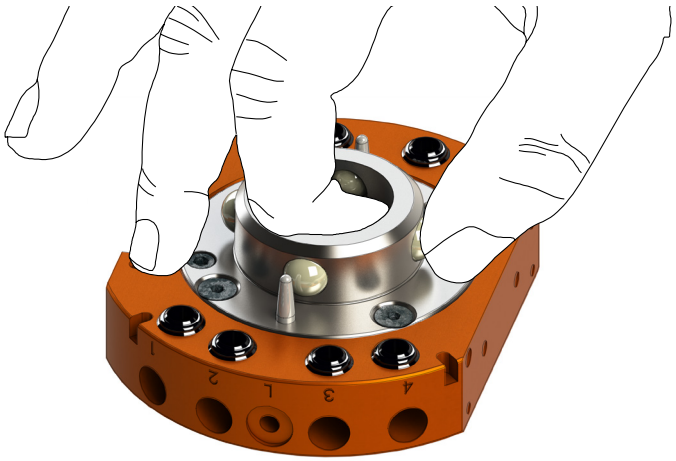
5. Use a clean rag to thoroughly remove any lubricant and debris from the inner surface of the male coupling and cam.

Figure 5.2—Cleaning Ball Bearings, Cam and Inner Surfaces of Male Coupling



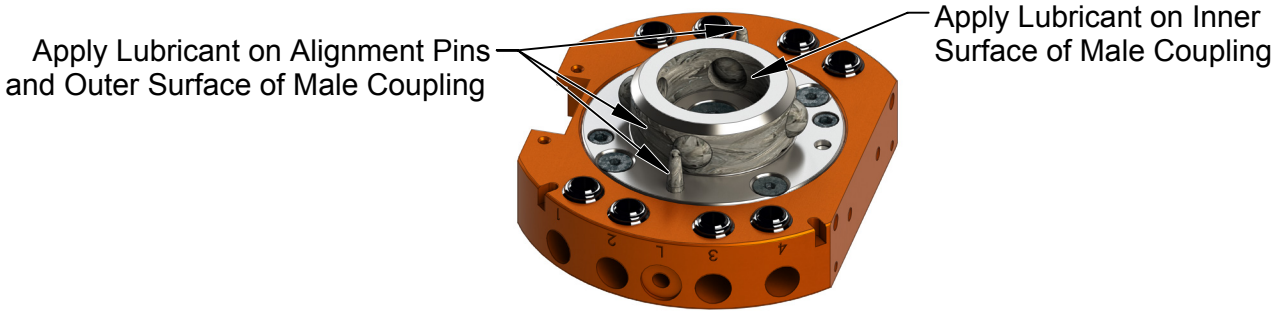
6. Check each ball bearing to make sure it moves freely in the male coupling. Additional cleaning may be necessary to free up any ball bearings that are sticking in place.

Figure 5.3—Check Ball Bearing Movement



7. Apply a liberal coating of lubricant to the ball bearings, the male coupling (inside and out), and the alignment pins.

Figure 5.4—Apply Lubricant to Locking Mechanism

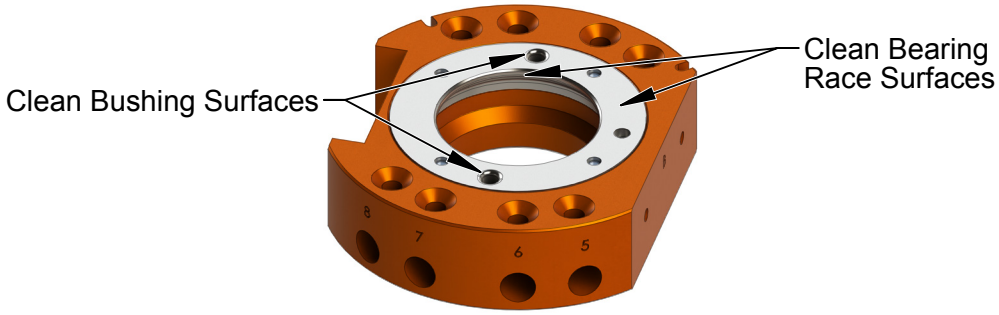


8. Use a clean rag to thoroughly remove any lubricant and debris from the Tool plate bearing race and bushings.

NOTICE: No application of lubrication is necessary on the Tool plate components.

9. Safely resume normal operation.

Figure 5.5—Clean Tool Plate Surfaces of Locking Mechanism



5.3 Optional Electrical Module Pin Block Inspection and Cleaning

Tools required: *Nylon Brush (ATI part number 3690-0000064-60)*

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits (for example: electrical, pneumatic, and hydraulic circuits).
4. Inspect the Master and Tool pin blocks for debris or darkened pins.

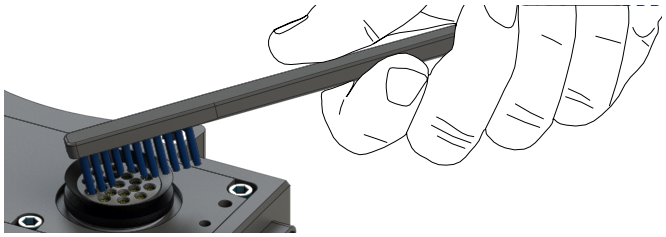
Figure 1.1—Inspect Master and Tool Pin Blocks



5. If debris or darkened pins are present, use a vacuum to remove the debris, and clean using a nylon brush (ATI part number 3690-0000064-60).

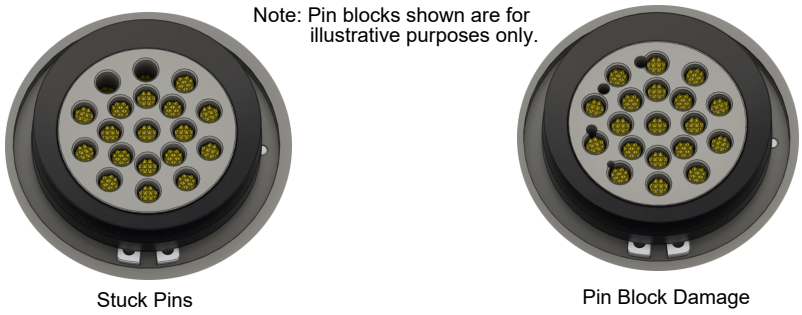
NOTICE: Do not use an abrasive media and/or cleaners or solvents to clean the contact pins. Using abrasive media and/or cleaners or solvents will cause damage to the contact surface or cause pins to stick. Clean contact surfaces with a vacuum or non-abrasive media such as a nylon brush (ATI part number 3690-0000064-60).

Figure 1.2—Clean Pin Blocks with a Nylon Brush



6. Inspect the Master and Tool pin blocks for stuck pins or pin block damage.

Figure 1.3—Stuck Pin and Pin Block Damage



7. If pins become stuck or if there is damage to the pin block, contact ATI for either a possible pin replacement procedure or module replacement.
8. Safely resume normal operation.

6. Troubleshooting and Service Procedures

The following section provides troubleshooting information to help diagnose conditions with the Tool Changer and service procedures to help resolve these conditions.

WARNING: Do not perform maintenance or repair(s) on the Tool Changer or modules unless the Tool is safely supported or placed in the tool stand, all energized circuits (for example: electrical, air, water, etc.) are turned off, pressurized connections are purged and power is discharged from circuits in accordance with the customer specific safety practices and policies. Injury or equipment damage can occur with the Tool not placed and energized circuits on. Place the Tool in the tool stand, turn off and discharge all energized circuits, purge all pressurized connections, and verify all circuits are de-energized before performing maintenance or repair(s) on the Tool Changer or modules.

CAUTION: Thread locker applied to fasteners must not be used more than once. Fasteners might become loose and cause equipment damage. Always apply new thread locker when reusing fasteners.

6.1 Troubleshooting

The troubleshooting table is provided to assist in diagnosing issues that may cause the Tool Changer not to function properly.

