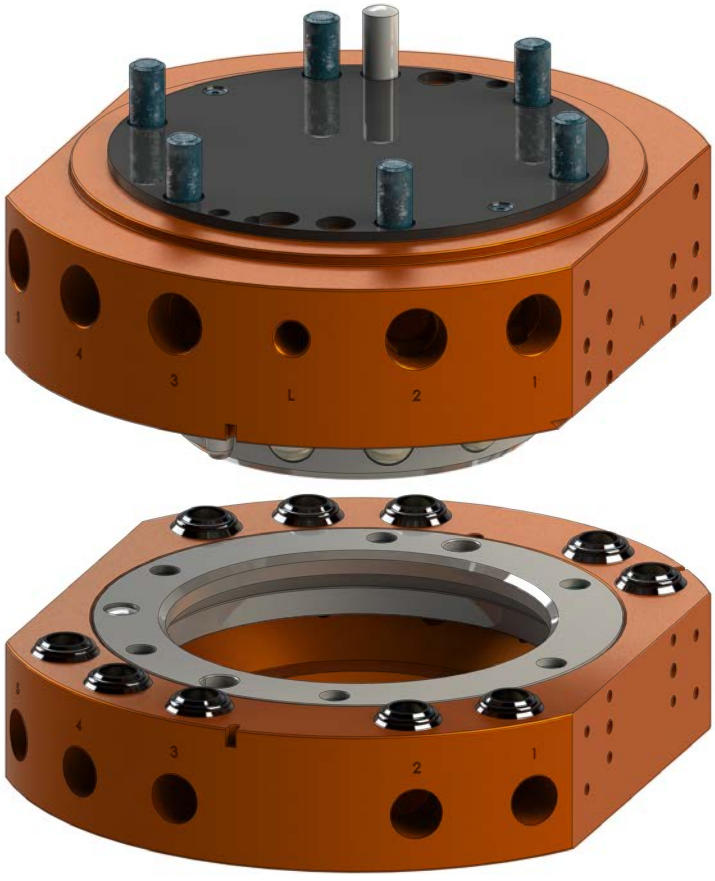
QC-150 Robotic Tool Changer

Manual



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Foreword

This manual contains basic information applicable to all ATI Tool Changer robotic Tool Changers. Certain Tool Changer 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 your particular model.

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

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Glossary of Terms

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 or Utility Coupler.
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 standard Master assemblies which closes the pneumatic chamber.
Detection Shaft	Threaded stem inserted into the robot side of the piston, 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	Component that adapts a Tool Changer or Utility Coupler to the user's robot or tooling.
Lock	The lock air pressure provided to the Master plate locking mechanism forcing the cam to press the locking balls against the bearing race. This locks the Master and Tool plates together.
Lock Port	Pneumatic port on the Master plate through which air pressure is supplied to Lock the Master plate to the Tool plate.
Locked	An output signal provided by a proximity sensor, indicating that the coupling mechanism is in the Locked position.
Locking Mechanism	Manual, pneumatic, or electrical driven device that draws the Master and Tool plates together securing them in a fail-safe or 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/Unlock sensing 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™	Design feature of all ATI Tool Changer products that allows coupling the Master plate and Tool plate without physical contact prior to locking.
Piston	Cylinder located in the Master plate that actuates the locking mechanism.
Pneumatic Module	Utility modules that pass air or vacuum through the Master and Tool modules to the end-effector.
Sensor Plate	Cover plate for the back side of the Master plate, 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.
SIP	Sensor Interface Plate used to adapt the Tool Changer Master to the robot. The SIP is 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 tools or end-effectors are mounted.
Tool Stand	Stand that holds Tools not being used by the robot.
Trip Dog	A physical device used to activate a mechanical switch, use 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 forcing the cam to release the locking balls from the bearing race. Allowing 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.

1. Safety

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

1.1 Explanation of Notifications

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

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

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

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

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

1.2 General Safety Guidelines

Prior to purchase and installation, the customer should verify that the Tool Changer selected is rated for the maximum loads and moments expected during operation. Refer to product specifications section in each module of this manual or contact ATI for assistance. Particular attention should be paid to dynamic loads caused by robot acceleration and deceleration. These forces can be many times the value of static forces in high acceleration or deceleration situations.

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 be prevented 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 the Tool Changer is specified with Lock/Unlock (L/U) and Ready-to-Lock (RTL) sensing capability, the status should be monitored and interlocks applied to prevent injury 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. Failure of critical electrical or pneumatic lines to function properly may result in injury to personnel and equipment.

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

1.3 Safety 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 (e.g. 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

The Tool Changer provides flexibility to robot applications by allowing the robot to change customer tooling (e.g., grippers, vacuum cup tooling, pneumatic and electric motors, weld guns, etc.) automatically. The Tool Changer consists of a Master plate and a Tool plate. The Master plate is attached to a robot, while end-effectors such as grippers, material handlers, etc. are attached to one or more Tool plates.

The Master plate locks to the Tool plate with a pneumatically driven locking mechanism. This locking mechanism uses a patented, multi-tapered cam with ball locking technology and a patented fail-safe mechanism.

The robot can be programmed to select the desired customer tooling by coupling the Master plate to the Tool plate attached to the tooling. Electrical signals, pneumatic power, and fluids can be transferred to the customer tooling through the Master plate and Tool plate by optional modules. See the respective manuals for these options for more details.

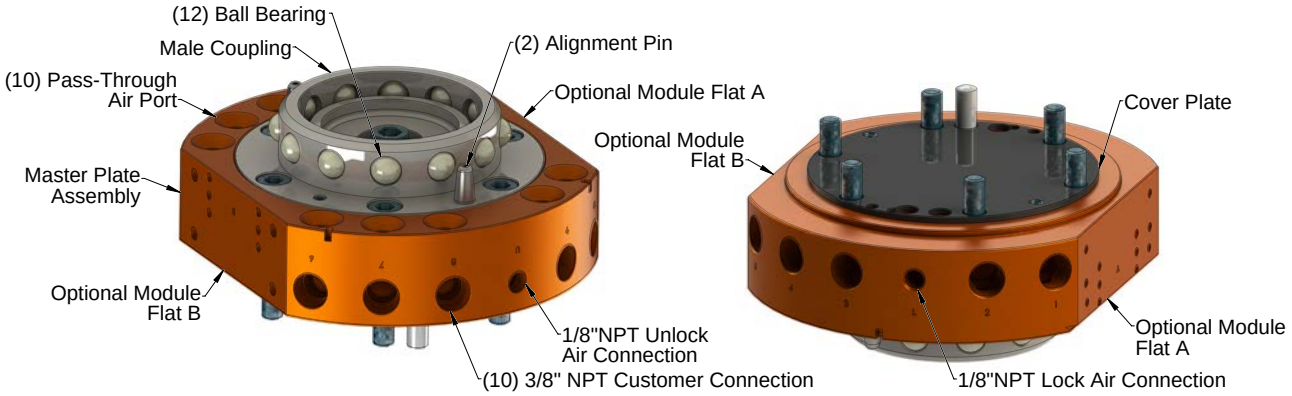
Table 2.1—Standard QC Tool Changer Models and Features

Model	Payload	Flats	Plate	Pneumatic Ports	Part No.
QC-150	440 lbs (200 kg)	(2) Flat	Master	(10) 3/8” NPT Pass through ports (2) 1/8” NPT Lock/Unlock air ports	9120-150M-000-000 9120-150M-000-000-B
			Tool	(10) 3/8” NPT Pass through ports	9120-150T-000-000 9120-150T-000-000-B
			Master	(10) 3/8”-19 BSPP Pass through ports (2) 1/8”-28 BSPP Lock/Unlock air ports	9120-150M-000-000-E
			Tool	(10) 3/8”-19 BSPP Pass through ports	9120-150T-000-000-E
			Master	(10) R 3/8” BSPT Pass through ports (2) R 1/8” BSPT Lock/Unlock air ports	9120-150M-000-000-R
			Tool	(10) R 3/8” BSPT Pass through ports	9120-150T-000-000-R
Notes: QC-150 Tool Changer Master and Tool plate assemblies with (-B and -E) part numbers have black anodized bodies					

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 (2) flats for mounting optional modules.

Figure 2.1—Master Plate Assemblies (9120-150M-000-000 Shown)



The air port provides lock and unlock air for the locking mechanism and pass through air for the end of arm tooling.

Alignment pins on the Master mate with bushings on the Tool to ensure repeatable alignment during the coupling process. An extreme pressure grease is applied to the cam, male coupling, ball bearings, and pins to maximize the life of the Master plate assembly.

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

2.2 Tool Plate Assembly

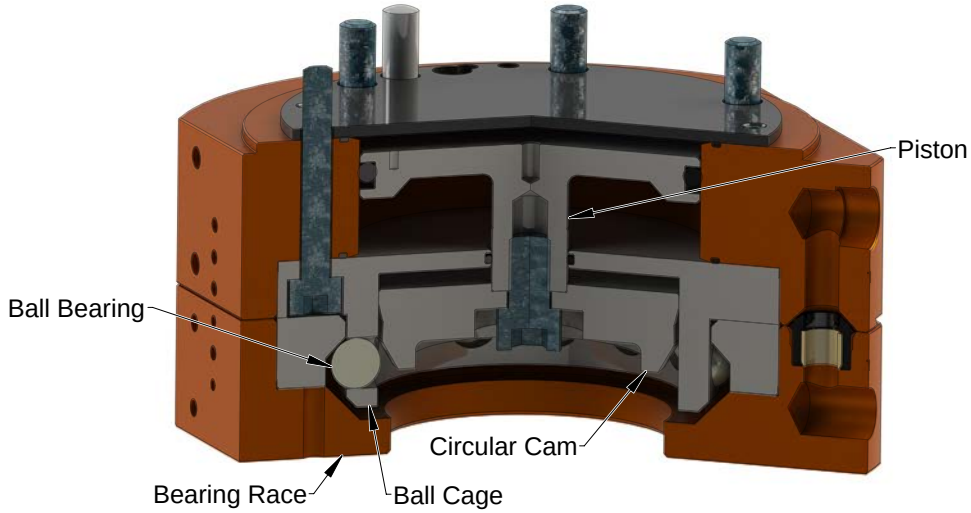
The Tool plate assembly includes an anodized aluminum body and hardened stainless-steel bearing race. The Tool plate provides (2) flats for mounting optional modules. The Tool plate is equipped with pass through air ports to supply air to the end of arm tooling.

Figure 2.2—Tool Plate Assembly

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)

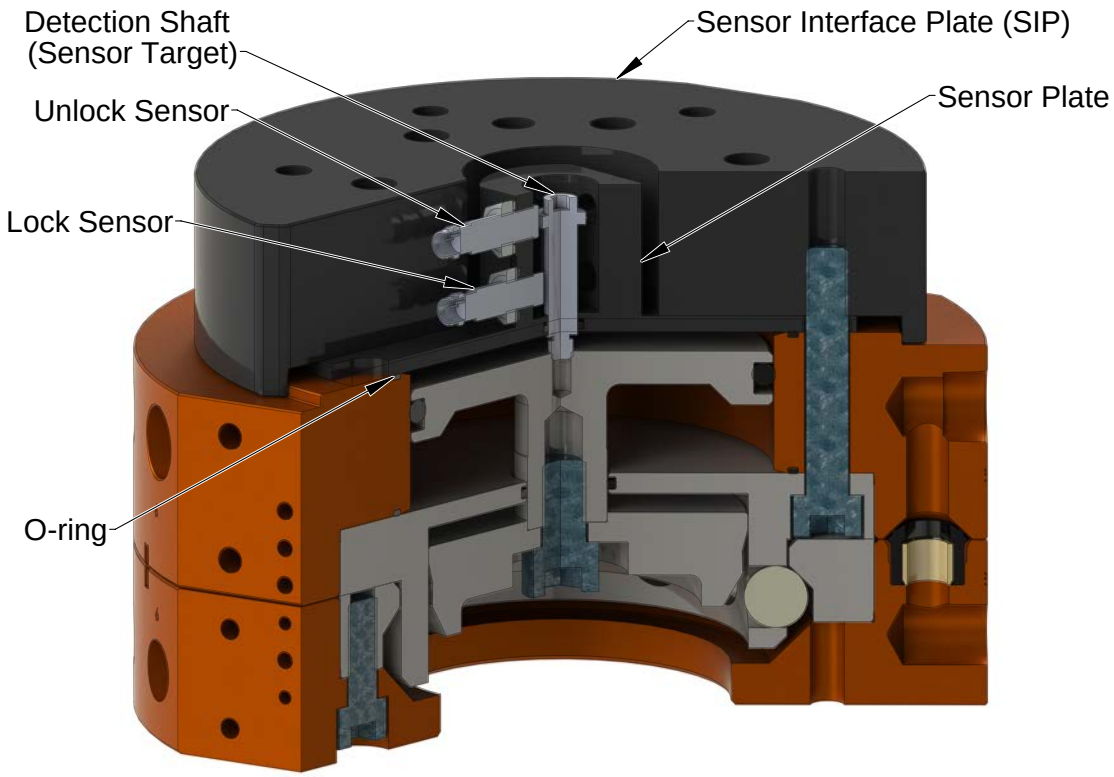
The sensor interface plate (SIP) system provides locking mechanism position signals to the customer process controller. These signals indicate (2) possible conditions for the Tool Changer Master plate: unlocked or locked.

