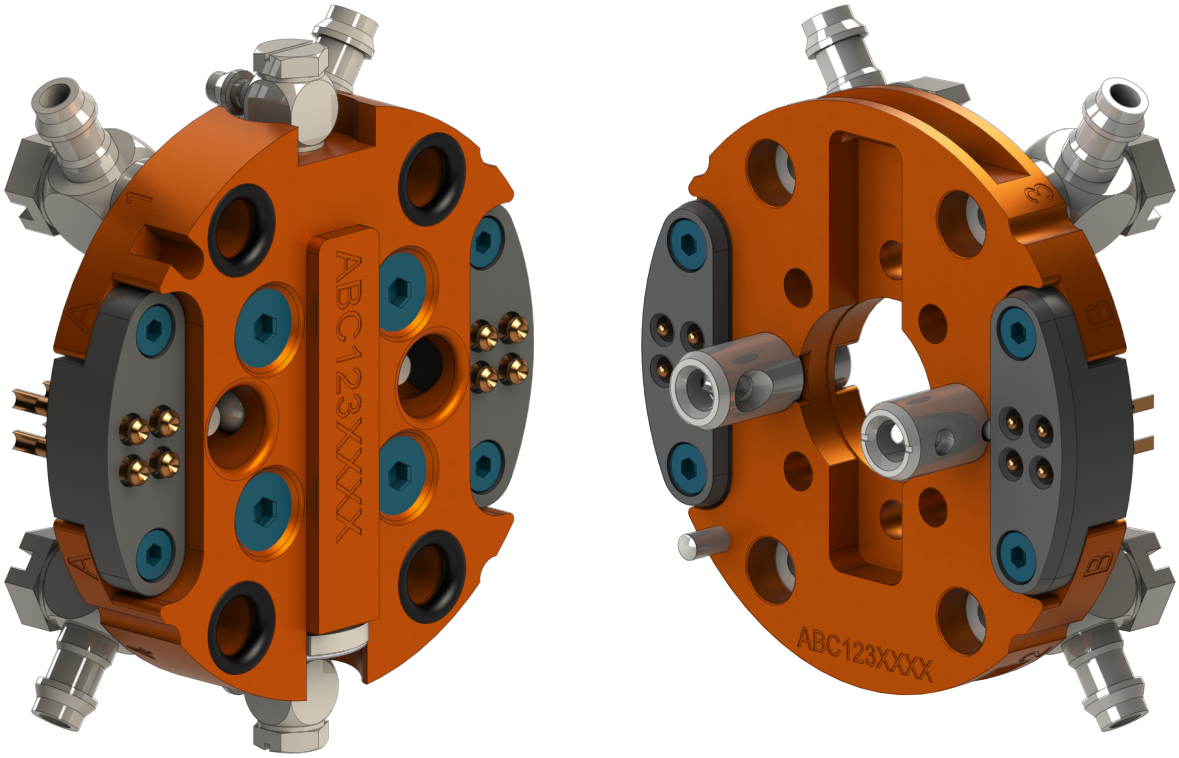
QC-001 Robotic Tool Changer

Manual



Document #: 9610-20-1955

Engineered Products for Robotic Productivity

Pinnacle Park • 1031 Goodworth Drive • Apex, NC 27539 USA • Tel: 919.772.0115 • Fax: 919.772.8259 • www.ati-ia.com

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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How to reach us:

Sale, Service and Information about ATI products:

ATI Industrial Automation
1031 Goodworth Drive
Apex, NC 27539 USA
WWW.ati-ia.com
Tel: 919.772.0115
Fax: 919.772.8259

Application Engineering
Tel: 919.772.0115
Fax: 919.772.8259
E-mail: applicationsengineers@ati-ia.com

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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 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
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.
Interface Plate	Component that adapts a Tool Changer or Utility Coupler to the user's robot or tooling.
L/U	Lock/Unlock sensing to determine the state of the master assembly locking mechanism.
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.
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.
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.
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.
Uncoupling	The physical action of unlocking the Master and Tool plates. See Unlock.
Unlatch	The output supplied to the ATI Master module to uncouple the Tool Changer.
Unlock Port	Pneumatic port on the Master plate through which air pressure is supplied to Unlock the Master plate from the Tool plate.
Unlocked	An output signal provided by a proximity sensor, indicating that the coupling mechanism is in the unlocked position.
Unlock	The unlock air pressure provided to the Master plate locking mechanism forcing the cam to release the locking balls from the bearing race. That allow the Master and Tool plates to be separated.

1. Safety

The safety section describes general safety guidelines to be followed with this product, Explanation of 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 the 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 the static forces in the 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 the 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 the electrical and pneumatic lines must minimize the possibility of stress/strain, kinking, rupture, etc. Failure of the 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 the all temporary protective materials (caps, plugs, tape, etc.) on the locking face of the 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 the 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 the applications other than intended will result in damage to the Tool Changer, modules, or end-of-arm tooling and could cause injury to personnel.

2. Product Overview

The QC-001 Tool Changer consists of the Master plate, Tool plate, and optional modules. 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 locking mechanism consists of a cam, alignment posts, and chrome-steel balls. Tapered pins, located on the Master plate, mate with alignment locking posts in the Tool plate to ensure repeatable alignment during the coupling process. Extreme pressure grease is applied to the posts on the Tool plate to enhance performance and maximize the life of the locking mechanism.

The QC-001 Tool Changer has (4) M5 x 0.8 integrated pneumatic only pass-through ports and is equipped with M5 elbow fittings for 6 mm diameter tubing.

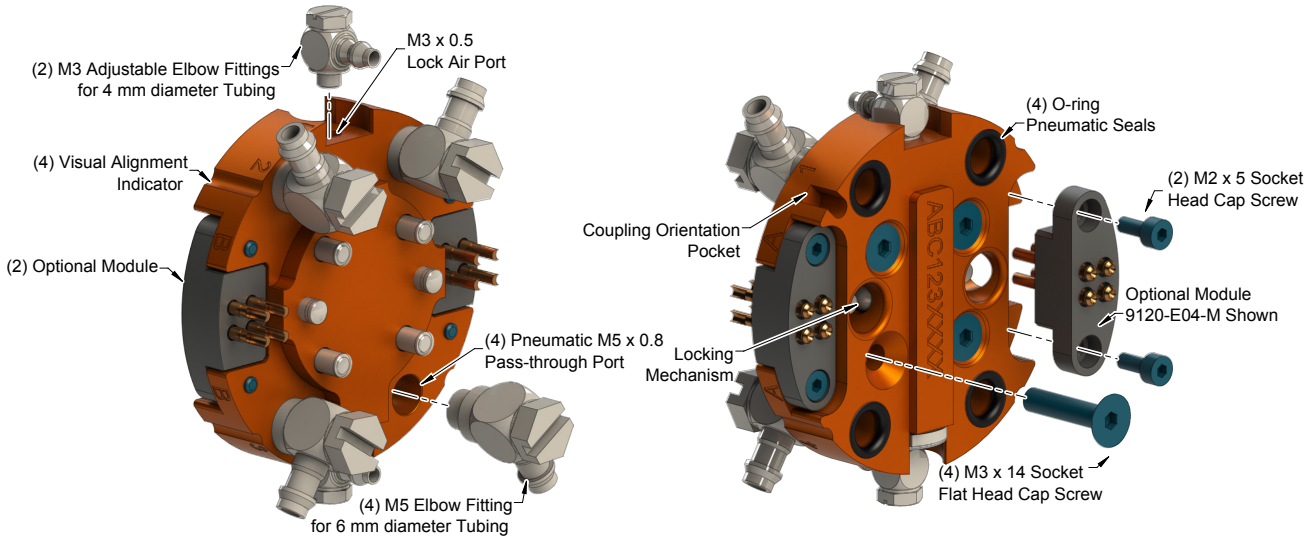
Both the Master and Tool plates have (2) mounting pockets that support optional modules for support of various utility pass-through connections. 9120-E0x modules provide signal connections to the QC-001 Tool Changer. For more information about optional modules, visit our website or contact an ATI Sales Representative.