Figure 6.2—Troubleshooting

Symptom	Cause	Resolution
The unit does not lock or unlock.	Insufficient or no air pressure supply to lock or unlock ports.	Verify proper air pressure and a pneumatic valve is supplied. Refer to *Section 3.9—Lock and Unlock Pneumatic and Valve Requirements*.
	Air pressure is trapped in de-energized Lock/Unlock ports.	Air pressure must be vented to the atmosphere properly. Refer to *Section 3.9—Lock and Unlock Pneumatic and Valve Requirements*.
	Pneumatic connections are loose or damaged.	Refer to the air/valve adapter manual for more information.
	Debris is caught between the Master and Tool plates.	Clean debris from between Master and Tool plates. Verify the mounting fasteners are secure and do not protrude above the mating surfaces.
	The ball bearings and/or cam are not moving freely in the male coupling.	Clean and lubricate as needed to restore smooth operation (Refer to *Section 5.2—Cleaning and Lubrication of the Locking Mechanism and Alignment Pins*.
	The Master plate and Tool plate are not within the specified No-Touch zone when attempting to lock.	Check that the Tool is properly seated in the tool stand. Refer to *Section 4—Operation*. Re-teach the robot to bring the Master plate and Tool plate closer together prior to attempting to lock.
Insufficient air supply to tooling or an air leak.	Rubber bushings are damaged.	Inspect the rubber bushings for damage. Replace damaged bushings. Refer to *Section 6.2.3—Rubber Bushing Inspection and Replacement.*
Units Equipped with Electrical Modules		
Loss of Communication.	Debris is in electrical contacts.	Inspect and clean the contacts pins, refer to *Section 5.3—Optional Electrical Module Pin Block Inspection and Cleaning*.
		Inspect the V-ring seal for damage. Replace the damaged seal. Refer to *Section 6.2.5—Optional Electrical Module V-ring Seal Inspection and Replacement*.
Units Equipped with and Sensor Interface Plate		
Unit is locked but Lock signal does not read “on” (true) or Unit is unlocked but Unlock signal does not read “on” (true)	Lock or Unlock sensor/cable is damaged. Sensor is loose or not adjusted properly.	Verify cable continuity, replace if necessary
		Replace the lock or Unlock sensor assembly as necessary. Refer to *Section 6.2.1—QC-11 and QC-27 Proximity Sensor Adjustment, Test, or Replacement,* or *Section 6.2.2—QC-20 and QC-21 Proximity Sensor Adjustment, Test, or Replacement.*

6.2 Service Procedures

The following service procedures provide instructions for inspection, adjustment, test, or replacement of components.

6.2.1 QC-11 and QC-27 Proximity Sensor Adjustment, Test, or Replacement

The proximity sensors are extremely reliable and should not require frequent replacement. Should malfunctions occur, evaluate all other possible solutions before testing or replacing the sensor. Check continuity, air supply, lubrication, and pneumatic components.

Parts required: *Refer to Figure 6.3 and Section 8.2—Models QC-11 Serviceable Parts or Section 8.6—Models QC-27 Serviceable Parts*

Tools required: *2 mm, 2.5 mm and/or 3 mm hex key, torque wrench*

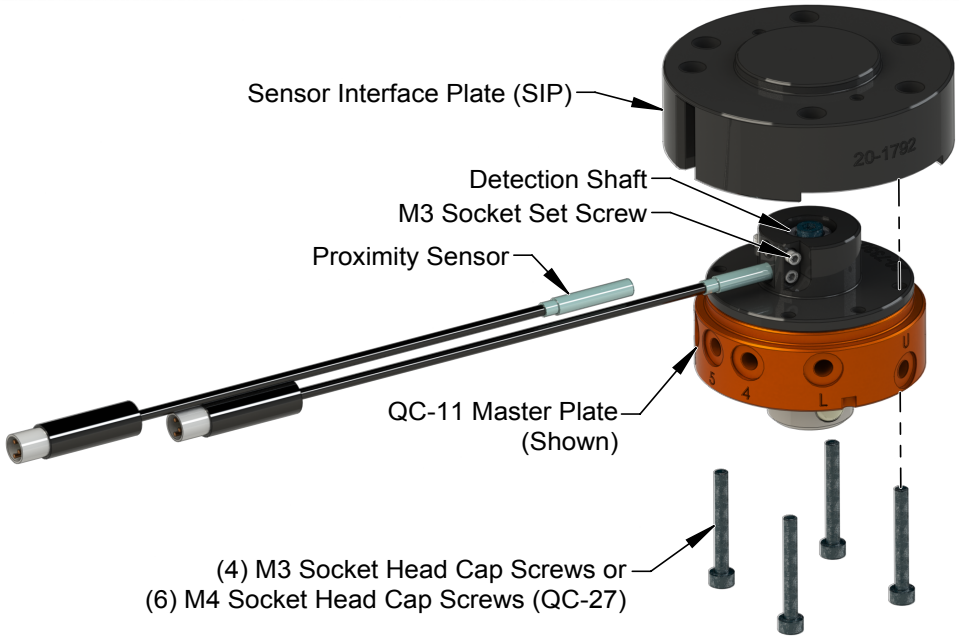
1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Test the sensors.
   a. If testing the Lock sensor, make sure the Tool Changer is in the **Locked** position. If testing the Unlock sensor, make sure the Tool Changer is in the **Unlocked.** For the sensor being tested, verify the signal is ON and the sensor LED is illuminated. If the sensors are not functioning, replace the sensor.
4. Turn off and de-energize all energized circuits (e.g. electrical, air, water, etc.).
5. Disconnect any cables, sensor cables, air line, etc. if required.
6. Remove the Master plate from the sensor interface plate, support the Master plate while loosening the screws.

- For a QC-11 remove the (4) M3 socket head cap screws securing the Master plate assembly to the Sensor Interface Plate using a 2.5 mm hex key.
- For a QC-27 remove the (6) M4 socket head cap screws securing the Master plate assembly to the Sensor Interface Plate using a 3 mm hex key.

7. Loosen the M3 socket set screw and unscrew the proximity sensor from the sensor plate using a 2 mm hex key. Discard the old sensor.

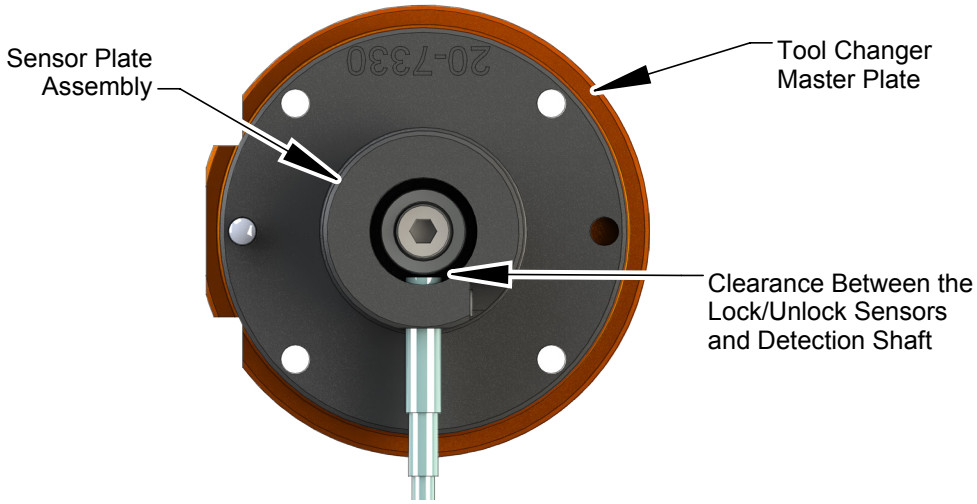
8. Thread the new proximity sensor into the Master plate assembly until it touches the detection shaft, then back the sensor out by a 1/2 turn.

Figure 6.3—QC-11 and QC-27 Replace Proximity Sensor



9. From a top-down view of the sensor plate assembly, verify the detection shaft does not touch the Lock and Unlock sensors. If the sensors touch the shaft, adjust the sensor position.

Figure 6.4—Verify Sensor and Detection Shaft Clearance



10. Connect the sensor cable. When power is turned on, the sensor LED should be illuminated and the sensor signal should be ON.

> **CAUTION:** Do not operate locking mechanism with sensor touching the detection shaft. Operating the locking mechanism with the sensor touching the detection shaft will damage the sensor. Back off the sensor ½ turn and secure with the set screw before operating the locking mechanism.