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.

Figure 2.4—Optional Sensor Interface Plate



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. Some modules require an adapter plate.

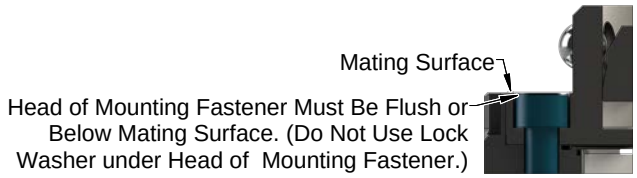
For assistance in choosing the right modules for your application, visit the specific QC-150 model webpage by clicking on the link *QC-150 Web Page* and select the Compatible Modules tab to see what is available or contact an ATI Sales Representative.

3. Installation

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 (e.g. 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: 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 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 or sensor interface plate (SIP). Applying air pressure can damage the cover plate, O-ring or may cause injury to personnel from flying debris. Always install an interface plate or SIP and have the Tool Changer mounted securely to the robot before applying air pressure. Refer to *Section 3.1—Robot Side Interface Plates* and *Section 3.2—Master Plate Installation* for more information.

CAUTION: Failure to follow the interface plate or tool interface plate design consideration in *Section 3.1—Robot Side Interface Plates* and *Section 3.4—Tool Interface Plate* may result in cover plate O-ring damage or loosening of the interface during operation. Follow the guidelines provided when designing an interface plate for the Tool Changer.

CAUTION: Do not use fasteners that exceed the thread depth in the Tool Changer. Refer to *Section 9—Drawings* for details on mounting hole thread depth. Secure the Tool Changer with the proper length fasteners. This is true for both robot and tool interfaces.

CAUTION: Do not use fasteners with pre-applied adhesive more than once. Fasteners might become loose and cause equipment damage. Always apply new thread locker when reusing fasteners.

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

The end-effector typically attaches to the Tool plate with an interface plate, standard and custom 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 tooling should be tightened to a torque value as indicated, refer to *Table 3.1*.

Pneumatic lines and electrical cables are attached, bundled, and must be strain-relieved to allows for movement during operation.

Table 3.1—Fastener Size, Class, and Torque Specifications

Mounting Conditions	Fastener Size and Property Class	Recommended Torque	Thread Locker
QC-150 Master plate to Interface plate or Sensor Interface plate, Supplied Fasteners	M10 x 1.5 Class 12.9		Pre-applied Adhesive or Loctite 242
	Socket head cap	55 ft-lbs (75 Nm)	
Tool Interface Plate to QC-150 Tool plate Minimum thread engagement of 15 mm [1.5X fastener Ø]. *Do not exceed maximum available thread depth as shown in Section 9—Drawings*	M10 x 1.5 Class 12.9		
	Socket head cap	55 ft-lbs (75 Nm)	
Optional Module or adapter plate to Master or Tool plate, Supplied Fasteners	M4 x 0.7 Class 12.9		Pre-applied Adhesive or Loctite 222
	Socket head cap	15 in-lbs (1.69 Nm)	
	Socket flat head cap	10 in-lbs (1.13 Nm)	

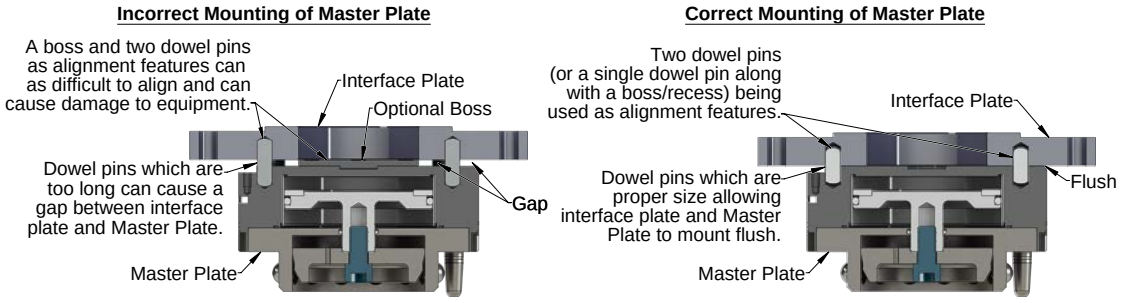
3.1 Robot Side Interface Plates

The interface plate is used to adapt the Master plate to a specific robot arm. The interface plate is designed with mounting features such as a boss and/or bolt and dowel holes. These features are used to accurately position and secure the Master plate to the robot arm. Custom interface plates are available from ATI upon request.

If the customer chooses to design and build an interface plate, the following points should be considered:

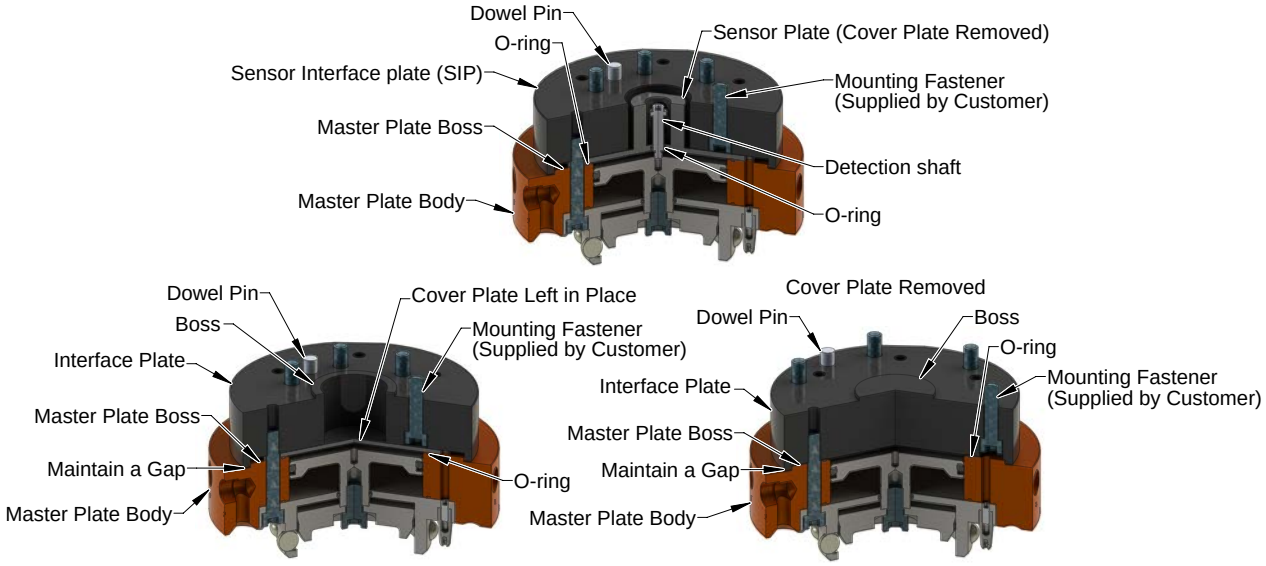
CAUTION: Do not use more than two alignment features when securing a Master plate to a robot interface plate. Using more than two alignment features can cause damage to equipment. Use either two dowel pins or a single dowel pin along with a boss/recess feature to align the Master plate with the robot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

CAUTION: Do not use dowel pins that are too long that will not allow the interface plate and Master body 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 causing damage to the equipment. Use the proper size dowel pins that will not extend further than allowed by the Master body.



- The interface plate must include bolt holes for mounting, dowel pins, and a boss for positioning on the robot and Master plate. (Refer to robot manual). (The dowel and boss features prevent rotation).
- A piston cover plate is provided with the Tool Changer Master plate. If the interface plate provides sealing for the piston cylinder, then the cover plate can be removed.
- The interface plate must be designed to provide rigid mounting on the boss surfaces. The interface plate must not contact the Master body outside of the boss. The recommended dimensions for the interface plate bore, with and without the cover plate, are provided in *Section 9—Drawings*. The mating diameters must provide sufficient clearance so that mating corner radii do not interfere.
- The thickness of the interface plate must be enough to provide the necessary thread engagement for the mounting bolts.
- Mounting bolts must not be too long that a gap is formed at the interface.

Figure 3.1—Interface Plate and SIP with Master Plate Configurations



3.2 Master Plate Installation

Tools required: *2.5 mm and 8 mm Allen® wrench, torque wrench*

Supplies required: *Clean rag, Loctite 242*

The Tool Changer Master plate mounts to the robot flange using an SIP or interface plate. A cover plate attaches to the Master plate to protect the internal locking mechanism during shipment. The cover plate must be removed if an SIP is being used, and may have to be removed if an interface plate is being used. The interface plate can be designed to accommodate the cover plate.

1. Clean the mating surfaces.
2. Align the dowel pin in the interface plate or SIP to the corresponding holes in the robot arm and secure with supplied or customer supplied fasteners, refer to *Figure 3.1*. Refer to *Table 3.1* for fasteners and torque.
3. What type of interface plate is being installed?
   If an interface plate that replaces the cover plate is being installed, go to step *4*.
   If an SIP or an interface plate that incorporates the cover plate, go to step *6*.
4. Using a 2.5 mm Allen wrench, remove the (2) M3 socket flat head screws and discard.
5. Remove the cover plate.

> **CAUTION:** Make sure the O-ring is seated in the groove in the Master plate. If the O-ring is not seated in the groove it can be cut or damaged, resulting in a leaking seal. Seat O-ring into groove in Master body.

6. Align the dowel pin in the interface plate or SIP to the corresponding holes in the Master plate and secure with supplied (6) M10 socket head cap screws using an 8 mm Allen wrench, refer to *Figure 3.2*. Refer to *Table 3.1* for fasteners and torque.
7. Connect all lock / unlock and pass through air connections to the connections on the Master plate. For lock and unlock air refer to *Section 3.10—Pneumatic Requirements.*
8. If equipped connected the lock and unlock sensor cables.
9. If equipped connect other utilities to the optional modules on the Master plate.
10. After the procedure is complete, resume normal operation.

3.3 Master Plate Removal

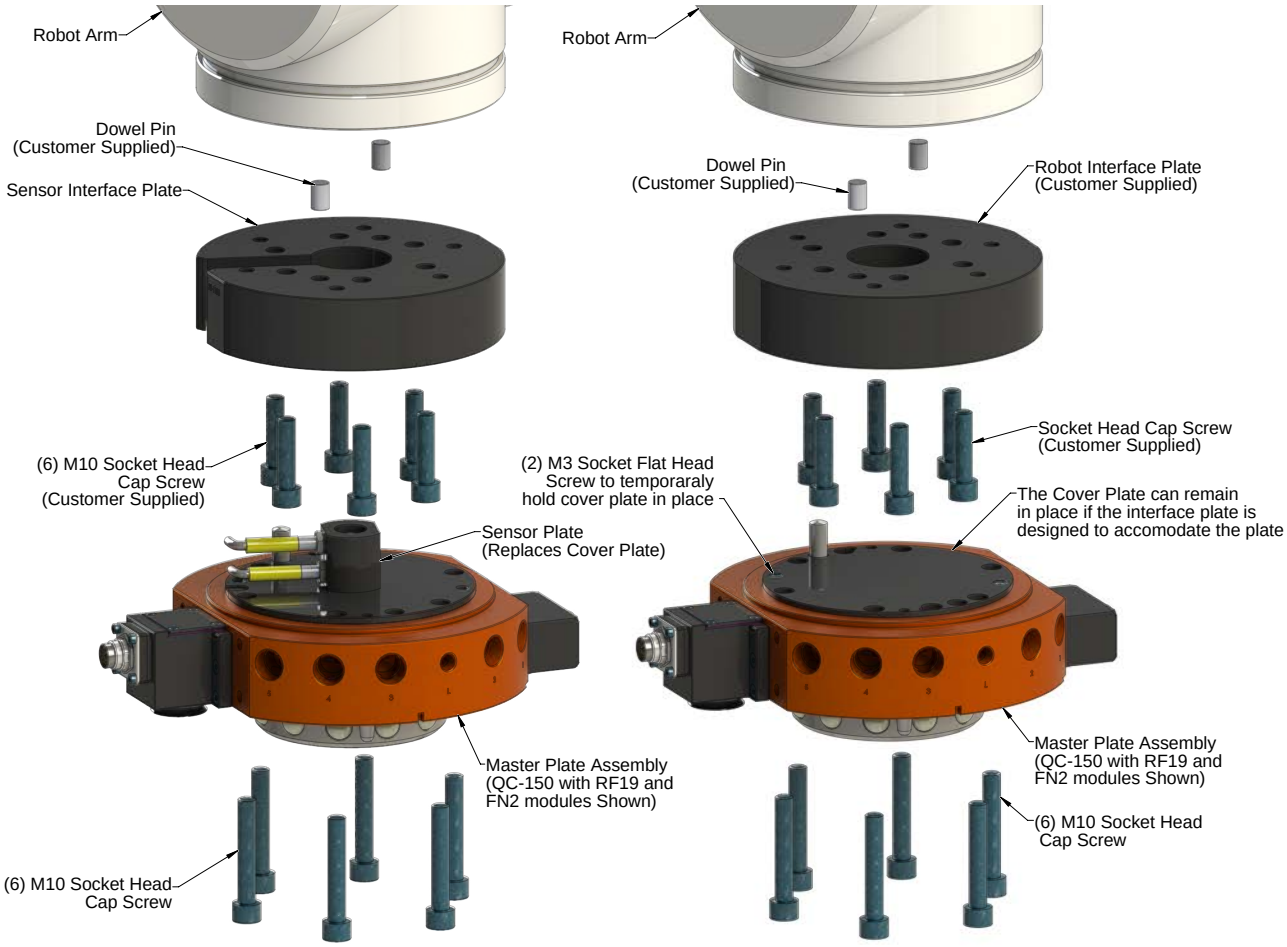
Tools required: *8 mm Allen wrench*

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. If equipped, disconnect the lock and unlock sensor cables.

