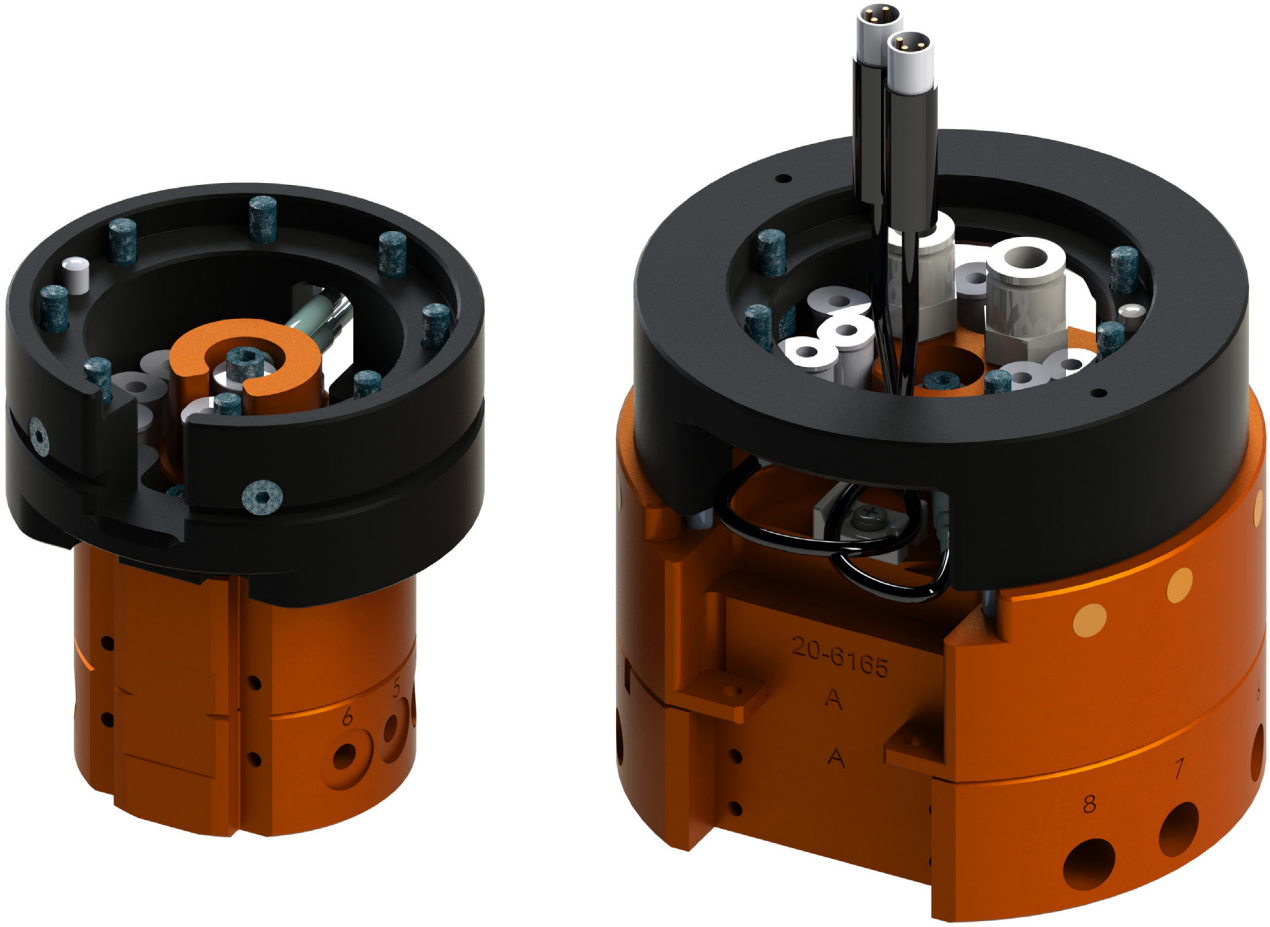
ATI INDUSTRIAL AUTOMATION

A Novanta Company

Hollow-Wrist Robotic Tool Changers
QC-11HM through QC-27HM

Manual



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Engineered Products for Robotic Productivity