11. Turn the M3 socket set screw, until it contacts the sensor, and tighten 1/4 turn using a 2 mm hex key.

CAUTION: Be careful not to over tighten set screw. Over tightening set screw can cause damage to the proximity sensor. Tighten until the nylon tip engages with the sensor threads and tighten 1/4 turn more.

12. Attach the Master plate to the interface plate:
    - For a QC-11 secure the Master plate to the interface plate using the (4) M3 socket head cap screws using a 2.5 mm hex key. Tighten to 10 in-lbs (1.13 Nm).
    - For a QC-27 secure the Master plate to the interface plate using the (6) M4 socket head cap screws using a 3 mm hex key. Tighten to 15 in-lbs (1.68 Nm).
13. Connect other utilities to the optional modules on the Master plate.
14. Confirm the operation of the replaced sensor.
    a. Provide Lock or Unlock air to the Tool Changer.
    b. Verify the corresponding sensor signal is ON and the sensor LED is illuminated.
15. Safely resume normal operation.

6.2.2 QC-20 and QC-21 Proximity Sensor Adjustment, Test, or Replacement

The proximity sensors are extremely reliable and should not require frequent replacement. Should malfunctions occur, evaluate all other possible solutions before testing or replacing the sensor. Check continuity, air supply, lubrication, and pneumatic components.

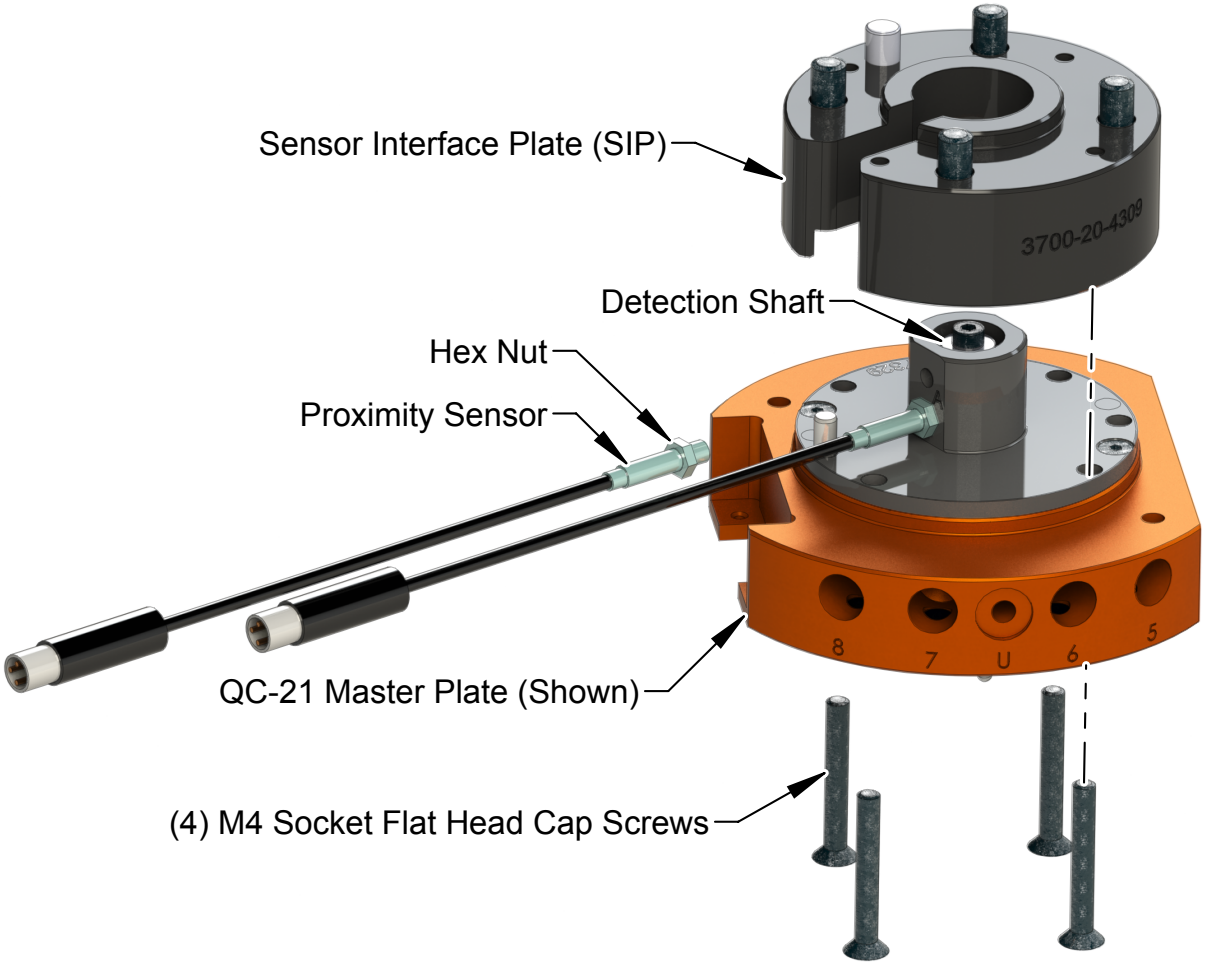
Parts required: *Refer to Figure 6.5 and Section 8—Serviceable Parts*

Tools required: *2.5 mm hex key, 6 mm wrench, torque wrench*

Supplies required: *Loctite 222*

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Confirm operation of the replaced sensor.
   a. If testing the Lock sensor, make sure the Tool Changer is in the **Locked** position. If testing the Unlock sensor, make sure the Tool Changer is in the **Unlocked** position.
   b. Check to see the signal is ON and the sensor LED is illuminated, for the sensor being tested. Replace the sensors if they are not functioning.
4. Turn off and de-energize all energized circuits (e.g. electrical, air, water, etc.).
5. Disconnect any cables, sensor cables, air lines, etc. if required.
6. Remove the (6) M4 socket head cap screws securing the Master plate assembly to the adapter plate using a 2.5 mm hex key. Refer to *Figure 6.5*.
7. Loosen the hex nut using a 6 mm wrench and unscrew the proximity sensor from the Master plate assembly. Discard the old sensor.

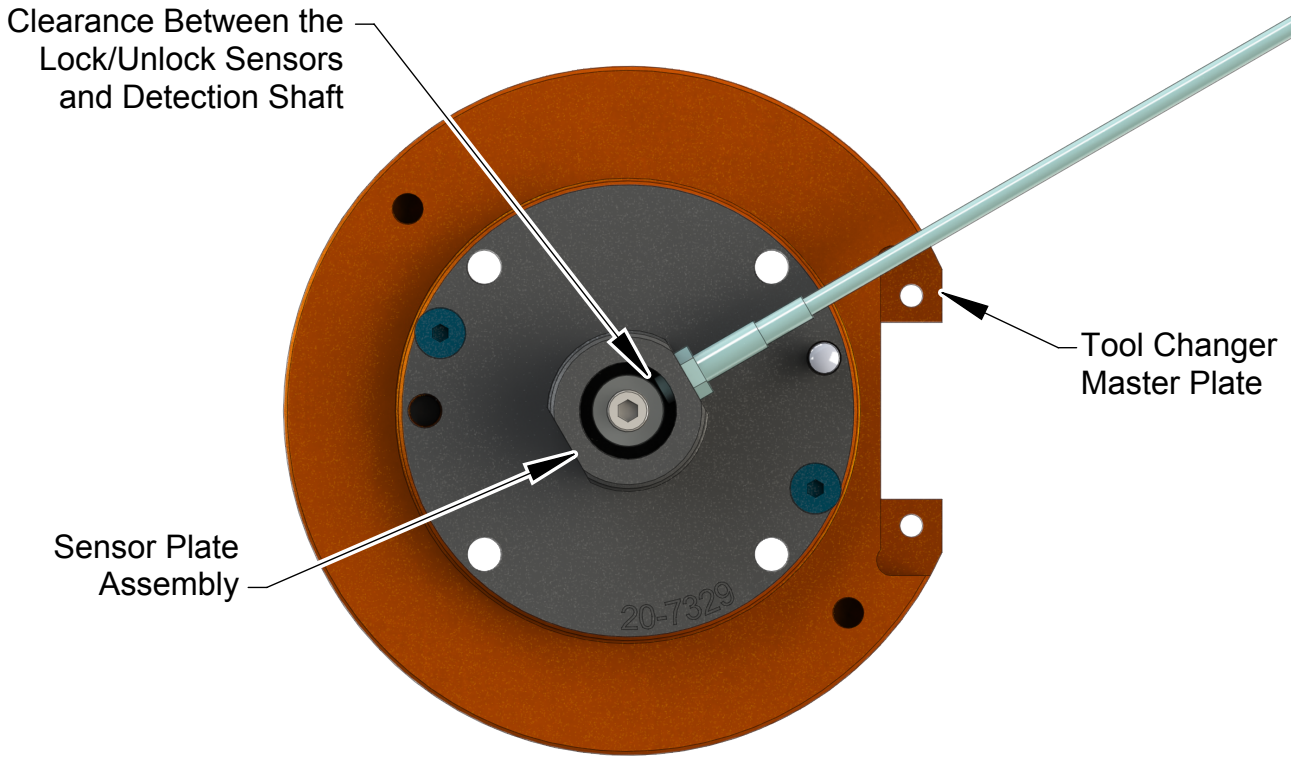
Figure 6.5—QC-20 and QC-21 Replace Proximity Sensor