NOTICE: Support the Master plate while removing the fasteners.

6. Using an 8 mm Allen wrench, remove the (6) M10 socket head cap screws securing the Master plate to the interface plate or SIP.
7. Remove the Master plate.

Figure 3.2—Typical Master Plate Installation



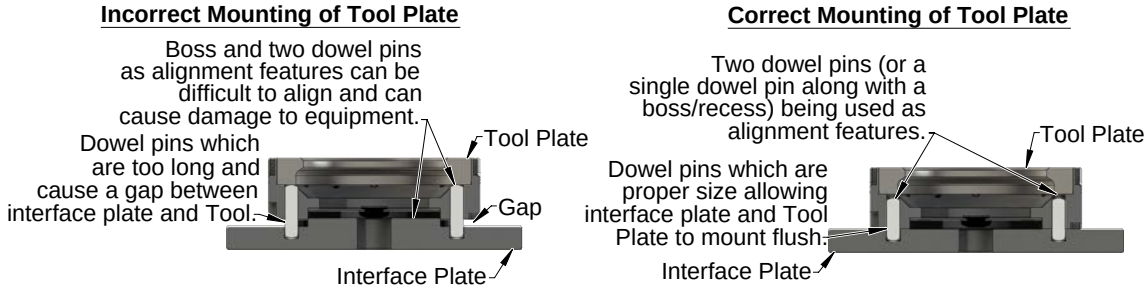
3.4 Tool Interface Plate

The end-effector typically attaches to the Tool plate with an interface plate. The interface plate is designed with mounting features such as a recess and/or bolt and dowel holes. These features are used to position and secure the customer tooling. An interface plate adapts the Tool plate to customer tooling that is not compatible with the Tool plate mounting features. Custom interface plates can be supplied by ATI (see *Figure 3.3*). Refer to *Section 9—Drawings* for specific mounting features for your model.

If the customer chooses to design and build a tool interface plate, the following should be considered:

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



- The interface plate must be designed to include bolt holes for mounting, dowel pins, and a boss that mates with the Tool plate recess for positioning. (The dowel and boss features prevent rotation).
- The locating boss height should not exceed the customer interface depth specified on the drawing.
- 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 Changer.
- The plate design must account for clearances required for Tool Changer module attachments and accessories.
- The interface plate should be designed with a hole in its center to allow 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 should be kept small [minimum recommended hole diameter: 1” (25.4 mm)] to prevent debris from contaminating the locking mechanism while operating in dirty environments.

3.5 Tool Plate Installation

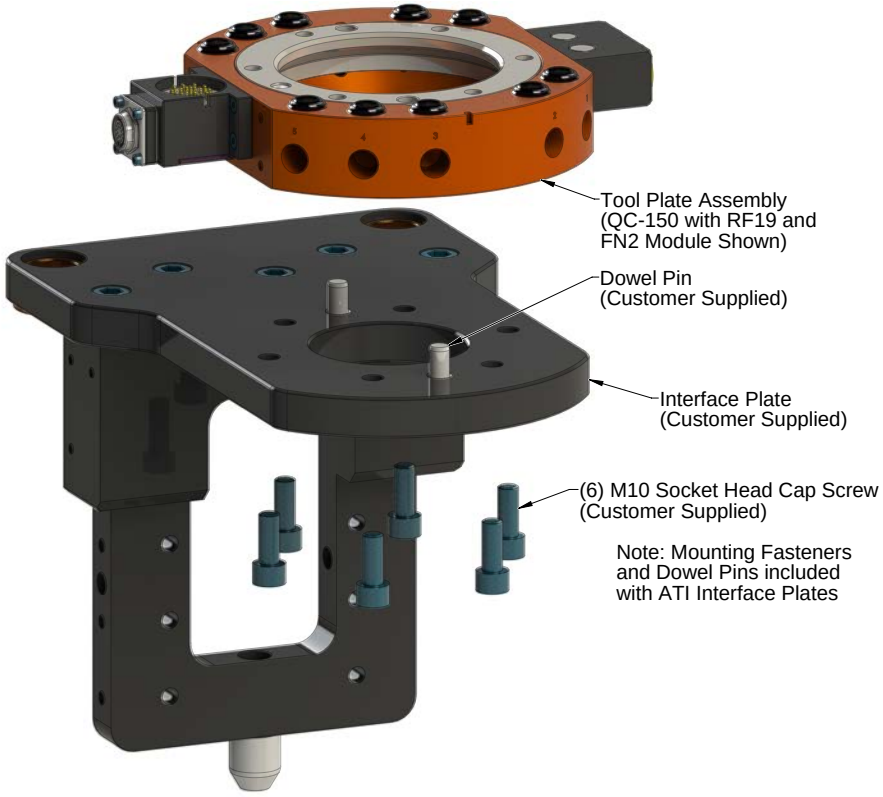
Refer to *Figure 3.3*.

Tools required: *8 mm Allen wrench, torque wrench*

Supplies required: *Clean rag, Loctite 242*

1. Clean the mating surfaces.
2. If not using fasteners with pre-applied adhesive, apply Loctite 242 to supplied fasteners. (Note: Mounting fasteners are supplied with ATI custom interface plates).
3. Align the dowel pins in the interface plate or customer tooling to the corresponding holes in the Tool plate and secure with customer supplied (6) M10 socket head cap screws using an 8 mm Allen wrench.
4. Connect utilities to the modules and Tool plate connections.
5. After the procedure is complete, resume normal operation.

Figure 3.3—Typical Tool Plate Installation



3.6 Tool Plate Removal

Tools required: *8 mm Allen wrench*

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. Using an 8 mm Allen wrench, remove the (6) socket head cap screws securing the Tool plate to the interface plate or customer tooling. Refer to *Figure 3.3*.
6. Remove the Tool plate.

3.7 Optional Module Installation

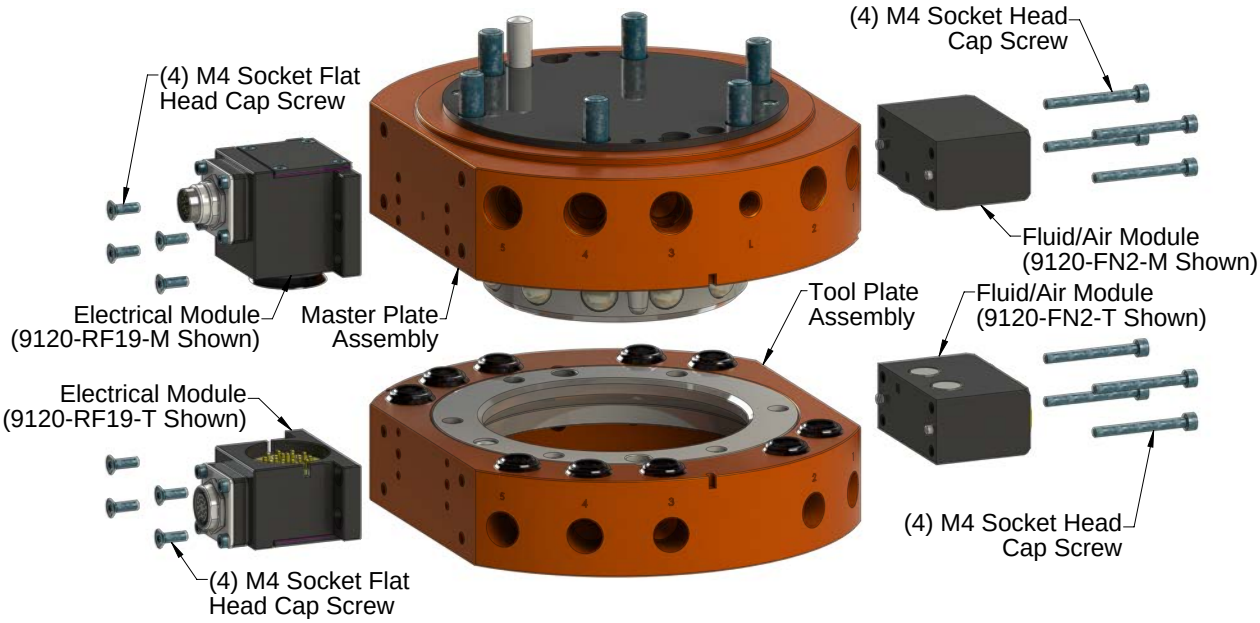
Tools required: *2.5 mm and 3 mm Allen wrench, torque wrench*

Supplies required: *Clean rag, Loctite 222*

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

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 mating surfaces.
5. Align optional module on the Master or Tool plate as shown in *Figure 3.4*.
6. If not using fasteners with pre-applied adhesive, apply Loctite 222 to supplied fasteners.
7. Using an Allen wrench, secure the module with (4) M4 mounting fasteners. Refer to *Table 3.1* for torque for your specific mounting fasteners.
8. Remove all protective caps, plugs, tape, etc from the module prior to operation.
9. After the procedure is complete, resume normal operation.

Figure 3.4—Optional Module Installation



3.8 Optional Module Removal

Tools required: *2.5 mm and 3 mm Allen wrench*

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 any cables, air line, etc. if required.
5. Supporting the module and using an Allen wrench, remove the M4 mounting fasteners.
6. Remove the module from the Master or Tool plate.

3.9 Installing an Optional (SIP) Sensor Interface Plate Assembly

The optional sensor interface plate is typically installed on Tool Changers by ATI prior to shipment. The following steps outline installation. The sensor interface plate assembly includes a custom interface plate. This 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. There is no need to remove the sensors or adjust the position. The small detection shaft O-ring is lubricated and installed in the sensor plate.