2.1 Master Plate Assembly

The Master plate assembly includes an anodized aluminum body, hardened stainless-steel locking mechanism, and hardened steel alignment pins. The Master plate is attached to the robot using (4) M3 x 14 socket flat head cap screws, which are included with the Tool Changer.

(4) M5 x 0.8 ports provide air pass-through and (2) M3 x 0.5 threaded ports for Lock and Unlock air to the Master and Tool plates. The Lock and Unlock air ports are equipped with M3 adjustable elbow fittings for 4 mm diameter tubing (2) mounting features support optional modules for electrical or other pass-through connections.

Figure 2.1—QC-001 Master Plate Assembly

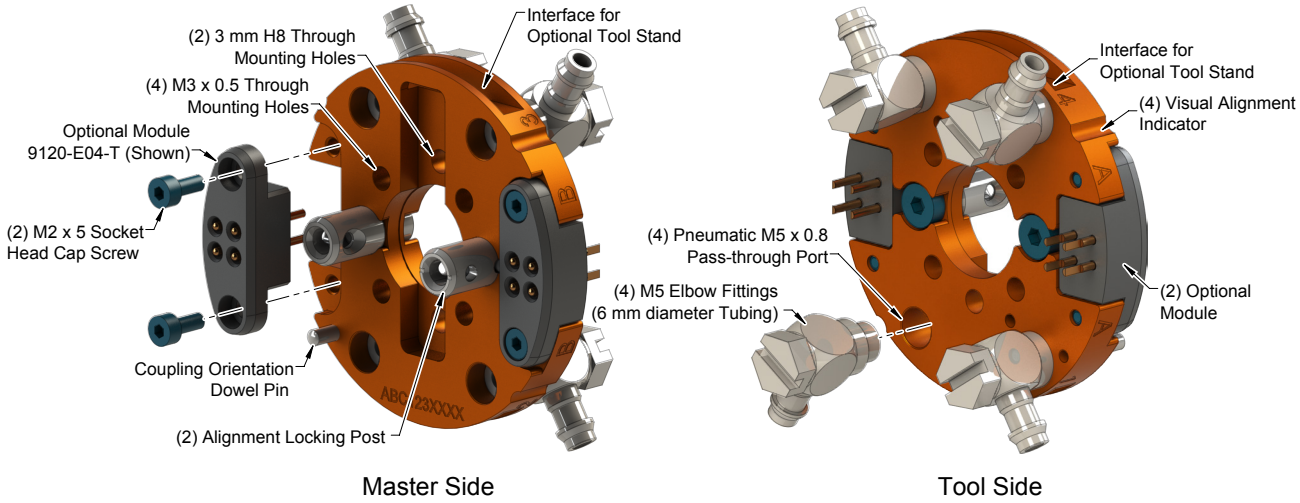


2.2 Tool Plate Assembly

The Tool plate assembly consists of an anodized aluminum body and hardened stainless-steel alignment locking posts (4) M5 x 0.8 ports provide air pass-through and (4) M5 elbow fittings accept 6 mm diameter tubing (2) mounting features support optional modules for electrical or other pass-through connections.

Alignment grooves are provided for interfacing with an optional tool stand. A dowel pin on the Tool plate aligns with a pocket in the Master plate to ensure proper coupling.

Figure 2.2—QC-001 Tool Plate Assembly



2.3 Optional Modules

The Tool Changer has (2) mounts for 9120-E0x modules. 9120-E0x modules support pass-through signals. For more information on optional modules, visit the *QC-001 Web Page* and select the Compatible Modules tab; or contact an ATI Sales Representative.

NOTICE: Do not operate the QC-001 Tool Changer with one optional module. Operating with one optional module can cause the Tool Changer to become unbalanced, which might result in damage to equipment or injury to personnel. Only operate the QC-001 with (0) or (2) optional modules.

3. Installation

The following section contains procedures for installing and removing the Master plate, Tool plate, and optional modules.

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 the 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 to malfunction and might result in injury to personnel or damage to equipment.

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.

3.1 Master Plate Installation

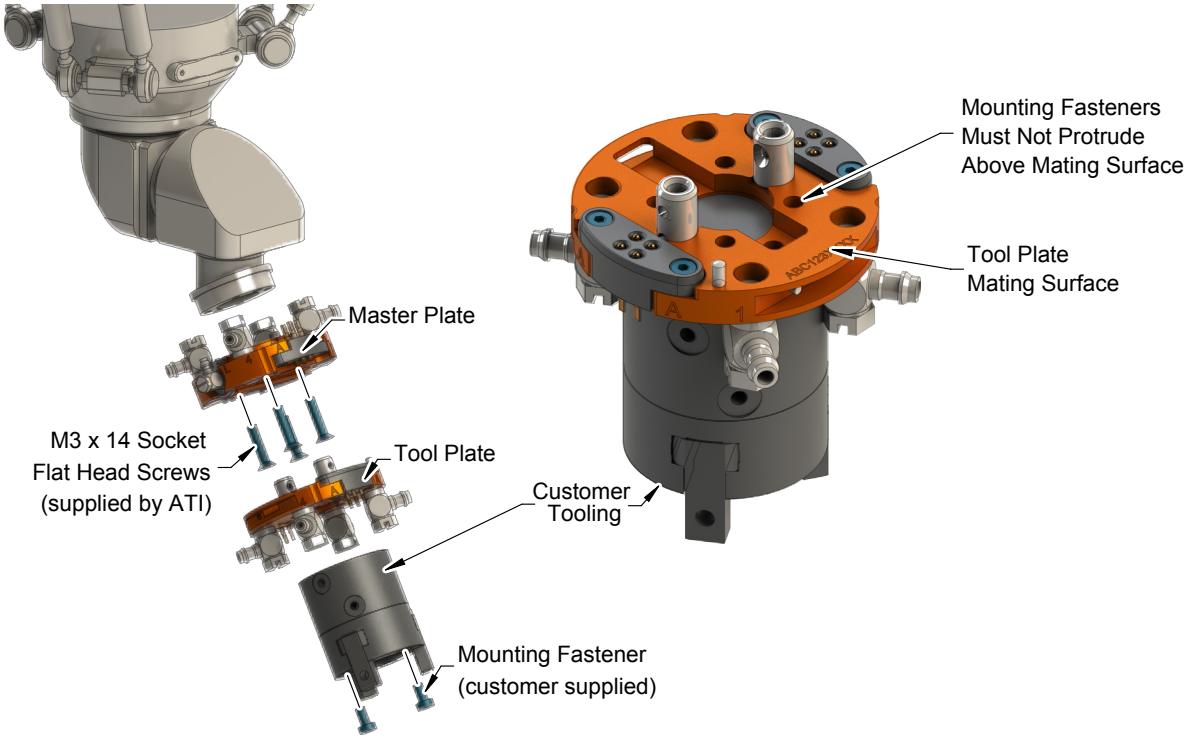
Refer to *Figure 3.1*.