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Foreword

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

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
Detection Shaft	Threaded stem inserted into the robot side of the piston, functions as a target to actuate the lock and unlock sensors.
EIP	**E**nd-effector **I**nterface **P**late – interface plate between the Tool plate and the customer's end-effector (tooling). Allows customized mounting to the end-effector.
Electrical Module	Any of a wide variety of 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	Any of a wide variety of utility modules that pass fluids through the Master and Tool modules to the end-effector.
High Current Module	Any of a wide variety of utility modules that pass electrical power through the Master and Tool modules to the end-effector.
Interface Plate (IP)	Optional customized component used to adapt a Tool Changer or Utility Coupler to the user's robot or tooling.
Lock and Unlock	Lock and Unlock sensing capability enables the customer 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.
Lock Sensor	A proximity sensor that detects the position of the pneumatically actuated piston when it is in the locked or missed tool position.
Locked	An output signal provided by a proximity sensor, indicating that the coupling mechanism is in the Locked position.
Locking Balls	Hardened steel ball bearings used in the fail-safe locking mechanism. The locking balls are forced outward by the cam against the bearing race to pull the Master and Tool plates together.
Locking Mechanism	Manual, pneumatic or electrical driven device that draws the Master and Tool plates together securing them in a fail-safe locked condition until the mechanism is unlocked. The locking mechanism consists of locking balls, cam, ball cage, bearing race, and either an lever, pneumatic cylinder or an electric motor.
Lock	**T**he lock **a**ir 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.
Pneumatic Module	Any of a wide variety of utility modules that pass air or vacuum through the Master and Tool modules to the end-effector.

Term	Definition
Sensor Plate	Cover plate for the back side of the Master plate, seals the pneumatic chamber and provides mounting points for the Lock and Unlock switches.
Servo Module	Any of a wide variety of 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	**S**ensor **I**nterface **P**late used to adapt the Tool Changer Master to the customer-supplied robot. The SIP contains sensors that determine the state (Locked/Unlocked/No Tool) of the Master plate.
Tool plate	The half of the Tool Changer to which various tools or end-effectors are mounted.
Tool Stand	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 Port	Pneumatic port on the Master plate through which air pressure is supplied to Unlock the Master plate from the Tool plate.
Unlock Sensor	A proximity sensor that detects the position of the pneumatically actuated piston when it is in the unlocked position.
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. Allowing the Master and Tool plates to be separated.

1. Safety

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

1.1 Explanation of Notifications

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

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

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

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

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

1.2 General Safety Guidelines

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

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

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

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

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

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

1.3 Safety Precautions

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

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

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

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

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

2. Product Overview

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

The Tool Changer consists of a Master plate, which is attached to the robot arm, and a Tool plate, which is attached to customer tooling. When the robot is ready to pick up an end-effector, the two plates lock together using a patented, multi-tapered cam with ball locking technology and a patented fail-safe mechanism.

Ports in the body of the Tool Changer and optional modules can pass electrical signals and provide pneumatic or fluid connections to customer tooling. See the respective manuals for these modules for more information.

Hollow-Wrist Tool Changers enable internal routing of cables and air lines in hollow-wrist robots. The axial air ports pass directly into the Hollow-Wrist robot, allowing the dress package to be protected and increase reliability. These Tool Changers feature push-to-connect fittings and couple with standard Tool side Tool Changers. The ATI Tool Changer has been designed to provide long life with minimal maintenance. Refer to *Table 2.1* for different Hollow-Wrist models and their respective features.

Table 2.1—Hollow-Wrist Models and Features

Model	Payload	Flats	Plate	Pneumatic Ports	Part No.	Sensor
QC-11HM	35 lbs	(1) Flat	Master	(6) 1/8" tube fittings Pass-through (2) 1/8" tube fittings Lock/Unlock air	9120-011HM-000-000-S0	None
					9120-011HM-000-000-SQ	PNP
					9120-011HM-000-000-SQN	NPN
				(6) 4 mm tube fittings Pass-through (2) 4 mm tube fittings Lock/Unlock air	9120-011HM-000-000-S0-E	None
					9120-011HM-000-000-SQ-E	PNP
					9120-011HM-000-000-SQN-E	NPN
			Tool	(6) M5 X 0.8 Pass-through Ports	9120-011T-000-000	N/A
QC-20HM	55 lbs	(1) Flat (K series modules)	Master	(12) 1/8" tube fittings Pass-through (2) 1/8" tube fittings Lock/Unlock air	9120-020HM-000-PM5-SQ	PNP
					9120-020HM-000-PM5-SQN	NPN
					9120-020HM-000-PM5-S0	None
				(12) 4 mm tube fittings Pass-through (2) 4 mm tube fittings Lock/Unlock air	9120-020HM-000-PM5-SQ-E 9120-020HM-000-PM5-SQ-M	PNP
			Tool	(12) M5 X 0.8 Pass-through Ports	9120-020T-000-PM5 9120-020T-000-PM5-B	N/A
QC-21HM	55 lbs	(2) Flats - (1) Flat for K series modules and (1) Flat for J16 mounting pattern (with adapter plate)	Master	(6) 1/8" tube fittings Pass-through (2) 1/4" tube fittings Pass-through (2) 1/8" tube fittings Lock/Unlock air	9120-021HM-000-000-SQ	PNP
					9120-021HM-000-000-S0	None
				(6) 4 mm tube fittings Pass-through (2) 6 mm tube fittings Pass-through (2) 4 mm tube fittings Lock/Unlock air	9120-021HM-000-000-SQ-E 9120-021HM-000-000-SQ-M	PNP
					9120-021HM-000-000-S0-E	None
			Tool	(8) 1/8 NPT Pass-through Ports	9120-021T-000-000	N/A
				(8) 1/8-28 BSPP Pass-through Ports	9120-021T-000-000-E	
				(8) 1/8-28 BSPT(R) Pass-through Ports	9120-021T-000-000-R	
QC-27HM	83 lbs	(1) Flat for K series modules	Master	(8) 4 mm tube fittings Pass-through (2) 4 mm tube fittings Lock/Unlock air	9120-027HM-000-000-S0-E 9120-027HM-000-000-S01-E	None
					9120-027HM-000-000-SQ-E 9120-027HM-000-000-SQ1-E	PNP
			Tool	(8) 1/8-28 BSPP Pass-through Ports	9120-027T-000-000-E	N/A