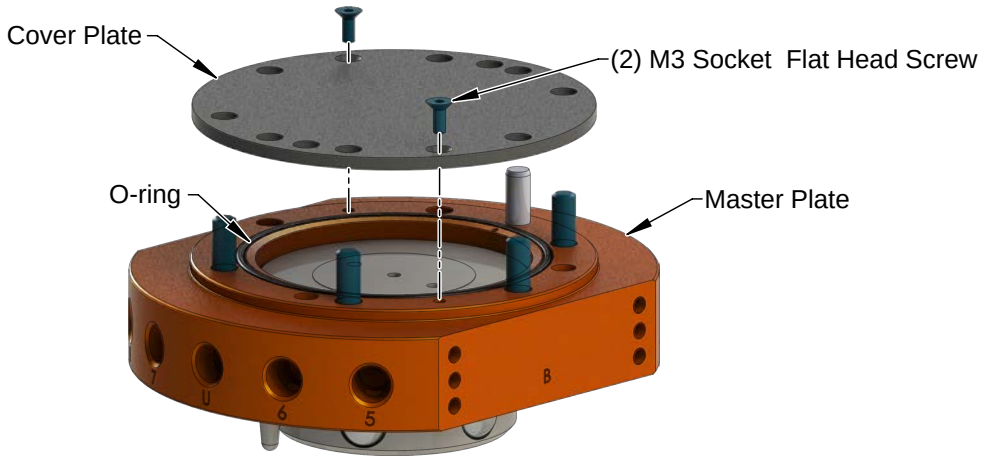
Parts required: *9120-150M-SIP-yyyy, (where yyyy is the custom SIP interface plate)*

Tools required: *2 mm, 2.5 mm, 3 mm, and 5 mm Allen® wrenches (hex key), torque wrench*

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

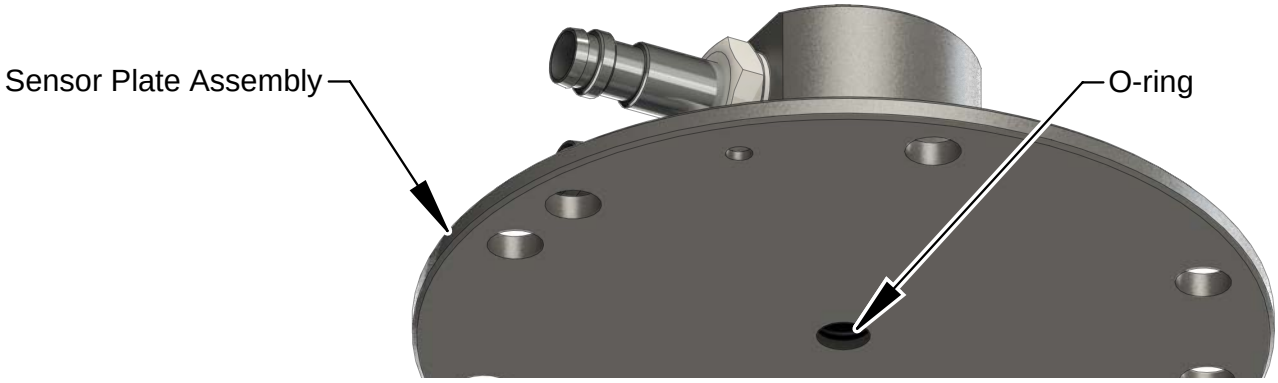
1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits (e.g. electrical, air, water, etc.).
4. Remove the Tool Changer Master plate from the robot and the interface plate , refer to *Section 3.3—Master Plate Removal.*
5. If the Tool Changer has a cover plate, remove the (2) M3 socket flat head screws securing the cover plate to the Tool Changer Master plate using a 2 mm Allen wrench. Refer to *Figure 3.5.*
6. Lift the cover plate off the Master plate.
7. Make sure the O-ring in the Master plate is present and in good condition, lubricate with Magnalube.

Figure 3.5—Cover Plate Removal



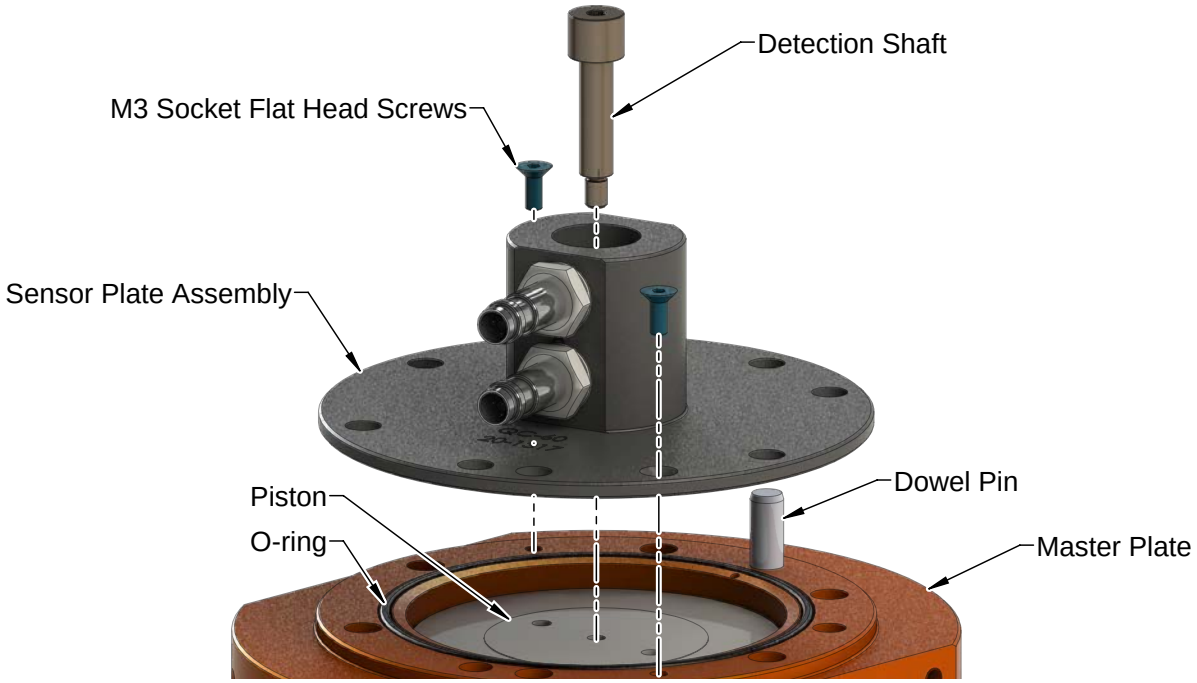
NOTICE: The sensor plate assembly comes assembled with the lock and unlock sensor installed. Do not remove the sensors, the sensors have been position properly from the factory. The sensor plate assembly has the detection shaft O-ring installed and lubricated, make sure it is present as shown in *Figure 3.6.*

Figure 3.6— Sensor Plate Assembly with Lock/Unlock sensors and O-ring



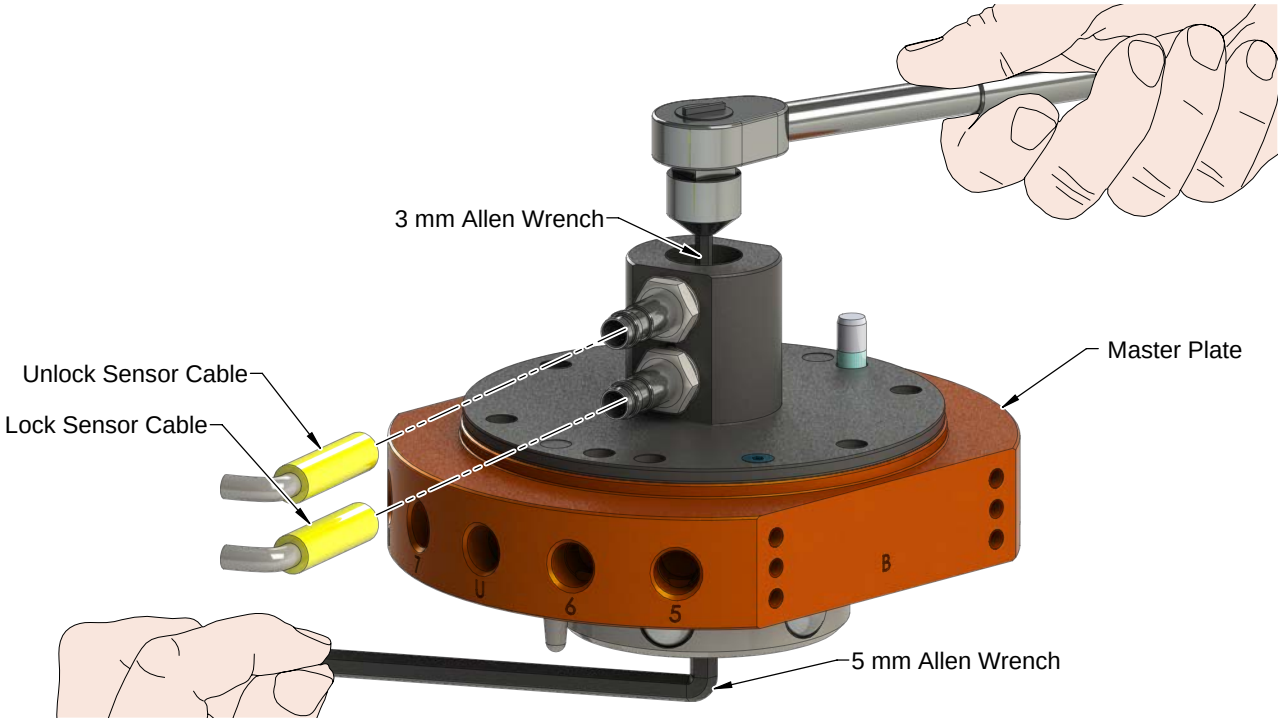
8. Apply tape over the threads of the detection shaft to protect the threads from grease contamination during assembly.
9. Lightly lubricate the detection shaft with Magnalube.
10. Carefully insert the taped detection shaft through the sensor plate assembly pushing it through until it stops.
11. Remove the tape from the detection shaft and apply Loctite primer 7649 to the threads of the detection shaft and the internal threads of the piston. Allow the primer to dry.
12. Apply Loctite 242 to the threads of the detection shaft and the internal threads of the piston.
13. Assemble the sensor plate assembly to the Master plate using the dowel pin to align the sensor plate assembly.
14. Secure the sensor plate to the Master plate with the (2) M3 socket flat head screws using a 2 mm Allen wrench. Tighten to 6 in lbs (0.68 Nm).

Figure 3.7—Sensor Interface Plate Installation



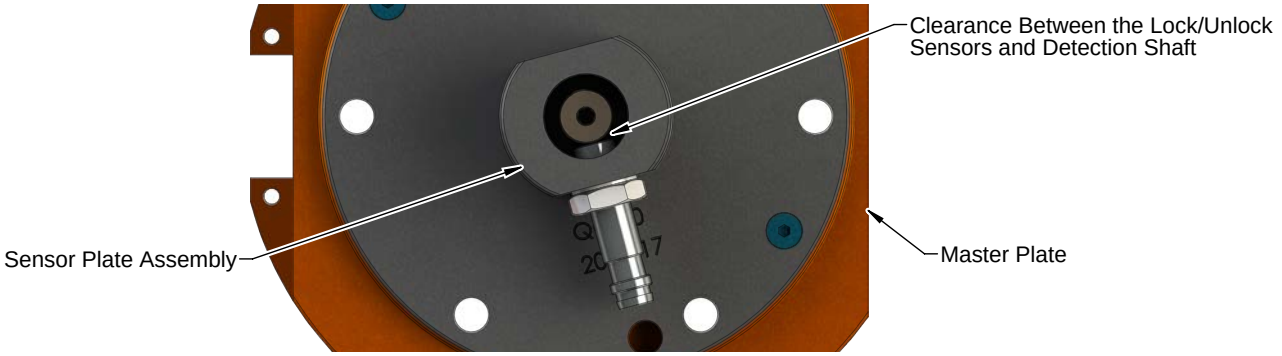
15. Use a 5 mm Allen wrench to hold the cam screw as shown in *Figure 3.8*.
16. Use a 3 mm Allen wrench to tighten the detection shaft. Tighten to 60 in lbs. (6.78 Nm).

Figure 3.8—Sensor Interface Plate Installation



17. Look into the sensor plate assembly to verify the detection shaft does not contact the lock and unlock sensors. If there is contact, adjust the sensor position. Refer to *Section 6.2.1—Proximity Sensor Adjustment, Test, or Replacement.*

Figure 3.9—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 or sensor interface plate (SIP). Applying air pressure can damage the cover plate, O-ring or may cause injury to personnel from flying debris. Always install an appropriate interface plate or SIP and have the Tool Changer mounted securely to the robot before applying air pressure. Refer to *Section 3.1—Robot Side Interface Plates* and *Section 3.2—Master Plate Installation* for more information.

18. Connect the lock and unlock sensor cables and manually move the Tool Changer piston to the locked and unlocked positions. Turn the power on to the sensor, verify that the locked signal turns ON and the sensor LED is illuminated when the Tool Changer is in the locked position. Verify that the unlocked signal turns ON and the sensor LED is illuminated when the Tool Changer is in the unlocked position. If not adjust and test the sensors, refer to *Section 6.2.1—Proximity Sensor Adjustment, Test, or Replacement.*

19. Install the new interface plate to the robot and the Master plate to the robot, refer to *Section 3.2—Master Plate Installation.*
20. After the procedure is complete, resume normal operation.

3.10 Pneumatic Requirements

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

- Pressure range of 60 to 100 psi (4.1 - 6.9 bar) Suggested 80 psi.
- Filtered minimum: 40 microns.
- Flow maximum: 1/3 CFM at 70 psi (4.8 bar), when cycled continuously.

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 the Tool Changer in a fail-safe condition. Damage to the locking mechanism can occur. Re-establish air pressure and ensure the Tool Changer is in a secure lock position before returning to normal operations.