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

Supplies required: *Clean rag, Loctite 222*

1. Wipe down the mounting surfaces with a clean rag.
2. Attach the Master plate to the robot arm.
   a. Apply Loctite 222 to the (4) M3 x 14 socket flat head cap screws (supplied by ATI).
   b. Align the dowel pin in the Master plate to the corresponding holes in the robot arm.
   c. Secure the Master plate with (4) M3 x 14 socket flat head cap screws using a 2 mm hex key.
   d. Torque to 7 in-lbs (0.79 Nm).
3. Install pneumatic lines and electrical cables. To prevent damage, bundle and strain-relieve pneumatic lines and electrical cables to allow adequate movement during operation. Refer to *Section 3.6—Optional Module Removal* for electrical cabling instructions.
4. After the procedure is complete, install the Tool plate to the customer tooling.

Figure 3.1—Master and Tool Plate Installation



3.2 Master Plate Removal

Tools required: *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 (for example: electrical, pneumatic, and hydraulic circuits).
4. Disconnect all utilities (for example: electrical, pneumatic, and hydraulic).

NOTICE: Support the Master plate while removing the fasteners.

5. Using a 2 mm hex key, remove the (4) M3 socket flat head cap screws that secure the Master plate to the robot.
6. Remove the Master plate.

3.3 Tool Plate Installation

Refer to *Figure 3.1*.

Tools required: *Hex keys, Torque wrench*

Supplies required: *Clean rag, Loctite 222*

1. Wipe down the mounting surfaces with a clean rag.
2. Attach the Tool plate to the customer tooling.
   a. Apply removable thread locker (Loctite 222) to customer-supplied fasteners, or use fasteners with pre-applied adhesive.
   b. Install the Tool plate using the (4) M3 x 0.5 mounting holes and customer-supplied mounting fasteners.
3. Install pneumatic lines and electrical cables. To prevent damage, bundle and strain-relieve pneumatic lines and electrical cables to allow adequate movement during operation. Refer to *Section 3.6—Optional Module Removal* for more information.
4. Safely resume normal operation.

3.4 Tool Plate Removal

Refer to *Figure 3.1*.

Tools required: *Hex keys*

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. Disconnect all utilities (for example: electrical, pneumatic, and hydraulic).
5. Using a hex key, remove the (4) M3 fasteners that secure the Tool plate to the interface plate or customer tooling.
6. Remove the Tool plate.

3.5 Optional Module Installation and Wiring Electrical Connections

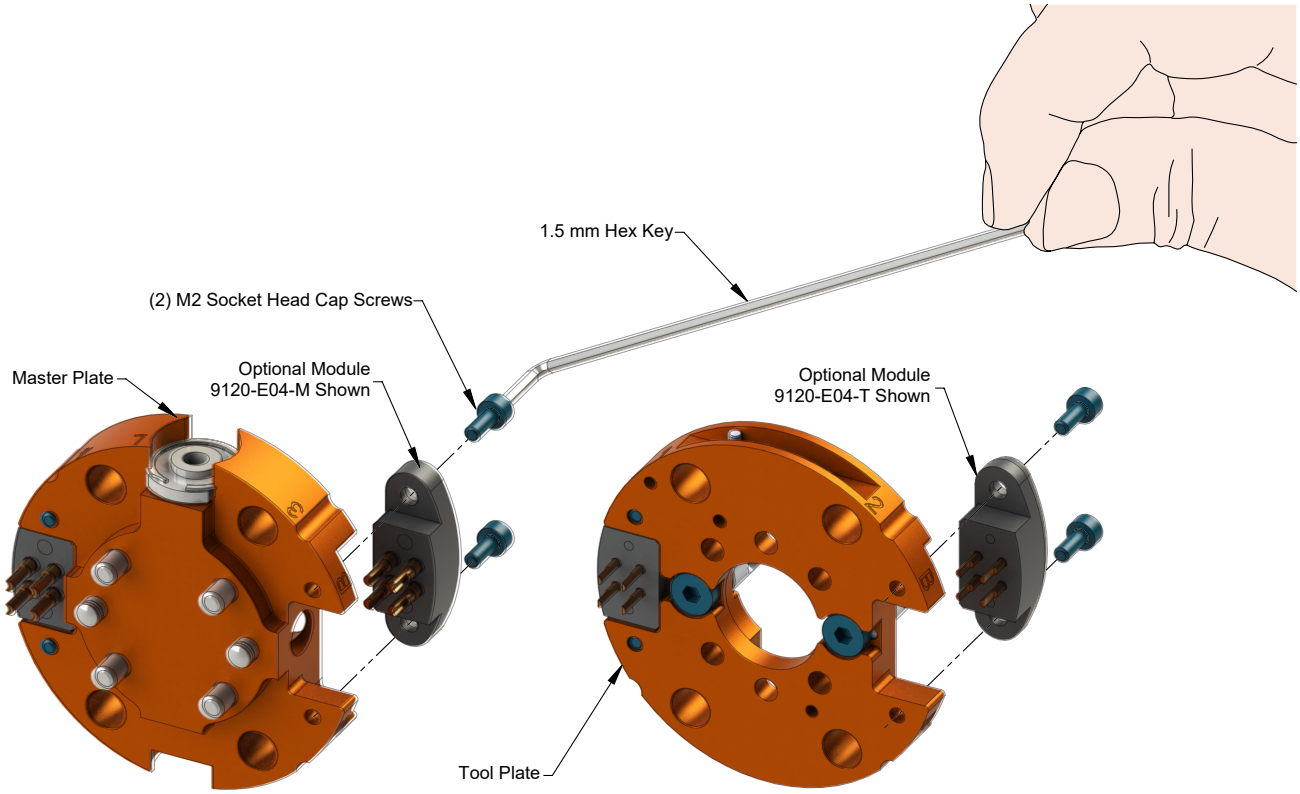
NOTICE: Do not operate the QC-001 Tool Changer with one optional module. Operating with one optional module can cause the Tool Changer to become unbalanced, which might result in damage to equipment or injury to personnel. Only operate the QC-001 with (0) or (2) optional modules.