8. On the new sensor, back the sensor hex nut to the cable end of the sensor.
9. Thread the proximity sensor into the Master plate assembly until it touches the detection Shaft, then back the sensor off one-half turn.

10. From a top-down view of the sensor plate assembly, verify the detection shaft does not touch the Lock and Unlock sensors. If the sensors touch the shaft, adjust the sensor position.

Figure 6.6—Verify Sensor and Detection Shaft Clearance



CAUTION: Do not operate locking mechanism with sensor touching the detection shaft. Operating the locking mechanism with the sensor touching the detection shaft will damage the sensor. Back off the sensor one-half turn and secure with the set screw before operating the locking mechanism.

11. Holding the sensor in position, apply Loctite 222 to the proximity sensor threads between the hex nut and the Master plate assembly. Tighten the hex nut using a 6 mm wrench and torque to 8 in-lbs (0.90 Nm).
12. Connect the sensor cable. When power is turned on to the sensor, the LED should illuminate, and sensor signal should be ON.
13. Attach the Master plate to the adapter plate using the (6) M4 socket head cap screws using a 2.5 mm hex key. Tighten to 10 in-lbs (1.13 Nm).
14. Connect other utilities to the optional modules on the Master plate.
15. Confirm operation of the replaced sensor.
    a. If testing the Lock sensor, make sure the Tool Changer is in the **Locked** position. If testing the Unlock sensor, make sure the Tool Changer is in the **Unlocked** position.
    b. Check to see the signal is ON and the sensor LED is illuminated, for the sensor being tested. Replace the sensors if they are not functioning.
16. Safely resume normal operation.

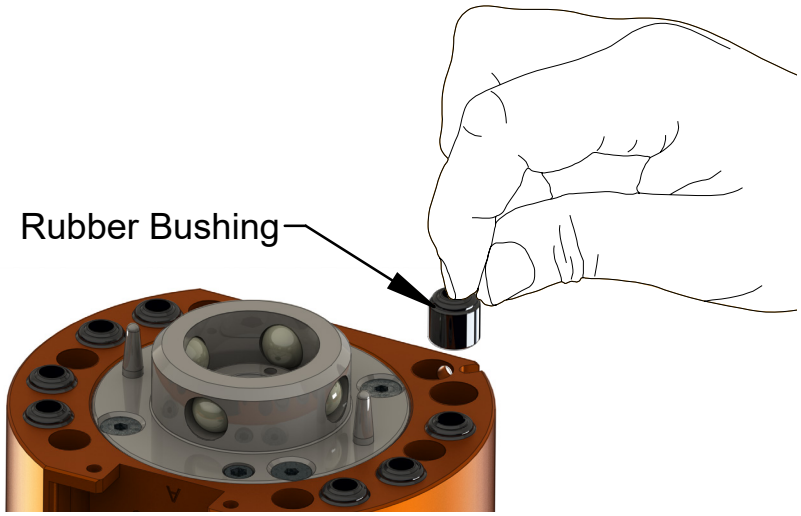
6.2.3 Rubber Bushing Inspection and Replacement

The rubber bushings seal the air passage from the Master plate to the Tool plate. Replace the bushings if they are cut or damaged.

Parts required: *Refer to Section 8—Serviceable Parts*

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits (e.g. electrical, air, water, etc.).
4. Remove the damaged rubber bushing from the body.
5. Dip the new bushing into water so that the bushing installs smoothly into the plate's bore.
6. Insert the beveled (chamfered) end of the rubber bushing into the bore, leaving ribbed end of the bushing facing outward.
7. Press the bushing in by hand until it is seated completely in the bore. If necessary, use a plastic or rubber soft-faced mallet to tap the bushings into place.
8. Safely resume normal operation.

Figure 6.7 —QC-5, QC-11, QC-20, QC-21, and QC-27 Rubber Bushing Replacement (QC-21 Shown)



6.2.4 QC-27M Alignment Pin Replacement

Excessive alignment pin/bushing wear could indicate poor robot positioning during pickup/drop-off. Adjust the robot position as needed. Check the tool stand for wear and alignment problems. If necessary, replace the alignment pins.

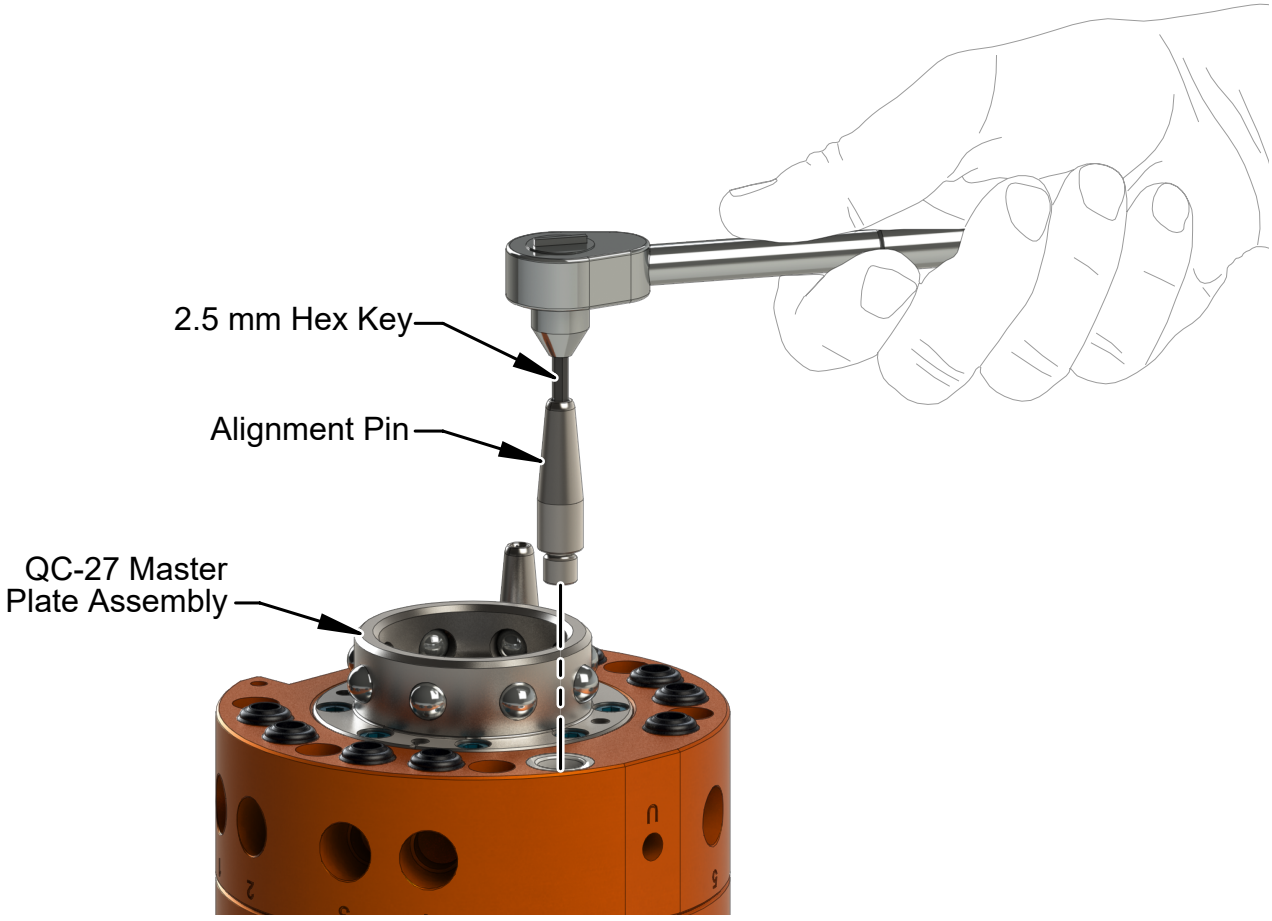
Tools required: *2.5 mm hex key, torque wrench*