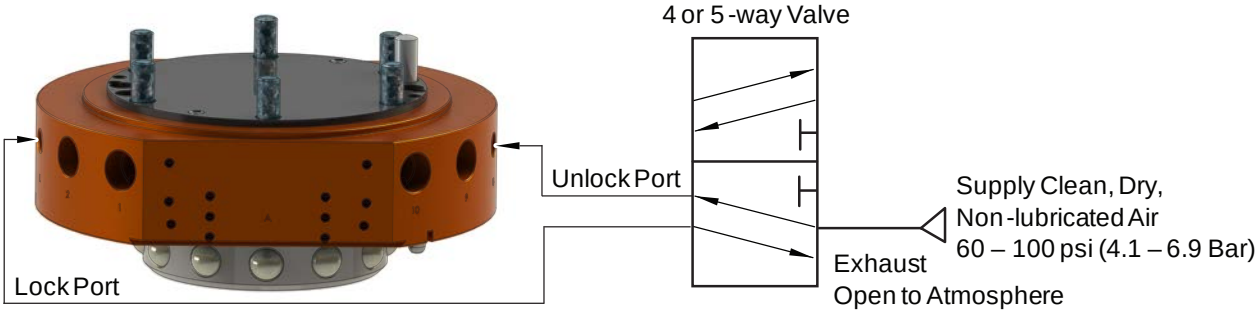
3.10.1 Valve Requirements

NOTICE: No valve is required when using a valve adapter module. The valve adapter module has an integrated solenoid valve and only requires the customer to supply a single air source to the valve adapter.

A customer supplied 2-position 4-way or 5-way valve must be used to actuate the locking mechanism in the Master plate. It is imperative that when air is supplied to the Lock or Unlock Port on the Master plate, that the opposite port be vented to atmosphere (i.e., when air is supplied to the Lock Port, the Unlock Port must be open to the atmosphere.) Failure to vent trapped air or vacuum on the inactive port may inhibit operation of the valve and prevent coupling or uncoupling.

CAUTION: The locking mechanism will not function properly when connected to a 3-way valve as this type of valve is incapable of venting trapped air or vacuum from within the Tool Changer. This could result in damage to the product, attached tooling, or injury to personnel. Connect the Lock and Unlock supply air to a 2-position 4-way or 5-way valve.

Figure 3.10—Lock and Unlock Pneumatic Connections



3.11 Electrical Connections

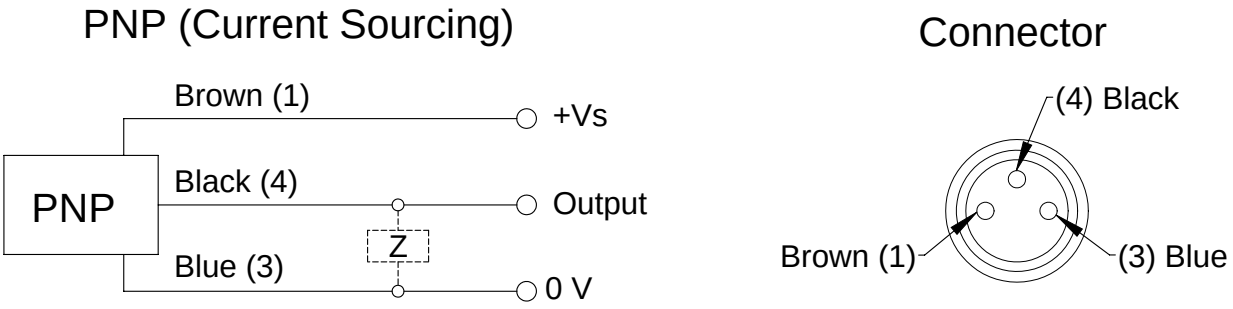
The Optional Lock and Unlock sensors are available in PNP and NPN type.

3.11.1 PNP Type Lock and Unlock Sensors

The PNP Lock and Unlock sensors are 8 mm cylindrical inductive proximity sensors.

Table 3.2—PNP (Current Sourcing)	
Description	**Value**
Voltage Supply Range	10-30 VDC
Output Circuit	PNP make function (NO)

Figure 3.11—PNP Type Lock, Unlock and RTL Sensors

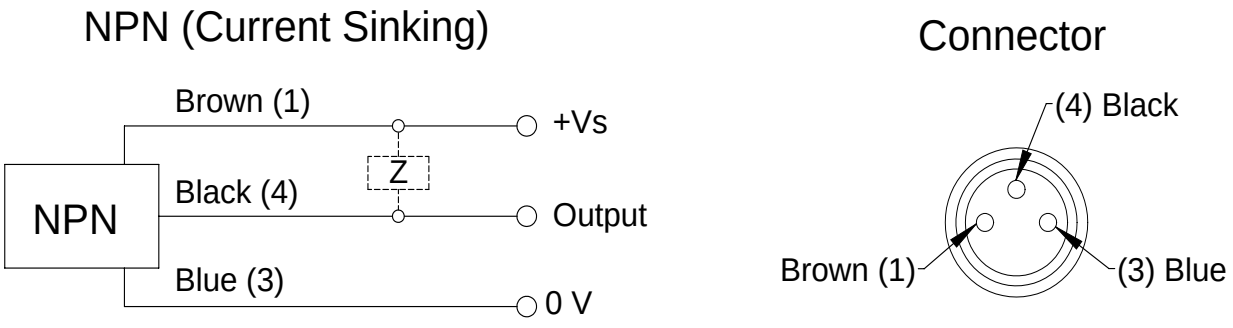


3.11.2 NPN Type Lock and Unlock Sensors

The NPN Lock and Unlock sensors are 8 mm cylindrical inductive proximity sensors.

Table 3.3—NPN (Current Sinking)	
Description	**Value**
Voltage Supply Range	10-30 VDC
Output Circuit	NPN make function (NO)

Figure 3.12—NPN Type Lock, Unlock and RTL 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. Robot motion should be halted if the air supply pressure drops below 60 psi for any reason.

NOTICE: All 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.

The robot should be programmed to minimize misalignment during coupling and uncoupling. Additionally, the tool stand should 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

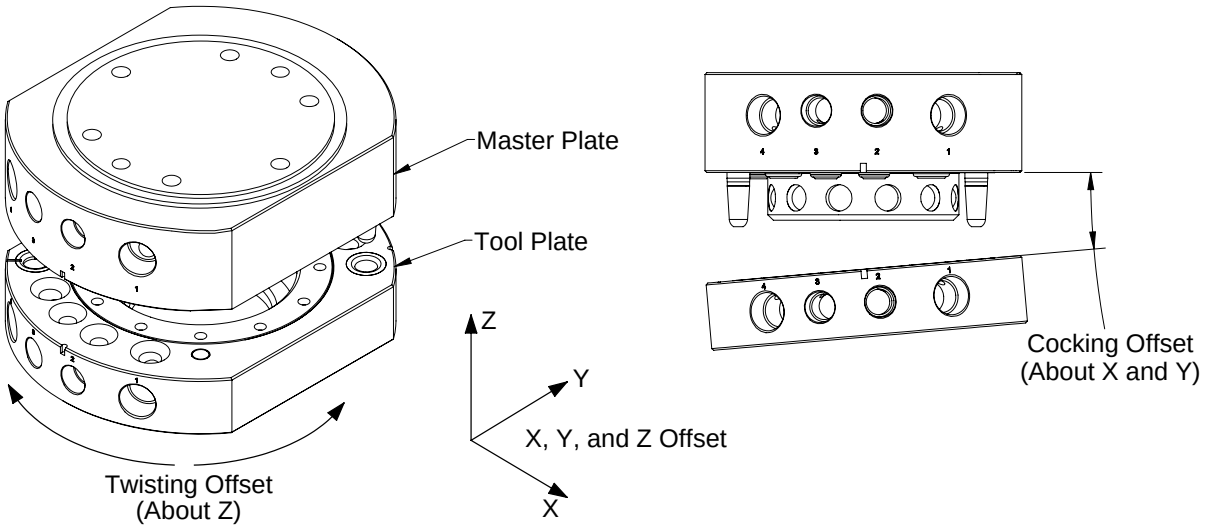


Table 4.1—Maximum Recommended Offsets Prior to Coupling

Model	No-Touch Zone Z Offset (Max)[1]	X and Y Offset (Max) [2]	Cocking Offset (Max)	Twisting Offset (Max)
QC-150	0.12” (3 mm)	±0.08” (2 mm)	±0.7°	±1°

Notes:
1. Maximum values shown. Decreasing values minimizes wear.
2. Allowable values may be greater, but greater offsets increase wear.

4.1 Conditions for Coupling

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 will indicate 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 will indicate 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 your 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 such 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 an unique code. Tool-ID can be used to verify that the robot has picked up the proper Tool. Modules with Tool-ID are available from ATI, refer to our Web site *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 the 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 TSM (Tool Stand Medium) system is compatible with ATI Tool Changer sizes QC-20 to QC-110. The TSM systems can be equipped with horizontal modules, clamp modules, and different types of tool sensing. Visit the ATI Web Site *http://www.ati-ia.com/products/toolchanger/toolstand/medium/MediumStand.aspx* for products available, or contact ATI for assistance.

If the customer is supplying the tool stand, it must provide a fixed, repeatable, level, and stable position for tool pick-up and drop-off. The tool stand must 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.

Ideally, the tool should be hanging 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, "horizontal-position" tool stands cause more wear on the locking mechanism and locating features of the Tool and tool stand.

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 vital in tool pick-up and drop-off.

A sensor that detects the presence of a Tool in the tool stand is recommended. The sensor may be used prior to coupling to ensure there is a Tool properly seated in the stand. Sensors may also be used as the robot starts to move away after uncoupling. Sensors provide safety measure if a Tool becomes jammed in the stand or if the Tool fails to release from the robot.

Proximity sensors should be positioned 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.

Tool stands debris shields can cover Tools and modules to protect them in dirty environments, such as grinding or welding. Alternatively, positioning tool stands in areas shielded from weld spatter, fluids, adhesives, or other debris would eliminate the need for debris shields.

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 (e.g. 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.

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:

- Placement of tool stands away from debris generators.
- Covers incorporated into the tool stands.
- 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 are designed to provide a long life with regular maintenance. A visual inspection and preventive maintenance schedule is provided in the following table depending upon the application. 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 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, 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. To replace worn alignment pins, refer to *Section 6.2.4—Alignment Pin Replacement.*
- ☐ Inspect for wear on the ball bearings/bearing race, may be an indication of excessive loading.

Sensors and Cables

- ☐ Inspect sensor cable connectors for tightness, if loose tighten connections.
- ☐ Inspect sensor cables for any damage, cuts, and abrasion. Replace as necessary.

Hoses

- ☐ Inspect hose connection for tightness and leaks. If leaking or loose secure 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. Clean pin blocks as required, refer to *Section 5.3—Optional Electrical Module Pin Block Inspection and Cleaning.*
- ☐

Seals Pass Through Air and Optional Modules

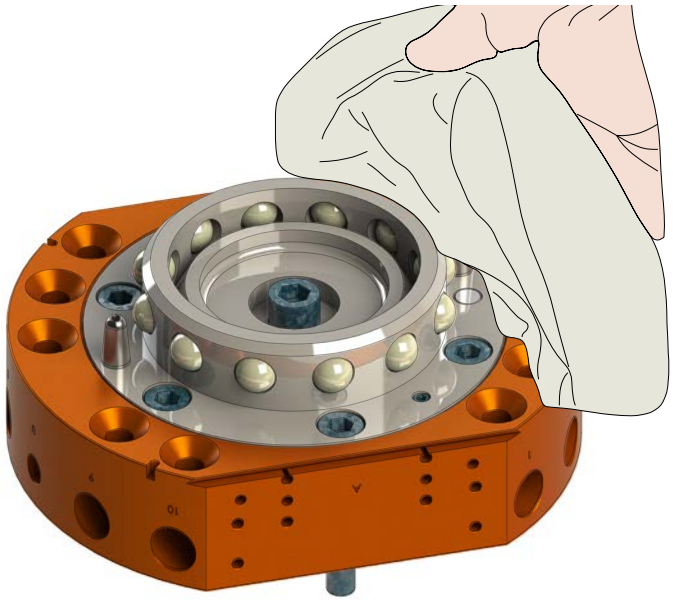
- ☐ Inspect for wear, abrasion, and cuts. Replace damaged seals or bushings as needed. Refer to *Section 6.2.3—3/8" Rubber Bushing Replacement* or *Section 6.2.2—Optional Electrical Module Seal Inspection and Replacement*

5.2 Cleaning and Lubrication of the Locking Mechanism and Alignment Pins

Supplies required: *Clean rag, MobilGrease® XHP222 Special Grease*

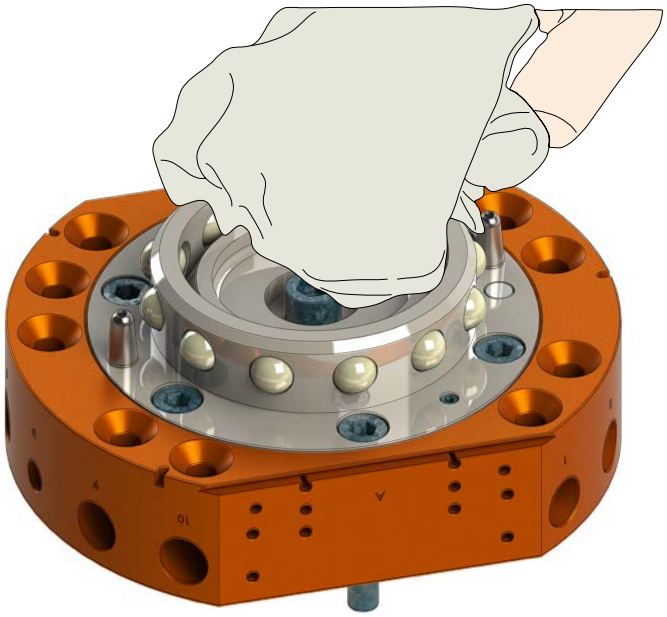
1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits (e.g. electrical, air, water, etc.).
4. Use a clean rag to thoroughly remove any lubricant and debris from the ball bearings, male coupling, cam, and alignment pins.