Tools required: *1.5 mm hex key, torque wrench, soldering iron*

Supplies required: *Solder, heat shrink*

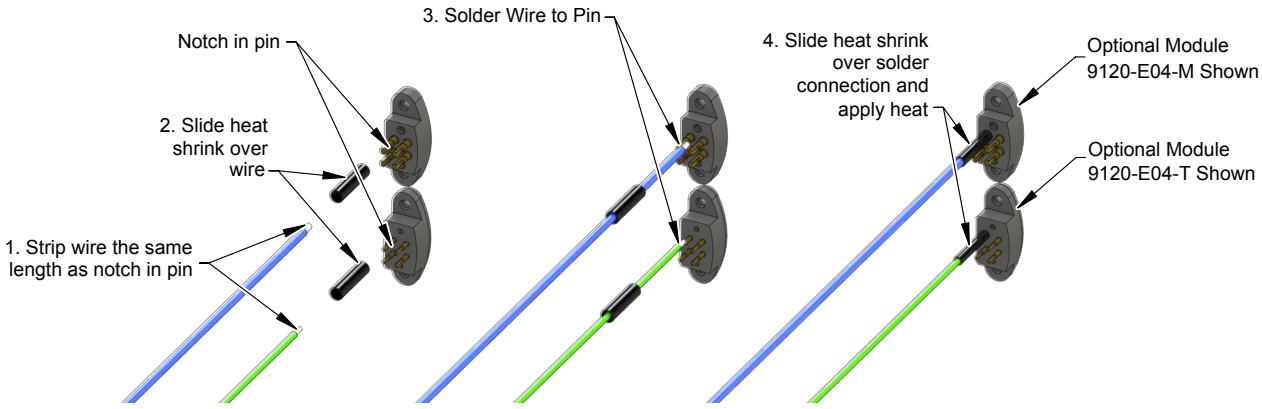
1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits (for example: electrical, pneumatic, and hydraulic circuits).
4. Both the Master and Tool plates have removable optional modules for electrical pass-through connections. The electrical connections must be soldered to the connection pins.
5. Remove the (2) M2 socket head cap screw from the optional module using a 1.5 mm hex key.
6. Remove the optional module from the Master or Tool plate.

Figure 3.2—Optional Module Installation



7. Strip the wire the same length as the notch in the pin. See *Figure 3.3*.
8. Slide a piece of the heat shrink tubing over the wire.
9. Solder the wire to the pin.
10. Slide the heat shrink tubing over the soldered connections and apply heat using a heat gun until the heat shrink restricts tightly over the connection.

Figure 3.3—Solder Connections



11. Repeat these steps for all connections.
12. Replace the optional module to the Master or Tool plate and secure with the (2) M2 socket head cap screws using a 1.5 mm hex key. Torque to 35 in-oz (1.18 Nm).
13. Safely resume normal operation.

3.6 Optional Module Removal

Refer to *Figure 3.2*.

Tools required: *1.5 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 (for example: electrical, pneumatic, and hydraulic circuits).
4. Disconnect any cables, air line, etc. if required.
5. While supporting the module, remove the (2) M2 socket head cap screw from the optional module using a 1.5 mm hex key.
6. Remove the module from the Master or Tool plate.

3.7 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.

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.

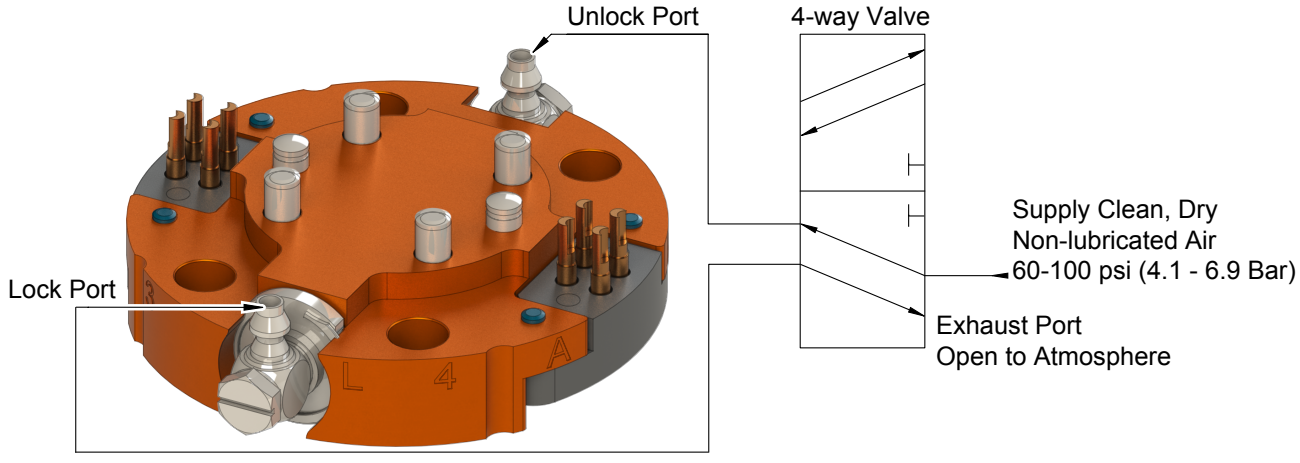
3.7.1 Valve Requirements

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 with either 4-port or 5-port configuration 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 (for example: 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 locking mechanism 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 with either 4-port or 5-port configuration.

Figure 3.4—Lock and Unlock Pneumatic Connections



4. Operation

The Master locking mechanism is pneumatically driven to couple and uncouple with the alignment Locking Posts 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 the service (See *Section 5.2—Cleaning and Lubrication of the Locking Mechanism*). 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 the accepted offsets. See *Figure 4.1* and *Table 3.1* for recommended maximum allowable offsets prior to coupling. Greater offsets than shown in *Table 3.1* 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 3.1*) but not touching the Tool plate. As locking occurs, the Master plate should draw the Tool plate into the locked position.