Parts required: *Refer to Section 8.6—Models QC-27 Serviceable Parts.*

Supplies required: *Loctite 242, MobilGrease XHP222 Special is a NLGI #2 lithium complex grease with molybdenum disulfide*

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits (e.g. electrical, air, water, etc.).
4. Using a 2.5 mm hex key, remove the alignment pin and discard.
5. Apply Loctite 242 to the threads of the new alignment pin and thread into the Master plate assembly. Tighten to 18 in-lbs (2.0 Nm).
6. Apply a liberal coating of MobilGrease XHP222 Special grease to the alignment pins.
7. Safely resume normal operation.

Figure 6.8—QC-27M Alignment Pin Replacement

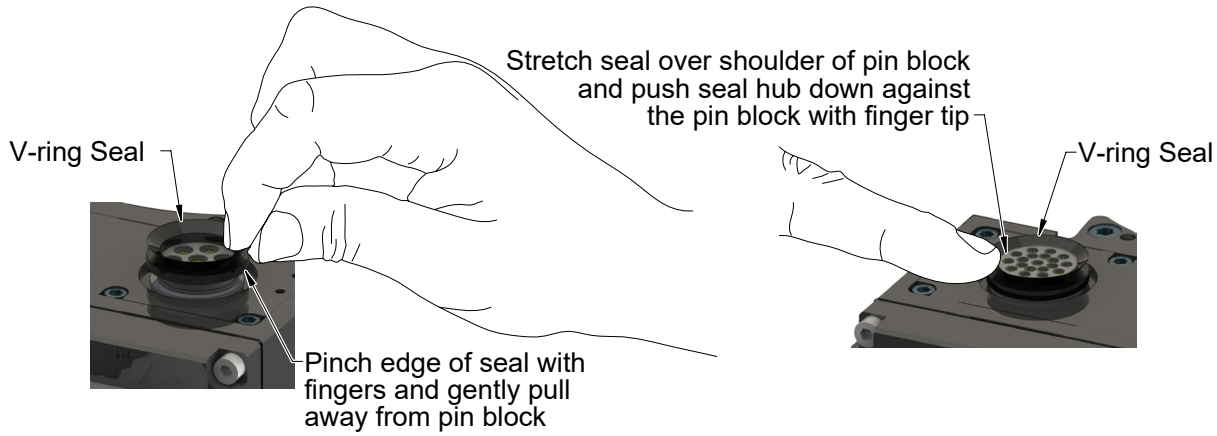


6.2.5 Optional Electrical Module V-ring Seal Inspection and Replacement

The seal protects the electrical connection between the Master and Tool module. Replace the seal if it becomes worn or damaged.

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits (for example: electrical, pneumatic, and hydraulic circuits).
4. To remove the existing seal, pinch the edge of the seal and pull the seal away from the pin block on the Master module.
5. To install a new seal, stretch the new seal over the shoulder of the pin block.
6. Push the seal hub down against the pin block.
7. Safely resume normal operation.

Figure 6.9—V-ring Seal Replacement



7. Specifications

Table 7.1—Tool Changer Specifications					
Specification	**Tool Changer Model**				
	QC-5	**QC-11**	**QC-20**	**QC-21**	**QC-27**
Recommended Max Payload	18 lbs. (8.2 kg)	35 lbs. (16 kg)	55 lbs. (25 kg)	55 lbs. (25 kg)	85 lbs. (25 kg)
Operating Temperature Range	-20–150°F (-30–66°C)	-20–150°F (-30–66°C)	-20–150°F (-30–66°C)	-20–150°F (-30–66°C)	-20–150°F (-30–66°C)
Operating Pressure Range (filtered to 50 micron or better)	60–100 psi (4.1–6.9 bar)	60–100 psi (4.1–6.9 bar)	60–100 psi (4.1–6.9 bar)	60–100 psi (4.1–6.9 bar)	60–100 psi (4.1–6.9 bar)
Coupling Force @ 80 psi	160 lbs (690 N)	240 lbs (1100 N)	520 lbs (2300 N)	520 lbs (2300 N)	780 lbs (3500 N)
Recommended Max Moment X-Y (Mxy)	110 lbf-in (12.4 Nm)	180 lbf-in (20.3 Nm)	500 lbf-in (56.5 Nm)	500 lbf-in (56.5 Nm)	750 lbf-in (84.7 Nm)
Recommended Max Torque about Z (Mz)	150 in-lbs (16.9 Nm)	110 lbf-in (12.4 Nm)	310 in-lbs (35 Nm)	310 in-lbs (35 Nm)	880 in-lbs (99.4 Nm)
Positional Repeatability	0.0004” (0.0102 mm)	0.0004” (0.0102 mm)	0.0006” (0.0152 mm)	0.0006” (0.0152 mm)	0.0006” (0.0152 mm)
Weight (coupled, no access.)	0.8 lbs. (0.363 kg)	0.54 lbs. (0.245 kg)	1.88 lbs. (0.853 kg)	1.75 lbs. (0.794 kg)	2.62 lbs. (1.19 kg)
Master Weight	0.6 lbs. (0.272 kg)	0.36 lbs. (0.163 kg)	1.18 lbs. (0.535 kg)	1.05 lbs. (0.476 kg)	1.95 lbs. (0.885 kg)
Tool Weight	0.2 lbs. (0.0907 kg)	0.18 lbs. (0.0816 kg)	0.7 lbs. (0.318 kg)	0.7 lbs. (0.318 kg)	0.67 lbs. (0.304 kg)
Max. Recommended distance between Master and Tool plate	0.08” (2 mm)	0.06” (1.5 mm)	0.08” (2 mm)	0.08” (2 mm)	0.08” (2 mm)
Pass through Port, (Qty) Connection Size (Maximum pressure of 100psi (6.9bar))	(6) M5 X 8[1]	(6) M5 X 8[1]	(12) M5 X 8[1] or (16) M5 x 8[1]	(8) 1/8 NPT or (8) G 1/8 BSPP	(8) 1/8 NPT or (8) G 1/8 BSPP
Pneumatic Lock and Unlock Port Connection size	M5 X 8[1]	M5 X 8[1]	M5 X 8[1]	M5 X 8[1]	M5 X 8[1]
Mounting/Customer Interface	Refer to *Section 9—Drawings*				

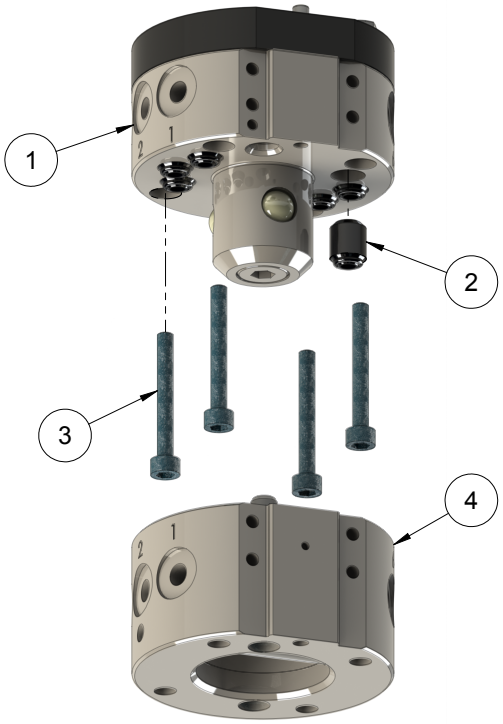
Notes:

1. Tool Changes with M5 X 8 threaded ports can also used with #10-32 air hose fittings.

8. Serviceable Parts

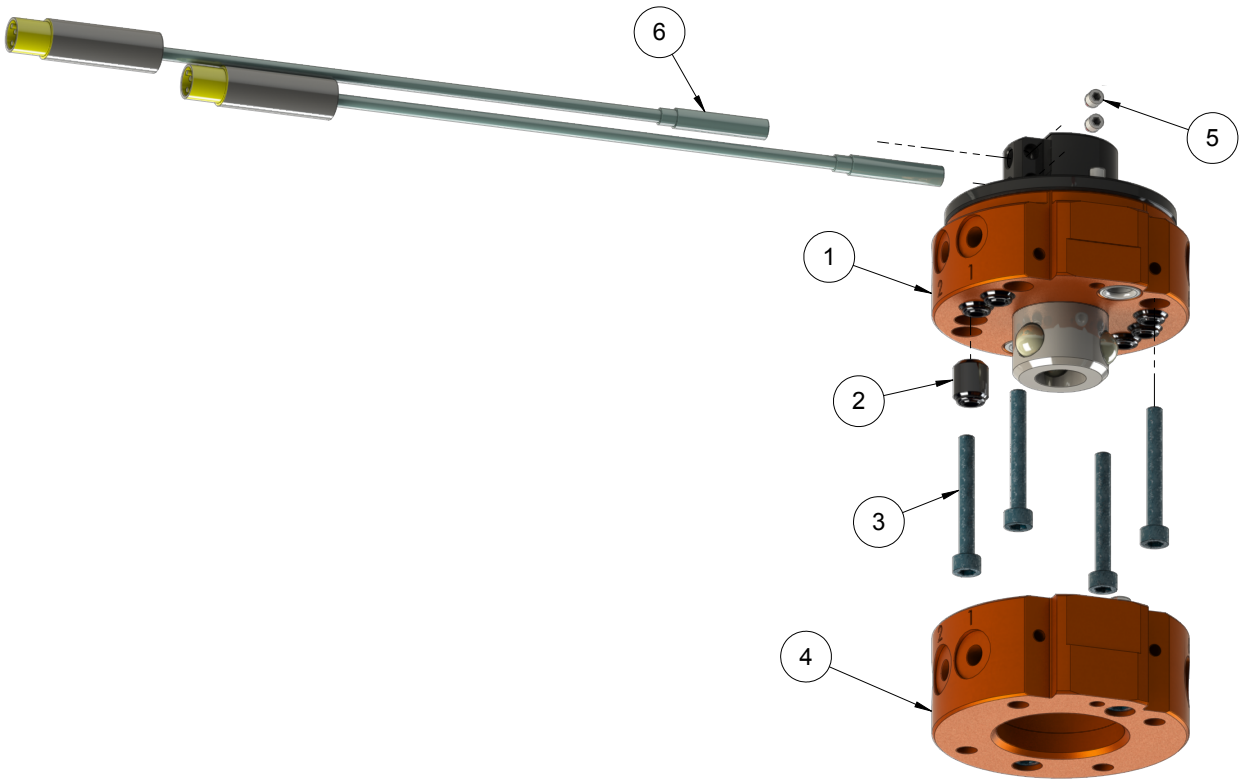
The following items are commonly used as spare parts for the QC-5 through QC-27 Tool Changers.

8.1 Models QC-5 Serviceable Parts



QC-5 Master plate			
Item No.	**Qty**	**Part Number**	**Description**
1	1	9120-005M-000-000	QC-5 Master, no options
2	6	4010-0000009-02	M5 Rubber Bushing, Nitrile, Light-5
3	4	3500-1058025-12	M3 x 25mm socket head cap screws Zinc
QC-5 Tool plate			
4	1	9120-005T-000-000	QC-5 Tool, no options

8.2 Models QC-11 Serviceable Parts

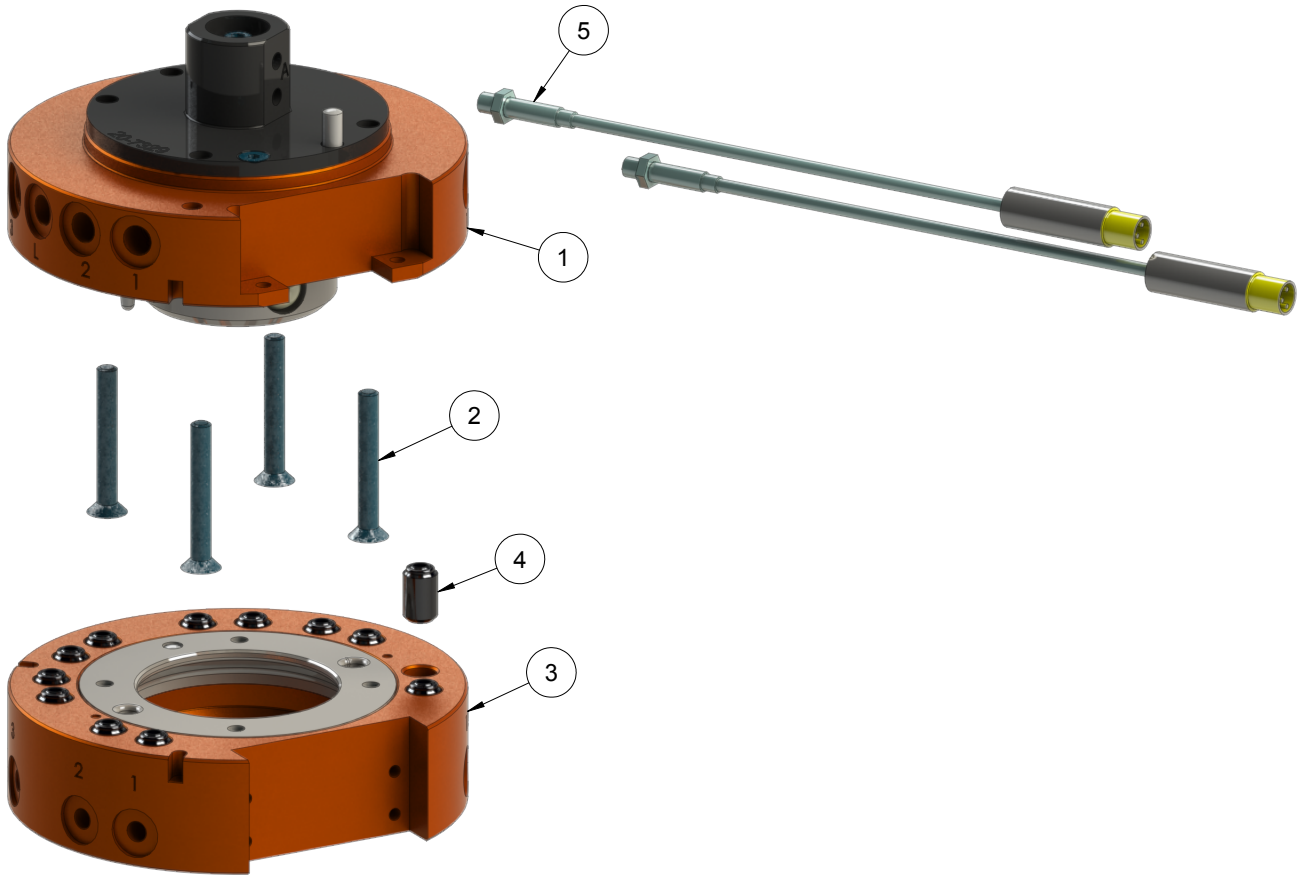


QC-11 Master plate			
Item No.	**Qty**	**Part Number**	**Description**
1	1	9120-011M-000-000	QC-11 Master Assembly, No Options (Orange Anodized)
		9120-011M-000-000-B	QC-11 Master Assembly, No Options (Black Anodized)
2	6	4010-0000009-02	M5 Rubber Bushing, Nitrile, Light-5
3	4	3500-1058025-11	M3 x 25mm socket head cap screws Black Oxide
QC-11 Tool plate			
4	1	9120-011T-000-000	QC-11 Tool Assembly, No Options (Orange Anodized)
		9120-011T-000-000-B	QC-11 Tool Assembly, No Options (Black Anodized)
SIP Assemblies			
5	2	3500-1957030-11	SSCR, M3 x 3, NYLON TIP
PNP Sensors - 9120-011M-000-000-SQ-yyyy (9120-011M-SIP Q-yyyy)			
6	2	8590-9909999-27	M4-0.5 PNP Sensor with M8 Male Plug
NPN Sensors - 9120-011M-000-000-SQN-yyyy (9120-011M-SIP-QN-yyyy)			
6	2	8590-9909999-78	M4-0.5 NPN Sensor