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



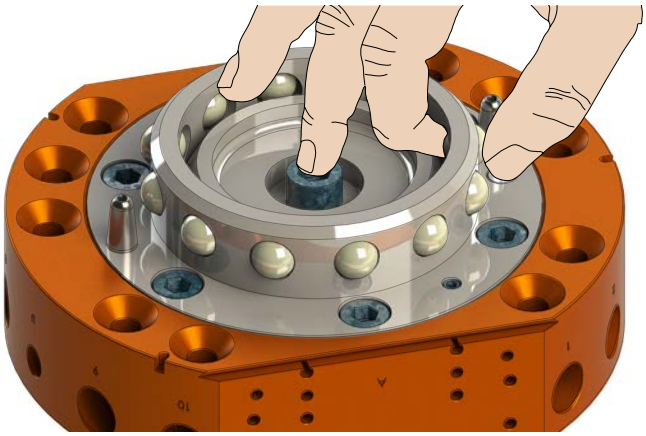
5. Use a clean rag to thoroughly remove any lubricant and debris from the inner surface of the male coupling and cam.

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



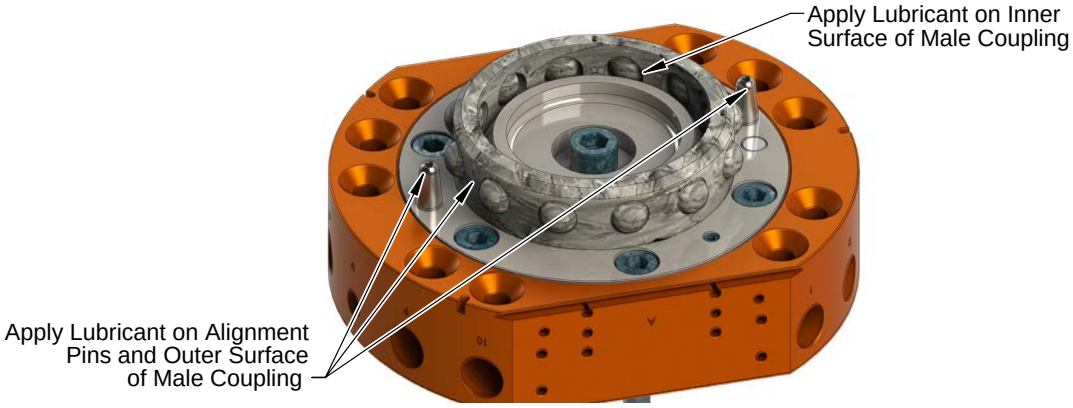
6. Check each ball bearing to make sure it moves freely in the male coupling. Additional cleaning may be necessary to free up any ball bearings that are sticking in place.

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

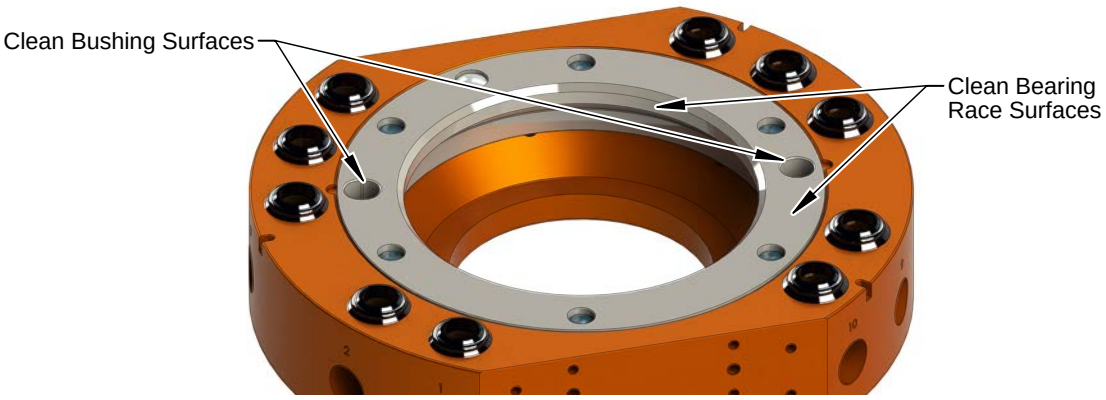


8. Use a clean rag to thoroughly remove any lubricant and debris from the Tool plate bearing race and bushings.

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

9. After the procedure is complete, resume normal operation.

Figure 5.5—Clean Tool Plate Surfaces of locking Mechanism

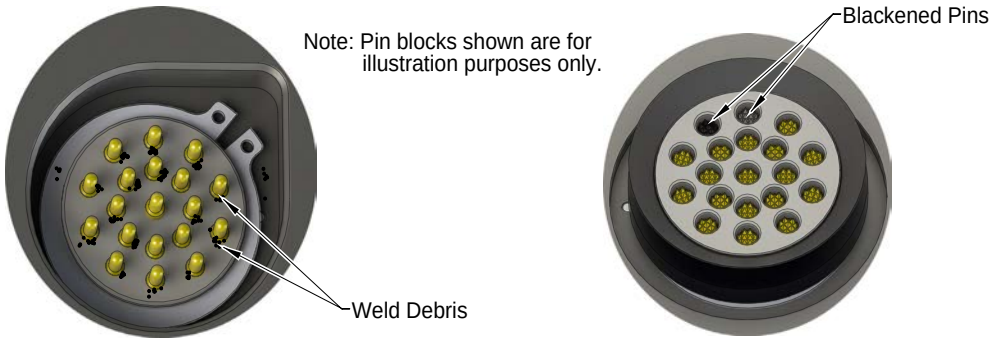


5.3 Optional Electrical Module Pin Block Inspection and Cleaning

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 (e.g. electrical, air, water, etc.).
4. Inspect the Master and Tool pin blocks for any debris or darkened pins.

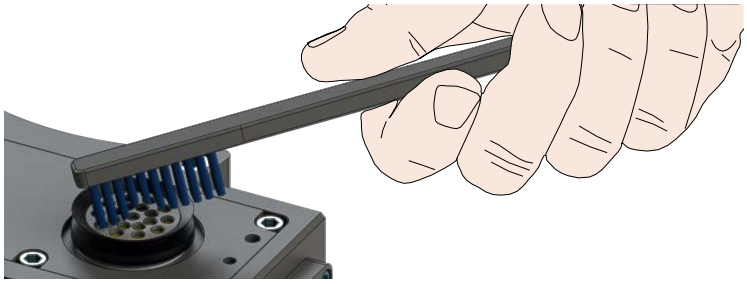
Figure 5.6—Inspect Master and Tool Pin Blocks



5. If debris or darkened pins exist, remove debris using a vacuum and clean using a nylon brush (ATI Part Number 3690-0000064-60).

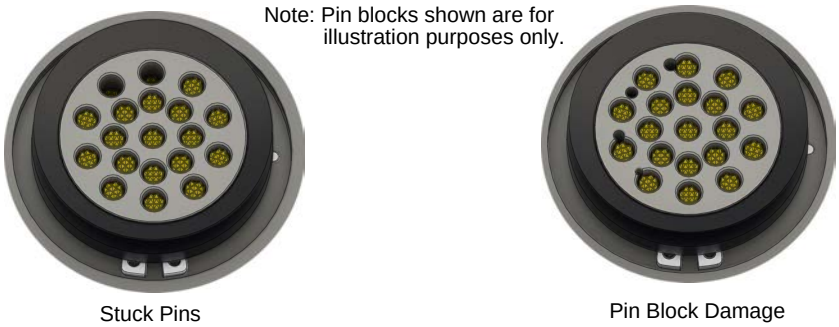
NOTICE: Do not use an abrasive media, cleaners, or solvents to clean the contact pins. Using abrasive media, cleaners, or solvents will cause damage to the contact surface or cause pins to stick. Clean contact surfaces with a vacuum or non-abrasive media such as a nylon brush (ATI Part Number 3690-0000064-60)

Figure 5.7—Clean Pin Blocks with a Nylon Brush



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

Figure 5.8—Stuck Pin and Pin Block Damage



7. If stuck pins or pin block damage exists, contact ATI for possible pin replacement procedures or module replacement.
8. After the procedure is complete, resume normal operation.

6. Troubleshooting and Service Procedures

The following section provides troubleshooting and service information to help diagnose conditions and repair the Tool Changer or control/signal module.

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 (e.g. 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.

6.1 Troubleshooting Procedures

Check these conditions for all symptoms prior to troubleshooting:

- Proper pneumatic and electrical connections have been made to the Tool Changer.
- Air is supplied at a minimum of 60 psi (4.1 Bar).
- No air or vacuum can be trapped in a de-energized Lock or Unlock Port (pressure must be vented to atmosphere). Refer to *Section 3.10—Pneumatic Requirements.*

Table 6.1—Troubleshooting

Symptom	Cause	Resolution
Tool Changer will not lock and/or unlock (or Lock sensor does not indicate Tool Changer is Locked)	Debris caught between the Master and Tool plates.	Clean debris from between Master and Tool plates. Verify mounting fasteners is secure and does not protrude above the mating surfaces.
	Insufficient or no air pressure supply to the lock or unlock ports.	Verify proper air pressure and pneumatic valve is supplied. Refer to *Section 3.10—Pneumatic Requirements.*
	Air pressure trapped in de-energized Lock or Unlock ports.	Air pressure must be vented to the atmosphere properly, refer to *Section 3.10—Pneumatic Requirements.*
	Pneumatic connections loose or damaged.	Inspect hose connection for tightness and leaks. If leaking or loose secure hose connection. Inspect hoses for interferences, abrasions, cuts, and leaks. Replace as required.
	The ball bearings and/or cam are not moving freely in the male coupling.	Clean and lubricate as needed to restore smooth operation (see *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 4.5—Tool Storage Considerations.* Re-teach the robot to bring the Master plate and Tool plate closer together prior to attempting to lock.
Unit is locked but Lock signal does not read “on” (true).	Lock sensor/cable is out of adjustment or damaged.	Adjust or replace the lock sensor assembly as necessary. Refer to *Section 6.2.1—Proximity Sensor Adjustment, Test, or Replacement.*
Unit is unlocked but Unlock signal does not read “on” (true).	Unlock sensor/cable is out of adjustment or damaged.	Adjust or replace the unlock sensor assembly as necessary. Refer to *Section 6.2.1—Proximity Sensor Adjustment, Test, or Replacement.*
Units Equipped with Electrical/Servo/Control/Signal Modules		
Loss of Communication	Debris in and around contact pins. Contact Pin worn or damaged.	Inspect V-ring seal for damage, replace damaged seal. Refer to *Section 6.2.2—Optional Electrical Module Seal Inspection and Replacement*
	Cable connections loose or cables damaged	Check that cable connection are secure and cables are not damaged.

6.2 Service Procedures

The following service procedures provide instructions for component replacement.