Figure 3.5— Offset Prior to Coupling

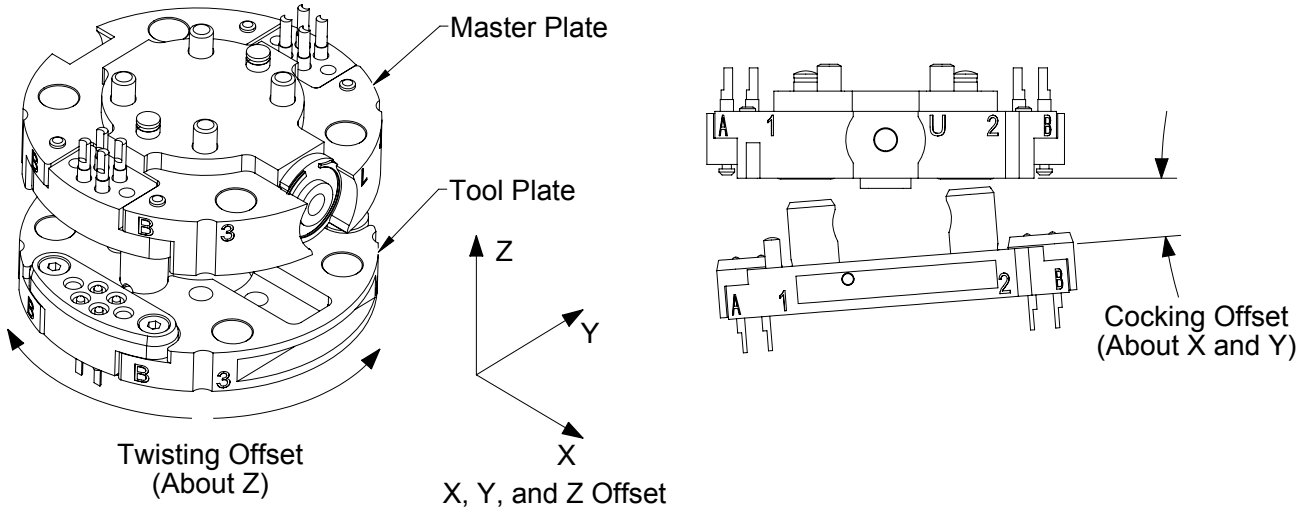


Table 3.1—Maximum Recommended Offsets Prior to Coupling				
Model	**No-Touch Zone Z Offset (Max)[1]**	**X and Y Offset (Max) [2]**	**Cocking Offset (Max)**	**Twisting Offset (Max)**
QC-001	0.12” (3 mm)	±0.08” (2 mm)	±0.7°	±1°

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 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 the 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 the 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 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 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 the 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 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 unlocking process.

4.4 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 TSS (Tool Stand Small) system is compatible with ATI Tool Changer sizes QC-001 to QC-41. The TSS systems can be equipped with horizontal modules, clamp modules, and different types of tool sensing (2) mounting styles are available: a pin and bushing style and a pin and rack style. Visit the ATI Web Site *http://www.ati-ia.com/products/toolchanger/toolstand/small/SmallStand.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.

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 a safety measure if the 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

The following section contains preventative maintenance procedures, periodic inspection recommendations, and cleaning instructions for the Tool Changer and optional modules. Use this section to maximize the life of the Tool Changer and its components.

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 the 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. The following table contains a visual inspection and preventive maintenance schedule. Detailed assembly drawings are provided in *Section 9—Drawings* of this manual.

Table 4.1—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*.
- ☐ Inspect for excessive alignment pin/bushing wear, may be an indication of the poor robot position during pickup/drop-off. Adjust robot position as needed. Check tool stand for wear and alignment problems.
- ☐ Inspect for wear on the ball bearings/bearing race, may be an indication of the excessive loading.

Hoses

- ☐ Inspect hose connection for tightness and leaks. If the 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.*
- ☐ Inspect electrical contacts for wear or damage. Refer to *Section 6.2.2—Spring Pin Replacement.*

Seals Pass Through Air and Optional Modules

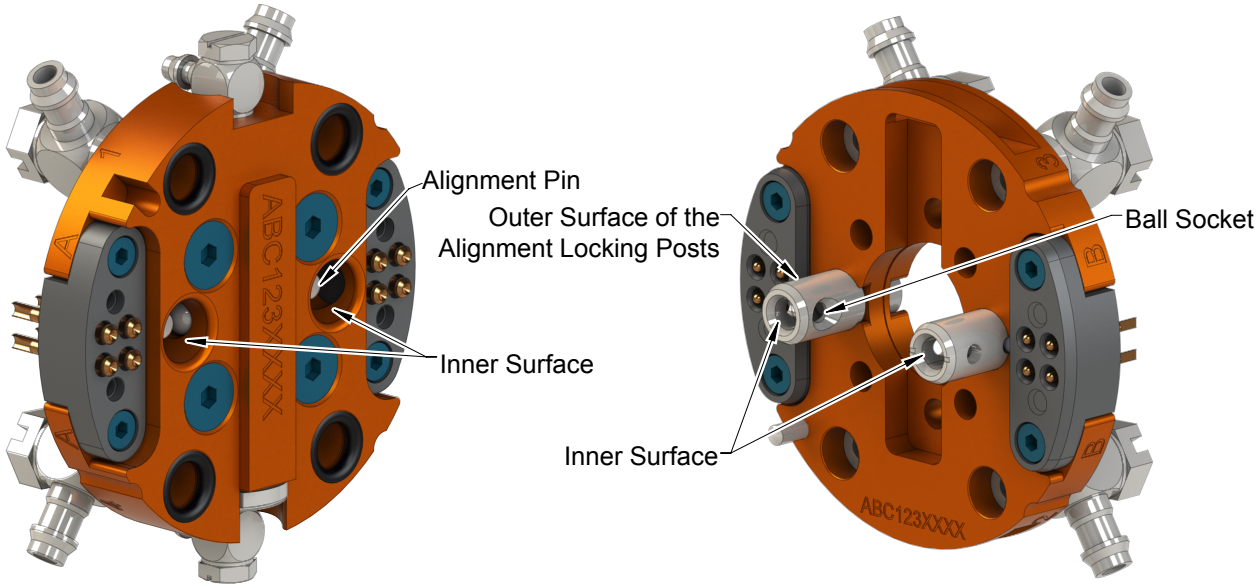
- ☐ Inspect for wear, abrasion, and cuts. Replace damaged seals or bushings as needed.

5.2 Cleaning and Lubrication of the Locking Mechanism

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

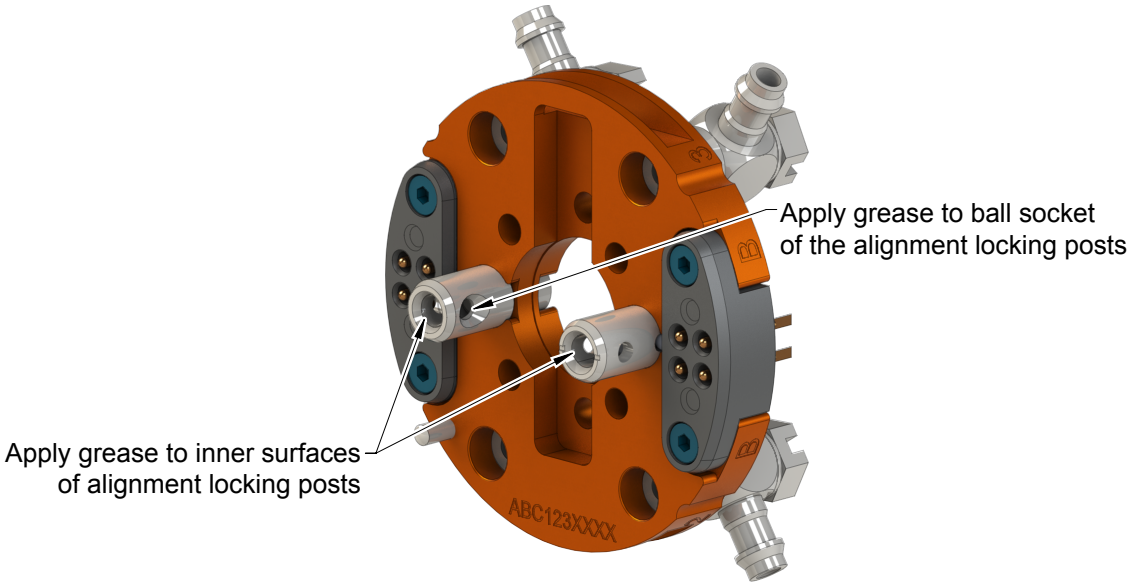
1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits (for example: electrical, pneumatic, and hydraulic circuits).
4. Use a clean rag to thoroughly remove the existing lubricant and debris from the outer surface of the alignment locking posts on the Tool plate. Clean the inner surfaces and ball sockets of the alignment locking posts by pushing the rag through in the narrow passages with a small shaft.