Notes:

1. Tool Changer Master Assemblies can be ordered with a (SIP) sensor interface plate. The -SQx in the Part Number indicates the sensor type, SQ for PNP type sensors or SQN for NPN type sensors. If no SIP is ordered, the -SQx will not exist in the Part Number (i.e. 9120-011M-000-000-B).
2. The -yyyy specifies the Interface plate model, contact an ATI sales representative for custom interface plate available.

8.3 Models QC-20 PM5 Model Serviceable Parts

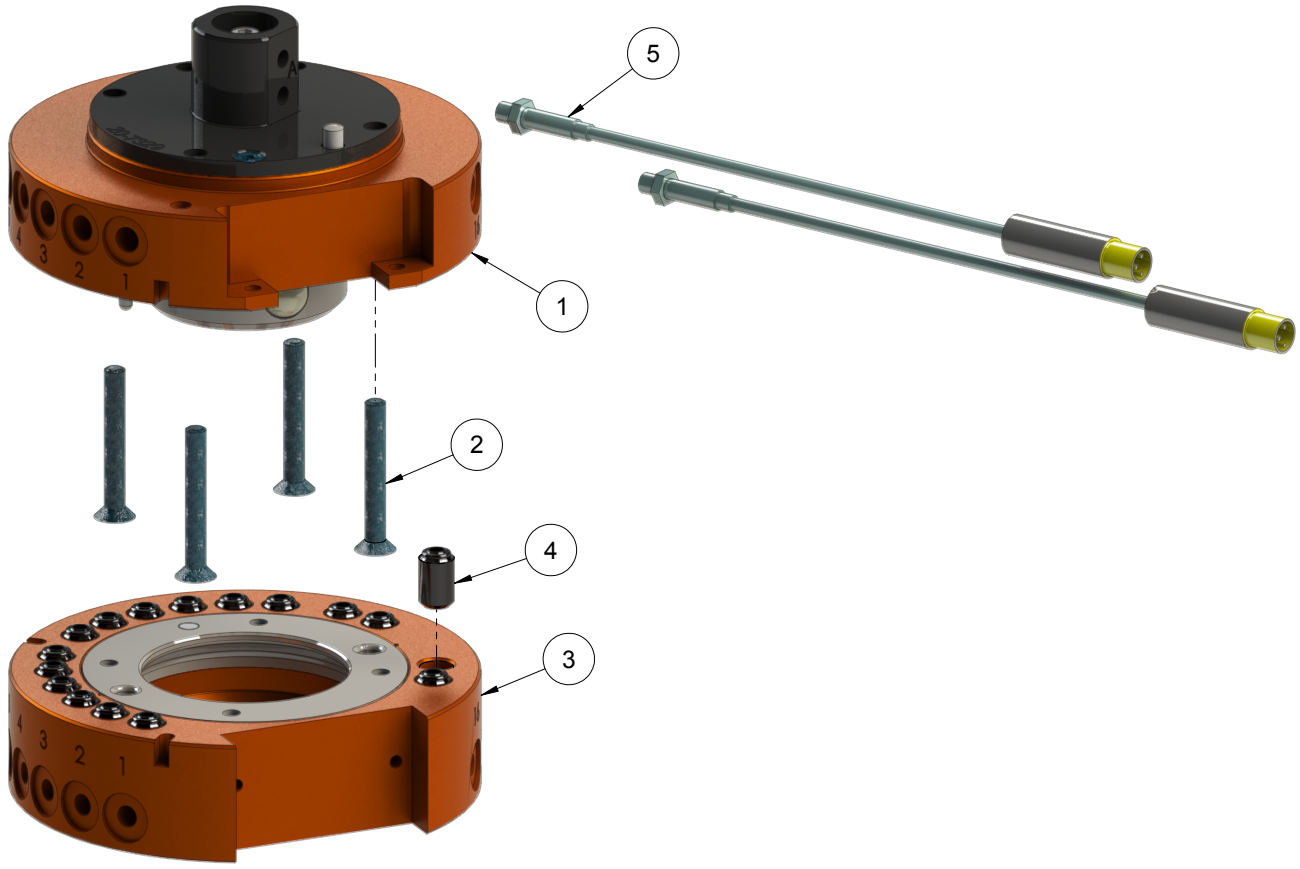


QC-20 Master plate			
Item No.	**Qty**	**Part Number**	**Description**
1	1	9120-020M-000-PM5	QC-20 Master, 12 air ports, no options (Orange Anodized)
		9120-020M-000-PM5-B	QC-20 Master, 12 air ports, no options (Black Anodized)
		9120-020M-000-PM5-C	QC-20 Master, 12 air ports, no options (Clear Anodized)
2	4	3500-1262035-15	M4 x 35mm SFHCS, Blue Dyed Magni-565
QC-20 Tool plate			
3	1	9120-020T-000-PM5	QC-20 Tool, 12 air ports, no options (Orange Anodized)
		9120-020T-000-PM5-B	QC-20 Tool, 12 air ports, no options (Black Anodized)
		9120-020T-000-PM5-C	QC-20 Tool, 12 air ports, no options (Clear Anodized)
4	12	4010-0000014-02	M5 Rubber Bushing, Nitrile
SIP Assemblies			
PNP Sensors - 9120-020M-000-PM5-SQ-yyyy (9120-020M-SIP-Q-yyyy)			
5	2	8590-9909999-27	M4-0.5 PNP Sensor with M8 Male Plug
NPN Sensors - 9120-020M-000-PM5-SQN-yyyy (9120-020M-SIP-QN-yyyy)			
5	2	8590-9909999-78	M4-0.5 NPN Sensor

Notes:

1. Tool Changer Master Assemblies can be ordered with a (SIP) sensor interface plate. The -SQx in the Part Number indicates the sensor type, SQ for PNP type sensors or SQN for NPN type sensors. If no SIP is ordered, the -SQx will not exist in the Part Number (i.e. 9120-020M-000-PM5-B).
2. The -yyyy specifies the Interface plate model, contact an ATI sales representative for custom interface plate available.