6.2.1 Proximity Sensor Adjustment, Test, or Replacement

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

Tools required: *8 mm Allen wrench, 13 mm wrench*

Supplies required: *Loctite 222*

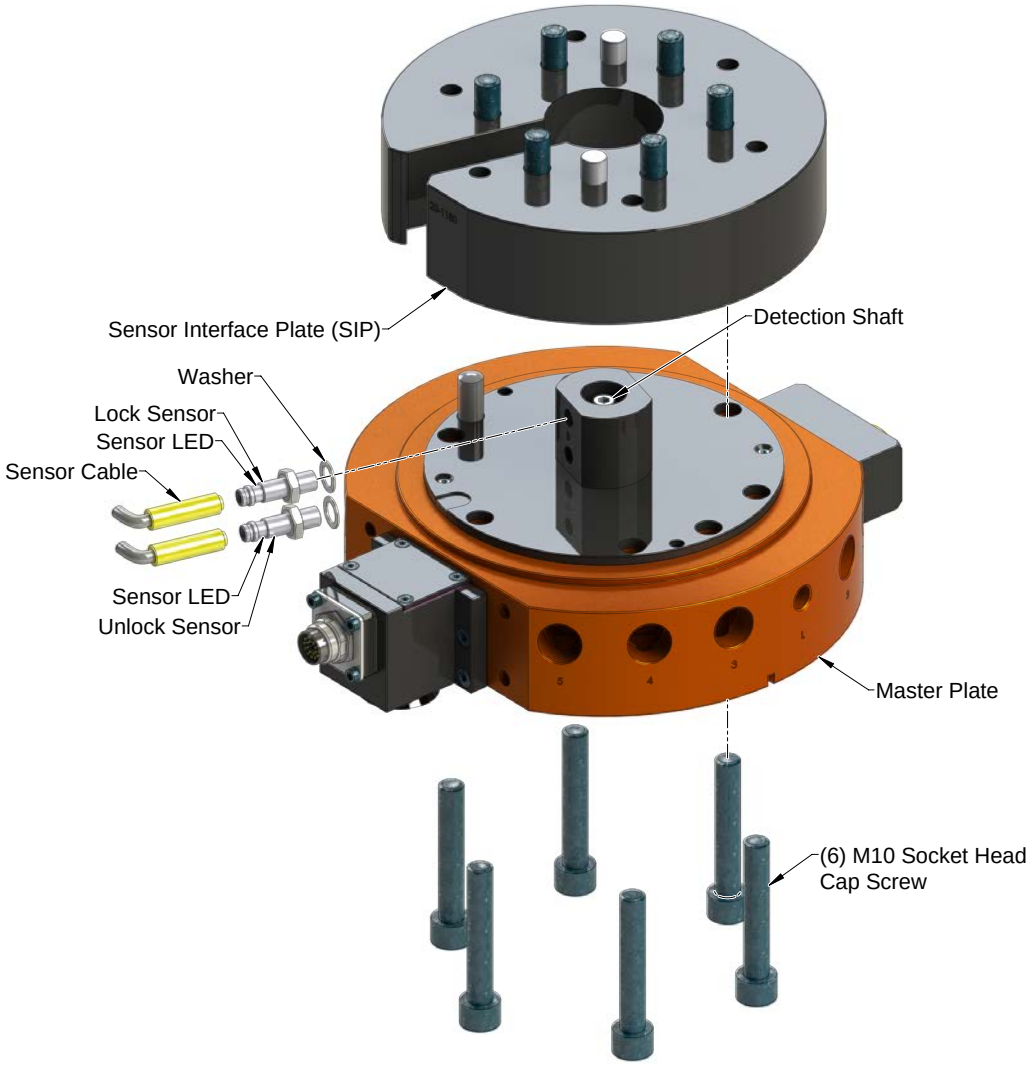
The proximity sensors are very reliable and normally do not need to be replaced. Exhaust all other possible solutions, check continuity, air supply, lubrication, and pneumatic components prior to testing or replacing the sensor.

1. Place the Tool in a secure location.
2. If you are testing or replacing the lock sensor make sure the Tool Changer is in the locked position, if you are replacing the unlock sensor, make sure the Tool Changer is in the unlocked position before continuing.
3. Turn off and de-energize all energized circuits (e.g. electrical, air, water, etc.).
4. Disconnect any cables, air line, etc. if required.
5. Remove the (6) M10 socket head cap screws securing the Master plate assembly to the sensor interface plate using an 8 mm Allen wrench. Refer to *Figure 6.1*
6. Disconnect the sensor cable.
7. Using a 13 mm wrench, loosen the hex nut and unscrew the proximity sensor from the Master plate assembly. Retain the washer from the sensor.
8. To test the suspect sensor, connect the sensor cable and place a ferrous target in front of the proximity sensor to confirm that the sensor is functional. The sensor lock or unlock signal should read “on”(true) and the sensor LED should illuminate.
9. If the proximity sensor is not functioning, replace. Disconnect the sensor cable and discard.
10. Back the sensor hex nut to the connector end of the new sensor.
11. Thread the proximity sensor into the Master plate assembly until it touches the detection shaft, then back the sensor off 1/2 turn.

> **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.

12. Connect the sensor cable. The proximity sensor LED should be illuminated.
13. 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 and torque to 20 in-lbs (2.3 Nm) using a 13 mm wrench.
14. Attach the Master plate to the sensor interface plate using the (6) M10 socket head cap screws using an 8 mm Allen wrench. Refer to *Table 3.1* for torque and thread locker specifications.
15. If required, connect other utilities to the optional modules on the Master plate.
16. Confirm the operation of the replaced sensor by issuing the lock command to lock a Tool to the Master and then checking to see that the LED in the replaced Sensor body is on.
17. After the procedure is complete, resume normal operation.

Figure 6.1—Replace Proximity Sensor



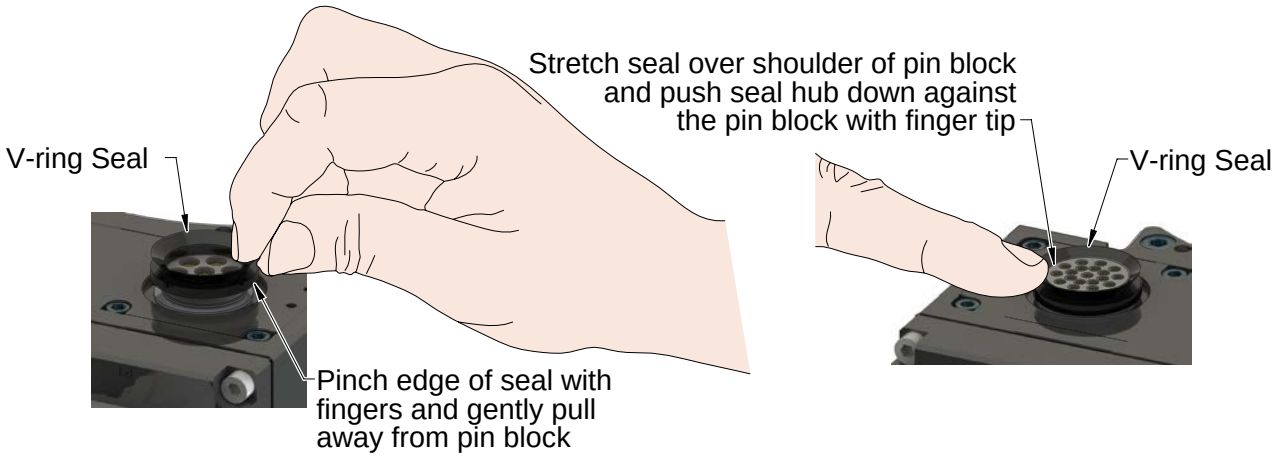
6.2.2 Optional Electrical Module Seal Inspection and Replacement

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

The seal protects the electrical connection between the Master and Tool module. If the seal becomes worn or damaged, it must be replaced.

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. To remove the existing seal, pinch the edge of the seal with your fingers and pull the seal away from the pin block on the Master.
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 using your finger tip.
7. After the procedure is complete, resume normal operation.

Figure 6.2—V-ring Seal Replacement



6.2.3 3/8" Rubber Bushing Replacement

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

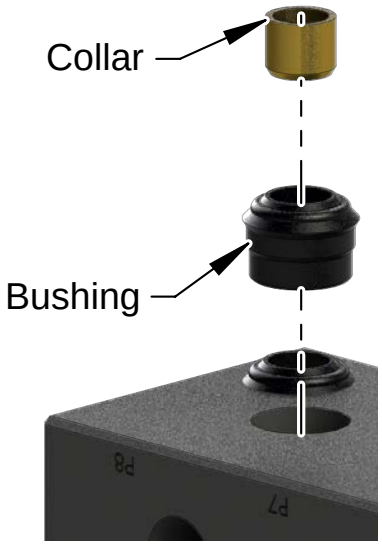
Tools required: *Needle-nose pliers*

Supplies required: *P80 lubricant*

Rubber bushings seal the ports in the Master and Tool plates. If the bushings are damaged, replace them.

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 bushing and collar.
   a. Use needle-nose pliers to remove the bushing from the module housing.
   b. If the collar remains in the module housing or inside the bushing, remove the collar.
5. Install the replacement bushing.
   a. Apply a thin coat of P80 lubricant to the outer surface of the replacement bushing.
   b. Insert the beveled (chamfered) end of the bushing into the port.
   c. Insert the collar into the bushing.
   d. Seat the bushing completely in the bore.
6. After the procedure is complete, resume normal operation.

Figure 6.3 —Replacing the Bushing and Collar



6.2.4 Alignment Pin Replacement

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

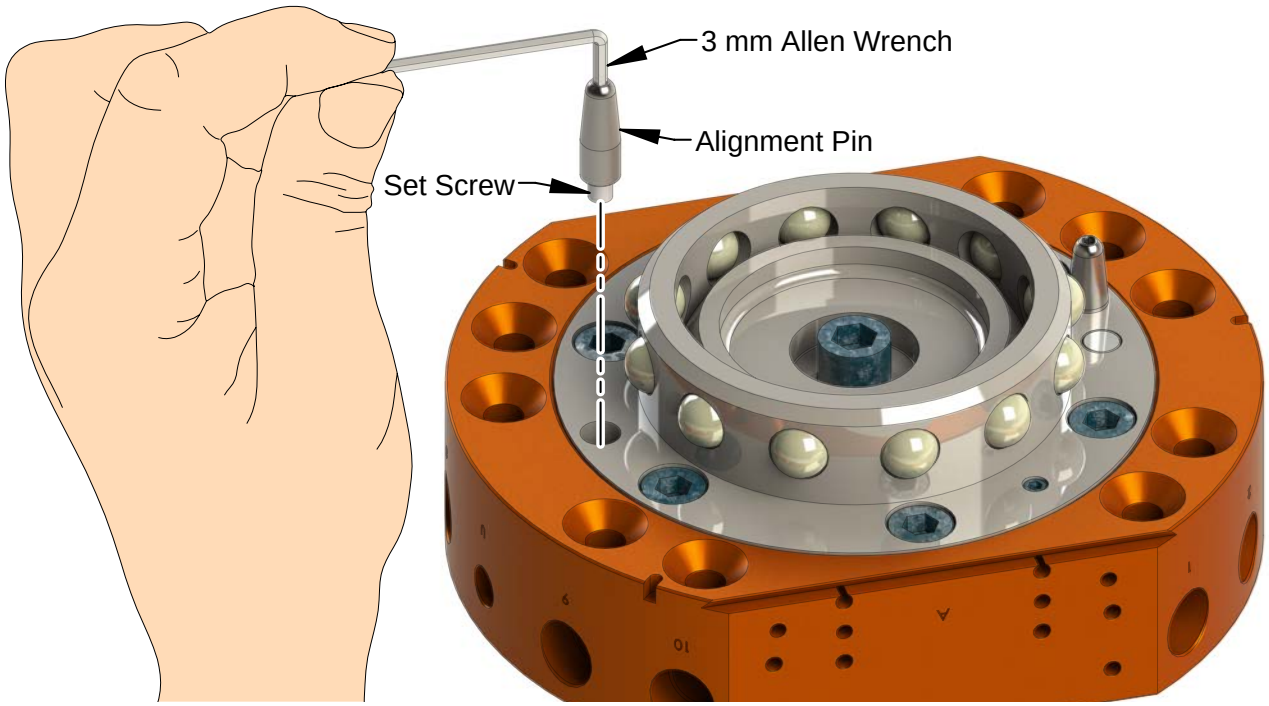
Tools required: *3 mm Allen wrench, torque wrench*

Supplies required: *Loctite 242, MobilGrease XHP222*

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. Unscrew the alignment pin assembly from the Master plate using a 3 mm Allen Wrench® (see *Figure 3.3*). If alignment pin cannot be removed using the Allen Wrench in the tip, go to step *5*. If alignment was remove go to step *7*.

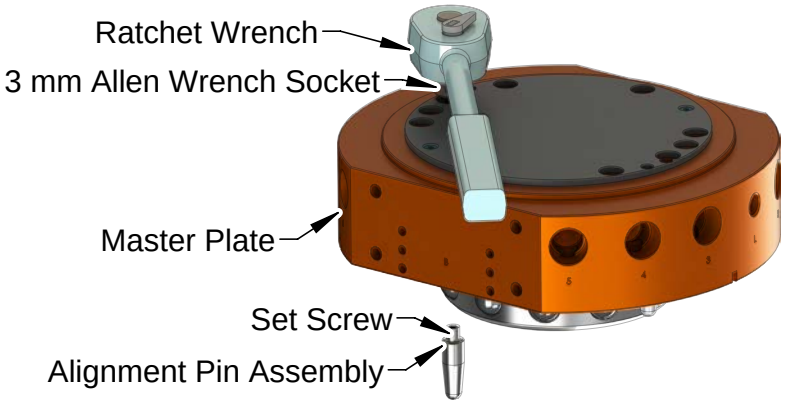
NOTICE: If the pin cannot be removed using the Allen Wrench in the tip, it may be necessary to remove it by other means, such as locking pliers.