Figure 4.1—Clean Outer and Inner Surfaces of Alignment Locking posts on the Tool Plate



5. Clean the inner surfaces, balls, and alignment pins of the Master plate by pushing the rag into the narrow socket with a small shaft.
6. Apply a moderate coating of the lubricant to the alignment locking posts inside and out. Note: Do not apply lubrication to the Master plate components.

Figure 4.2—Applying Grease to Locking Posts

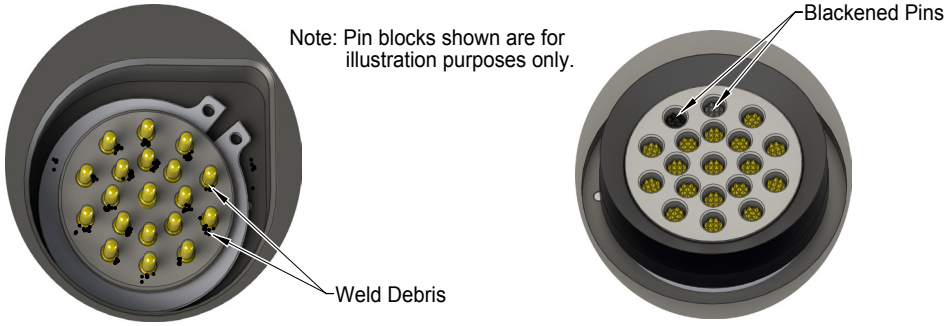


5.3 Optional Electrical Module Pin Block Inspection and Cleaning

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 any debris or darkened pins.

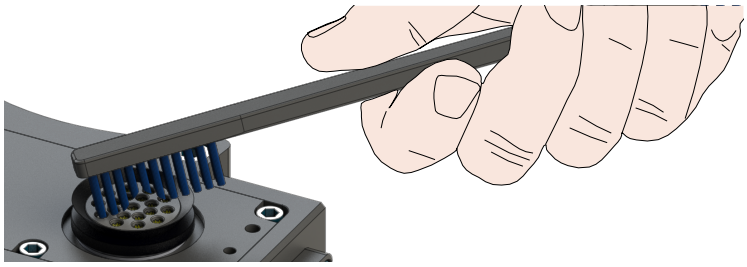
Figure 4.3—Inspect Master and Tool Pin Blocks



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

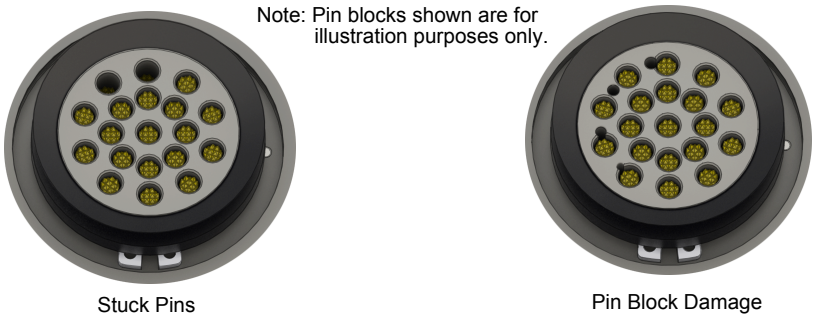
NOTICE: Do not use an abrasive media, cleaners, or solvents to clean the contact pins. Using abrasive media, cleaners, or solvents will cause damage to the contact surface or cause pins to stick. Clean contact surfaces with a vacuum or non-abrasive media such as a nylon brush (ATI Part Number 3690-0000064-60)

Figure 4.4—Clean Pin Blocks with a Nylon Brush



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

Figure 4.5—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. Safely 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 the 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 the 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 3.7—Pneumatic Requirements.*

Table 5.1—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 3.7—Pneumatic Requirements.* To unlock the Tool Changer manually, refer to *Section 6.1.1—Manually Uncoupling Master and Tool Plates.*
	Air pressure trapped in the de-energized Lock or Unlock ports.	Air pressure must be vented to the atmosphere properly, refer to *Section 3.7—Pneumatic Requirements.* To unlock the Tool Changer manually, refer to *Section 6.1.1—Manually Uncoupling Master and Tool Plates.*.
	Pneumatic connections loose or damaged.	Inspect hose connection for tightness and leaks. If the 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*).
	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 4.4—Tool Storage Considerations.* Re-teach the robot to bring the Master plate and Tool plate closer together prior to attempting to lock. Refer to *Section 4—Operation*.
Units Equipped with Electrical/Servo/Control/Signal Modules		
Loss of Communication	Debris in and around contact pins.	Clean contact pins with a nylon brush. Refer to *Section 5.3—Optional Electrical Module Pin Block Inspection and Cleaning*.
	Contact Pin worn or damaged.	Replace contact pin, refer to *Section 6.2.2—Spring Pin Replacement*.
	Cable connections loose or cables damaged.	Check that cable connections are secure and cables are not damaged.