8.4 Models QC-20 with 16 M5 X 0.8 Pass through Ports Serviceable Parts

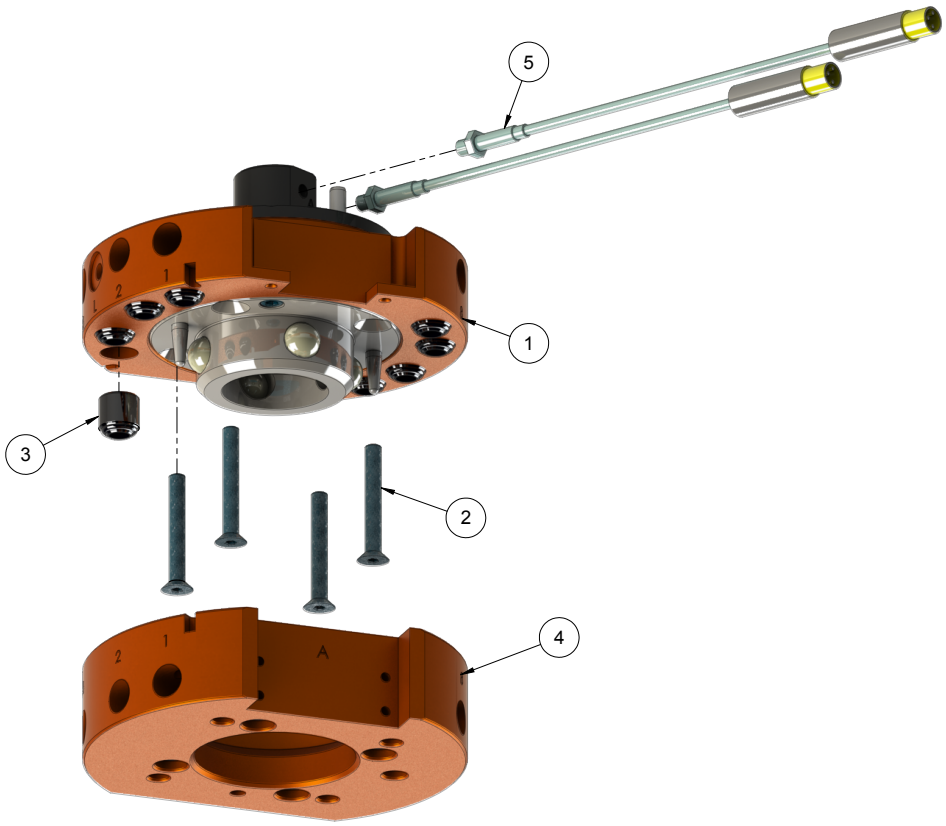


QC-20 Master plate			
Item No.	**Qty**	**Part Number**	**Description**
1	1	9120-020M-000-P16	QC-20 Master, 16 Ports, No Options, (Orange Anodized)
		9120-020M-000-P16-B	QC-20 Master, 16 Ports, No Options (Black Anodized)
2	4	3500-1262035-15	M4 x 35mm SFHCS, Blue Dyed Magni-565
QC-20 Tool plate			
3	1	9120-020T-000-P16	QC-20 Tool, 16 Ports, No Options, (Orange Anodized)
		9120-020T-000-P16-B	QC-20 Tool, 16 Ports, No Options, (Black Anodized)
4	16	4010-0000014-02	M5 Rubber Bushing, Nitrile
SIP Assemblies			
PNP Sensors - 9120-020M-000-P16-SQ-yyyy (9120-020M-SIP-Q-yyyy)			
5	2	8590-9909999-27	M4-0.5 PNP Sensor with M8 Male Plug
NPN Sensors - 9120-020M-000-P16-SQN-yyyy (9120-020M-SIP-QN-yyyy)			
5	2	8590-9909999-78	M4-0.5 NPN Sensor

Notes:

1. Tool Changer Master Assemblies can be ordered with a (SIP) sensor interface plate. The -SQx in the Part Number indicates the sensor type, SQ for PNP type sensors or SQN for NPN type sensors. If no SIP is ordered, the -SQx will not exist in the Part Number (i.e. 9120-020M-000-P16-B).
2. The -yyyy specifies the Interface plate model, contact an ATI sales representative for custom interface plate available.

8.5 Models QC-21 Serviceable Parts

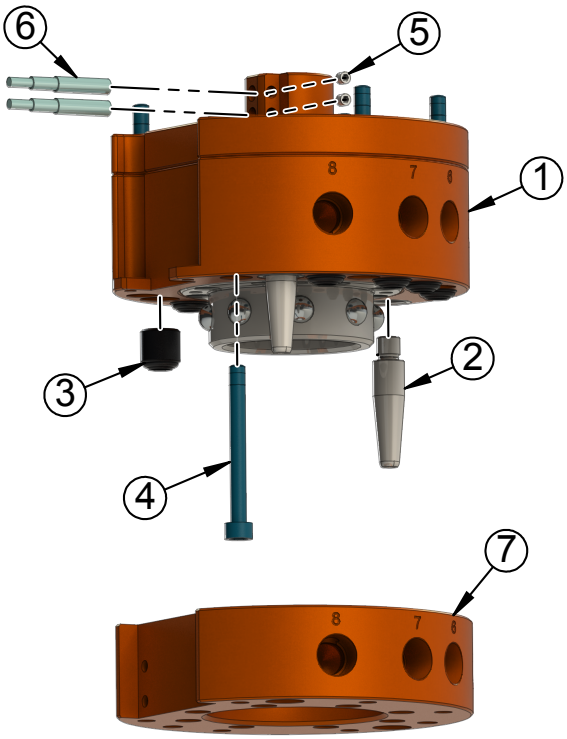


QC-21 Master plate			
Item No.	**Qty**	**Part Number**	**Description**
1	1	9120-021M-000-000	QC-21 Master, no options, 1/8 NPT ports (Orange Anodized)
		9120-021M-000-000-E	QC-21 Euro Master, no options, G 1/8 (BSPP) (Black Anodized)
2	4	3500-1262035-15	M4 x 35mm SFHCS, Blue Dyed Magni-565
3	4	4010-0000013-01	1/8” NPT Rubber Bushing, Nitrile
QC-21 Tool plate			
4	1	9120-021T-000-000	QC-21 Tool, no options (Orange Anodized)
		9120-021T-000-000-E	QC-21 Euro Tool, no options (Black Anodized)
SIP Assemblies			
PNP Sensors - 9120-021M-000-000-SQ-yyyy (9120-021M-SIP-Q-yyyy or 9120-021ME-SIP-Q-yyyy)			
5	2	8590-9909999-27	M4-0.5 PNP Sensor with M8 Male Plug
NPN Sensors - 9120-021M-000-000-SQN-yyyy (9120-020M-SIP-QN-yyyy)			
5	2	8590-9909999-78	M4-0.5 NPN Sensor

Notes:

1. Tool Changer Master Assemblies can be ordered with a (SIP) sensor interface plate. The -SQx in the Part Number indicates the sensor type, SQ for PNP type sensors or SQN for NPN type sensors. If no SIP is ordered, the -SQx will not exist in the Part Number (i.e. 9120-021M-000-000-E).
2. The -yyyy specifies the Interface plate model, contact an ATI sales representative for custom interface plate available.

8.6 Models QC-27 Serviceable Parts



QC-27 Master plate			
Item No.	**Qty**	**Part Number**	**Description**
1	1	9120-027M-000-000	QC-27 Master, no options, 1/8 NPT ports (Orange Anodized)
		9120-027M-000-000-E	QC-27 Euro Master, no options, G 1/8 (BSPP) (Black Anodized)
2	2	3700-20-1373	Monolithic Alignment Pin
3	8	4010-0000013-01	1/8” NPT Rubber Bushing, Nitrile
4	6	3500-1062040-15A	M4 x 40mm Socket Head Cap Screw Blue Dyed Magni-565 w/Microspheres
5	2	3500-1957030-11	Socket Set Screw, M3 x 3, Nylon Tip
QC-27 Tool plate			
7	1	9120-027T-000-000	QC-21 Tool, no options (Orange Anodized)
		9120-027T-000-000-E	QC-21 Euro Tool, no options (Black Anodized)
Sensor Options			
9120-027M-000-000-SQ-yyyy or 9120-027M-000-000-SQ-yyyy-E			
6	2	8590-9909999-27	M4-0.5 PNP Sensor with M8 Male Plug
9120-021M-000-000-SQ1-yyyy or 9120-021M-000-000-SQ1-yyyy-E			
6	2	8590-9909999-97	PNP proximity sensor, M4-0.5, 2 m long, no conn

Notes:

1. QC-27 Tool Changer Master Assemblies are equipped with a (SIP) sensor interface plate. The -SQx in the Part Number indicates the sensor type, SQ for PNP type sensors or SQN for NPN type sensors. If no SIP is ordered, the -SQx will not exist in the Part Number (i.e. 9120-027M-000-000-B).
2. The -yyyy specifies the Interface plate model, contact an ATI sales representative for custom interface plates available.

9. Drawings

Drawings are available on the *ATI website* or by contacting an ATI representative.