Figure 6.4—QC-100 Alignment Pin Replacement



5. Alternately, use the access hole in the back side of the Master plate. If not already removed, remove the Master plate refer to *Section 3.3—Master Plate Removal*.
6. Use a 3 mm Allen Wrench to remove the alignment pin from the back side of the Master plate. Loosen the alignment pin by turning it clockwise, the alignment pin will be removed from the locking side of the Master plate.

Figure 6.5—3 mm Allen Wrench



7. With the alignment been removed, verify that the assembly (pin and set screw) are intact. If the set screw portion of the assembly did not come out, remove it separately using the access hole in the back plate of the Master plate.
8. Apply Loctite 242 and install the new alignment pin assembly into the bushing on the Tool Changer using a 3 mm Allen wrench. Tighten to 60 in-lbs (6.8 Nm).
9. Apply MobilGrease XHP222 Special grease to the Alignment Pin.
10. After the procedure is complete, resume normal operation.

7. Specifications

Table 7.1—Master and Tool Specifications		
Recommended Max Payload	440 lbs. (00 kg)	The mass attached to the Tool Changer.
Operating Temperature Range	-20–150°F (-30–66°C)	Temperature range for operation.
Operating Air Pressure Range	60–100 psi (4.1–6.9 bar)	Locking mechanism supply air pressure operating range. Supply to be clean, dry, and filtered to 40 micron or better.
Coupling Force @ 80 psi	3600 lbs. (16,000 N)	Axial holding force
Recommended Max Moment X-Y (Mxy) Recommended Max Torque about Z (Mz)	12000 in-lb (1360 Nm) 10000 in-lb (1130 Nm)	Maximum recommended working load for optimum performance of the Tool Changer. Maximum recommended working torque for optimum performance of the Tool Changer.
Weight (coupled, no access)	18.2 lbs. (8.3 kg)	Master 12.3 lbs (5.6 kg) / Tool 5.94 lbs (2.7 kg)
Positional Repeatability	0.0006” (0.015 mm)	Repeatability tested at rated load at one million cycles.
Max. Recommended Distance between Master and Tool plate	0.10” (2.5 mm)	No-Touch locking technology allows the Master and Tool plates to lock with separation when coupling.
Sensor Information, Signal Name	L/U (Lock/Unlock) RTL (Ready-To-Lock)	Internal proximity sensors (2) with cable and connector for direct wiring to the control/signal module to indicate locking mechanism position. Flat Pack proximity sensor with cable and connector for direct wiring to control/signal module to indicate Master and Tool mating surfaces within close proximity of each other.
Mounting/Customer Interface	Refer to *Section 9—Drawings*.	

8. Serviceable Parts

The following items are commonly used as spare parts for the QC-150 Tool Changer. The following image goes with *Table 8.1*.

8.1 Models QC-150

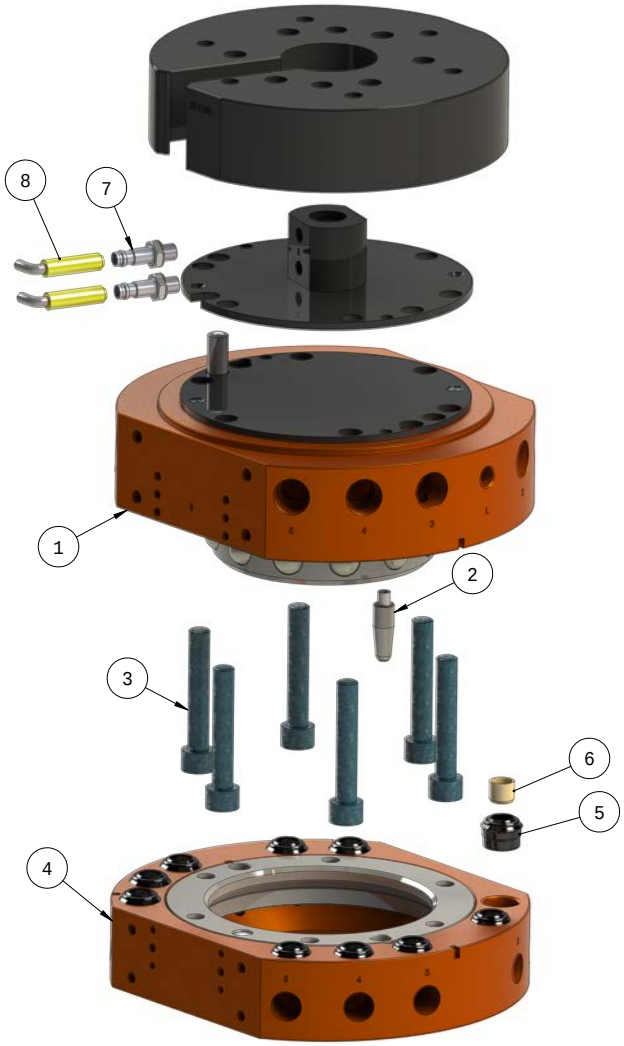
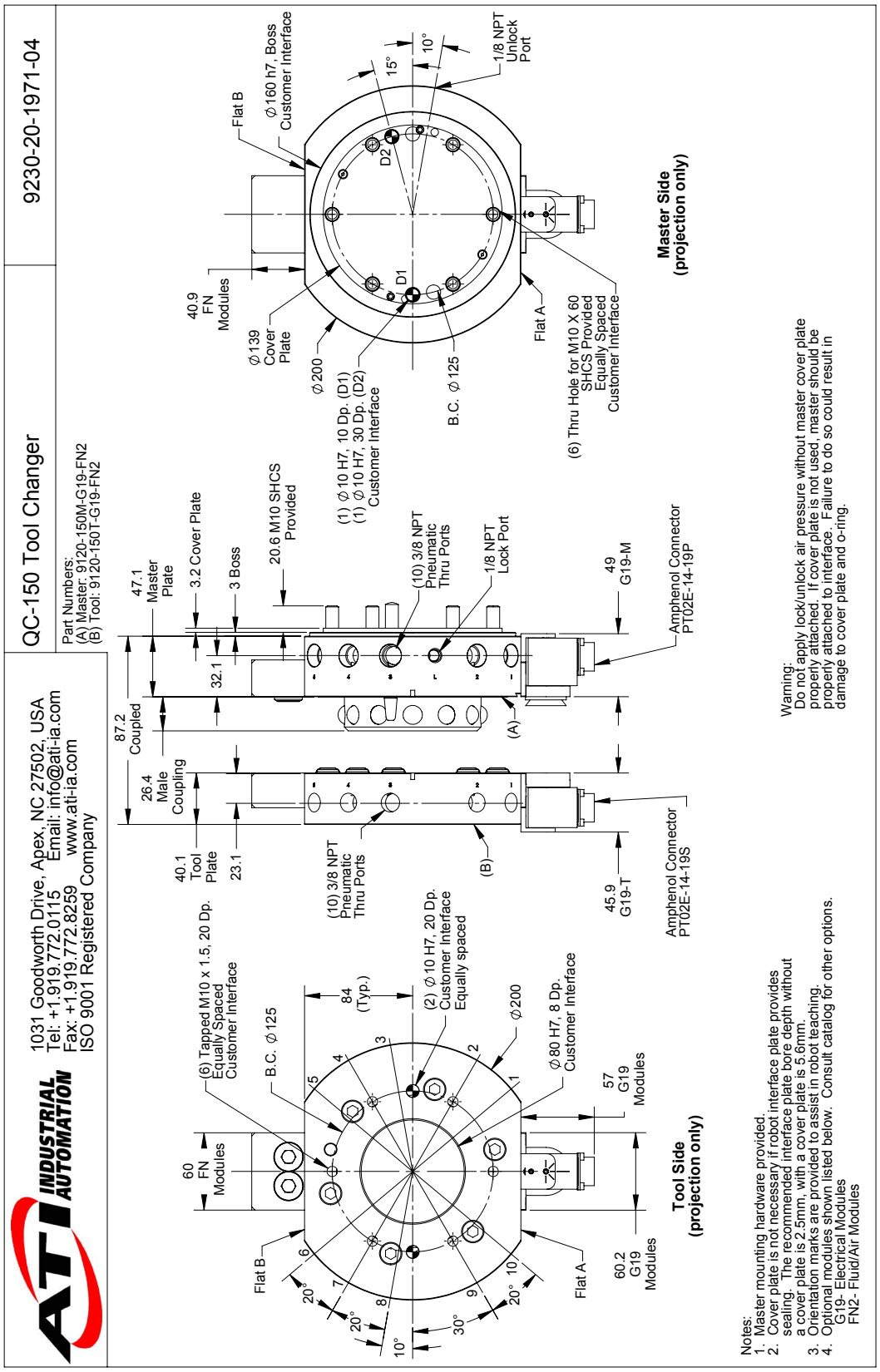


Table 8.1—Serviceable Parts			
QC-150 Master Plate			
Item No.	**Qty**	**Part Number**	**Description**
1	1	9120-150M-000-000	QC-150 Master, no options
		9120-150M-000-000-B	QC-150 Master, no options, Black
		9120-150M-000-000-E	QC-150 Master, no options, Euro
		9120-150M-000-000-R	QC-150 Master with no options and R Ports
2	2	9005-20-1059	QC-150 Alignment Pin Assembly
3	6	3500-1070060-15	M10 X 60 socket head cap screws Metric Blue
QC-150 Tool Plate			
4	1	9120-150T-000-000	QC-150 Tool, no options
		9120-150T-000-000-B	QC-150 Tool, no options, Black
		9120-150T-000-000-E	QC-150 Tool, no options, Euro
		9120-150T-000-000-R	QC-150 Tool with no options and R Ports
5	10	4010-0000010-01	3/8” Rubber Bushing. Nitrile
6	10	3700-20-2000	Collar for 3/8” Bushing
QC-150 SIP Assemblies			
PNP Sensors - 9120-150M-SIP-B-XXXX			
7	2	8590-9909999-04	PNP Prox Switch Hardwired
PNP Sensors - 9120-150M-SIP-D-XXXX and 9120-150M-SIP-G-XXXX			
7	2	8590-9909999-08	PNP Prox Switch
8*	2	8590-9909999-07	High-flex cable w/ straight snap-on connector, 5M flying leads (Type-BU)
NPN Sensors - 9120-150M-SIP-E-XXXX and 9120-150M-SIP-F-XXXX			
7	2	8590-9909999-14	NPN Proximity Sensor w/ LED
8*	2	8590-9909999-07	High-flex cable w/ straight snap-on connector, 5M long flying leads (Type-BU)
Note: *Sensor cables for 9120-150M-SIP-D-XXXX and 9120-150M-SIP-F-XXXX models.			

9. Drawings

9.1 QC-150 Tool Changer with G19 and FN2 Modules



10. Terms and Conditions of Sale

The following Terms and Conditions are a supplement to and include a portion of ATI's Standard Terms and Conditions, which are on file at ATI and available upon request.

ATI warrants to Purchaser that robotic Tool Changer products purchased hereunder will be free from defects in material and workmanship under normal use for a period of three (3) years from the date of shipment. This warranty does not cover components subject to wear and tear under normal usage or those requiring periodic replacement. ATI will have no liability under this warranty unless: (a) ATI is given written notice of the claimed defect and a Description thereof within thirty (30) days after Purchaser discovers the defect and in any event not later than the last day of the warranty period; and (b) the defective item is received by ATI not later ten (10) days after the last day of the warranty period. ATI's entire liability and Purchaser's sole remedy under this warranty is limited to repair or replacement, at ATI's election, of the defective part or item or, at ATI's election, refund of the price paid for the item. The foregoing warranty does not apply to any defect or failure resulting from improper installation, operation, maintenance or repair by anyone other than ATI.

ATI will in no event be liable for incidental, consequential or special damages of any kind, If ATI has been advised of the possibility of such damages. ATI's aggregate liability will in no event exceed the amount paid by purchaser for the item which is the subject of claim or dispute. ATI will have no liability of any kind for failure of any equipment or other items not supplied by ATI.

No action against ATI, regardless of form, arising out of or in any way connected with products or services supplied hereunder may be brought more than one (1) year after the cause of action accrued.

No representation or agreement varying or extending the warranty and limitation of remedy provisions contained herein is authorized by ATI, and may not be relied upon as having been authorized by ATI, unless in writing and signed by an executive officer of ATI.

Unless otherwise agreed in writing by ATI, all designs, drawings, data, inventions, software and other technology made or developed by ATI in the course of providing products and services hereunder, and all rights therein under any patent, copyright or other law protecting intellectual property, shall be and remain ATI's property. The sale of products or services hereunder does not convey any express or implied license under any patent, copyright or other intellectual property right owned or controlled by ATI, whether relating to the products sold or any other matter except for the license expressly granted below.

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Without ATI's prior written permission, Purchaser will not use such information for any other purpose or provide or otherwise make such information available to any third party. Purchaser agrees to take all reasonable precautions to prevent any unauthorized use or disclosure of such information.

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