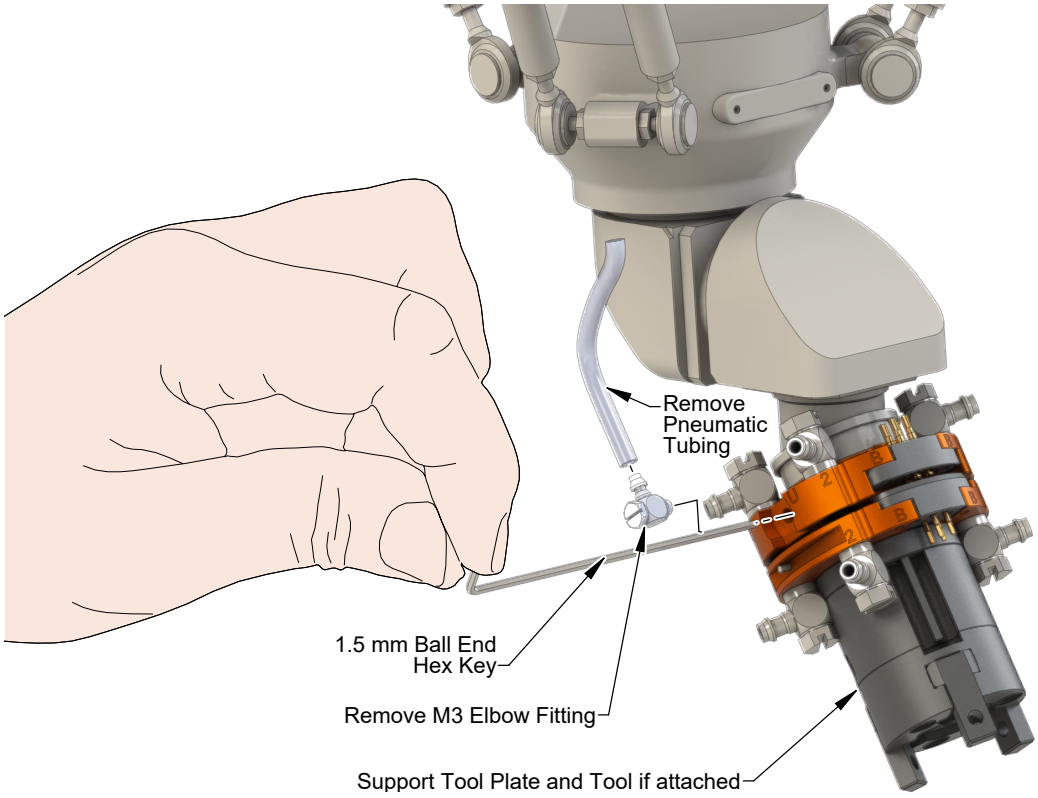
6.1.1 Manually Uncoupling Master and Tool Plates

Tools required: *1.5 mm ball end hex key, flat head screw driver*

You can manually uncouple the Master and Tool plates if air pressure is lost. This procedure is not standard and should only be performed when no alternative is available.

1. Remove the Unlock air tubing by hand.
2. Remove the M3 elbow fitting from the Master plate using a flat head screwdriver.
3. Using a 1.5 mm ball end hex key, insert it through the Unlock air port and push the locking piston to the unlocked position.
4. Separate the Tool plate from the Master plate, supporting the Tool plate and tool if attached.

Figure 5.1—Manually Uncoupling the Tool Changer



6.2 Service Procedures

Component replacement procedures are provided in the following section.

6.2.1 Rubber O-ring Inspection and Replacement

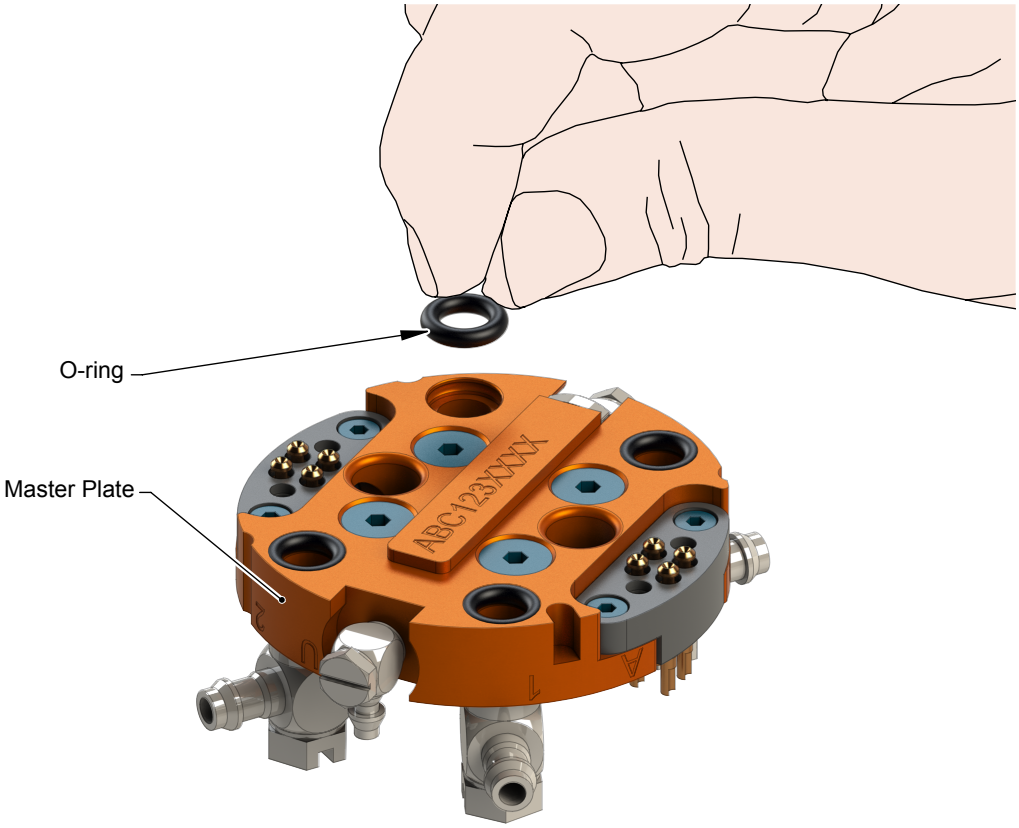
Parts required: *O-ring.*

Rubber O-rings seal the air passage from the Master plate to the Tool plate. If an O-ring becomes cut or damaged, replace it.

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. Disconnect any cables, air lines, etc. if required.
5. Remove the damaged rubber O-ring by pinching with finger tips or prying with finger nail and pulling the O-ring out of the body.

6. Dip the new O-ring in water to aid in installation.
7. Insert the rubber O-ring into the bore.
8. Press the O-ring in by hand until it is seated completely in the bore.
9. Safely resume normal operation.

Figure 5.2—Rubber O-ring Replacement



6.2.2 Spring Pin Replacement

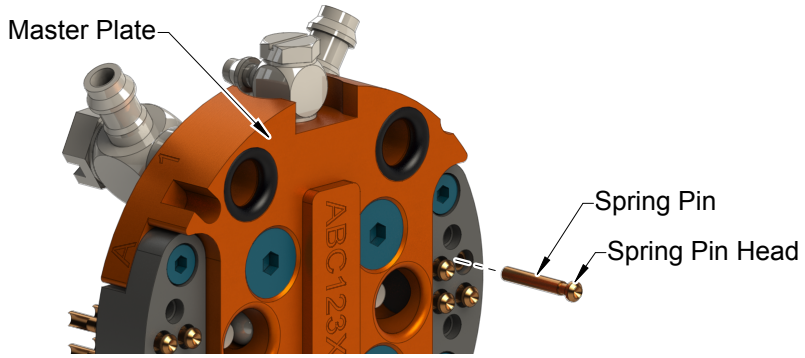
Parts required: *Spring pin*

Tools required: *Pin insertion tool*

Replacing spring pins may be necessary If the they become damaged or worn. The following procedure describes the replacement of the spring 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. Disconnect any cables, air line, etc. if required.
5. Using your finger nails, catch the spring pin under the head.
6. Gently and evenly pull the spring pin out until it clears the pin block.

Figure 5.3—Cleaning Master and Tool Plates

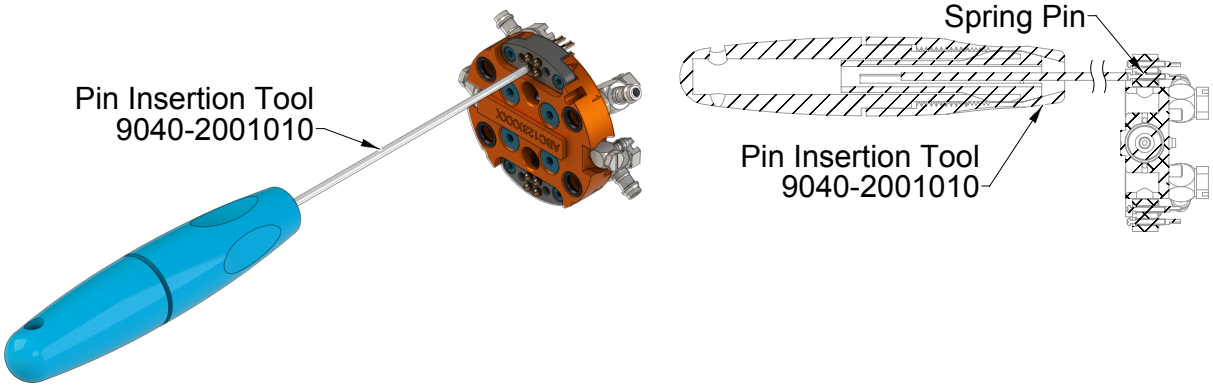


7. Start the new spring pin into the pin block by hand.

> **CAUTION:** Do not use excessive force to push spring pin into pin socket. Use of excessive force can cause the socket to move in the pin block and damage the pin block assembly. This may require the replacement of the entire pin block assembly. Gently push the spring pin into the block until you feel a click.

8. Using the pin insertion tool, gently push the pin into the block until you feel a click. Note: The pin socket has (2) sets of dimples that the spring pin clicks into.

Figure 5.4—Cleaning Master and Tool Plates

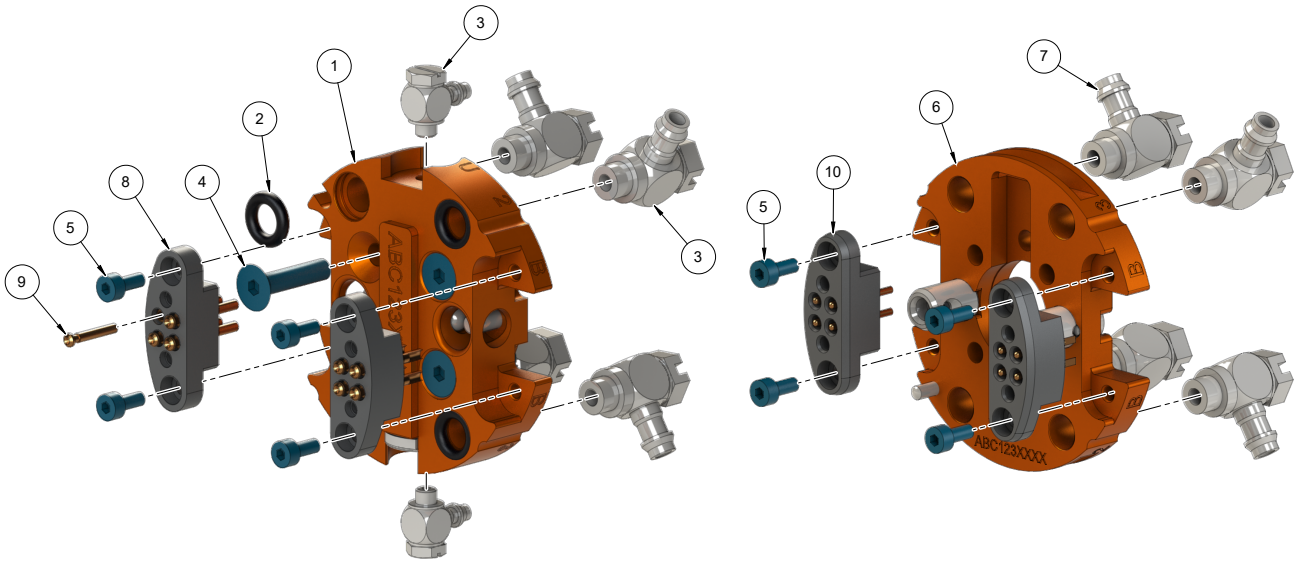


9. Ensure that the spring pin is at the proper height by comparing it to other spring pins. If not, continue to push the pin into the block until you feel a click or the pin is at the proper height.
10. Safely resume normal operation.

7. Serviceable Parts

Table 6.1—Serviceable Parts			
Item No.	**Qty**	**Part Number**	**Description**
QC-001 Master Plate			
1	1	9120-001M-000-000	QC-001 Master base assembly
2	1	3410-0001370-01	O-ring
3	1	9005-20-2085	QC-001 Master Fitting Kit with Lock / Unlock air
4	4	3500-1258014-15	M3 x 14 mm Socket Flat Head Cap Screw Blue Dyed Magni-565
5	4	3500-1053005-11	M2 x 5 Socket Head Cap Screw
QC-001 Tool Plate			
6	1	9120-001T-000-000	QC-001 Tool Base Assembly
7	1	9005-20-2086	QC-001 Tool Fitting Kit
5	4	3500-1053005-11	M2 x 5 Socket Head Cap Screw
QC-001 Electrical Modules (4-Pin)			
8	2	9120-E04-M	Electrical Module, 4-Pin, 3Amp/50VAC (Master)
9	2	1700-1140003-01	Spring Probe (Master)
10	2	9120-E04-T	Electrical Module, 4-Pin, 3Amp/50VAC (Tool)
QC-001 Electrical Modules (6-Pin)			
*	2	9120-E06-M	Electrical Module, 6-Pin, 3Amp/50VAC Master
9	2	1700-1140003-01	Spring Probe (Master)
*	2	9120-E06-T	Electrical Module, 6-Pin, 3Amp/50VAC Tool
Accessories			
*	1	9040-2001010	Pin Insertion Tool

Figure 6.1 Serviceable Parts



Master Side

Tool Side

8. Specifications

Table 7.1—Master and Tool Specifications		
Recommended Max Payload	3.0 lbs. (1.36 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	39 lbs. (173.5 N)	Axial holding force
Recommended Max Moment X-Y (Mxy) **Recommended Max Torque about Z (Mz)**	8.7 in-lb 0.98 (Nm) 10.2 in-lb 1.15 (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)	0.079 lbs (0.036 kg) 0.051 lbs (0.023 kg)	Master Tool
Positional Repeatability	0.0004 in. (0.0102 mm)	Repeatability tested at rated load at one million cycles.
Max. Recommended Distance between Master and Tool plate	0.04 in. (1.0 mm)	No-Touch locking technology allows the Master and Tool plates to lock with separation when coupling.
Mounting/Customer Interface	Refer to *Section 9—Drawings*.	

9. Drawings

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