Notes:

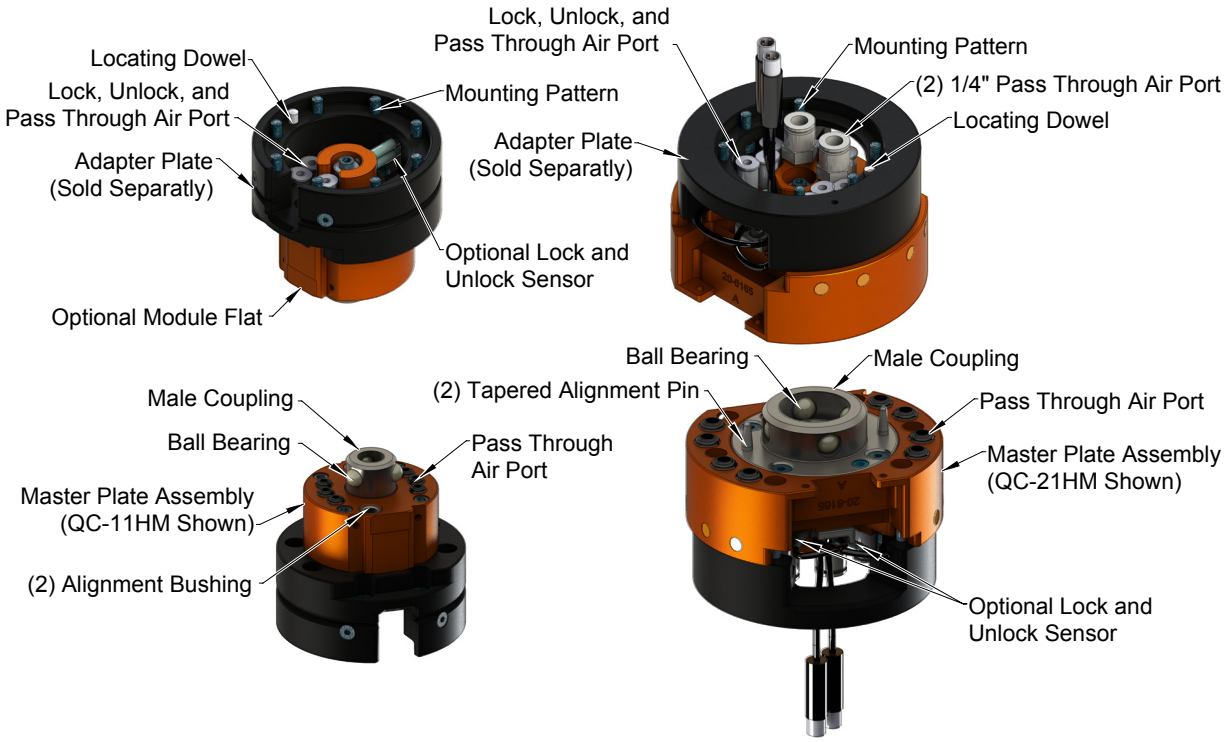
1. Hollow-Wrist Master Plate Assemblies with (-E) part numbers have black anodized bodies all other have orange anodized bodies.
2. Hollow-Wrist Tool plate Assemblies with (-B or -E) part numbers have black anodized bodies
3. Hollow-Wrist Master Plate Assemblies with (-SQ1) part numbers have sensor with flying leads.

A Tool Changer enhances the flexibility and reliability of a robotic cell. Robotic Tool Changers are used in automated Tool change applications, as well as manual Tool change operations. Robotic Tool Changers also provide a method for quick Tool change for maintenance purposes.

2.1 Hollow-Wrist 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 one or two flat sides for mounting optional modules, depending on the model and application.

Figure 2.1—Hollow-Wrist Master Plate Assemblies



The Master plate is equipped with axial air ports that pass directly into the hollow-wrist robot, increasing reliability. The air ports provide lock and unlock air for the locking mechanism and pass-through air for the end of arm tooling. A separate adapter plate assembly provides a standoff for the air ports and a mounting pattern to attach to the robot arm. Adapter plates are available from ATI.

Alignment pins mate with bushings to ensure repeatable alignment during the coupling process. An extreme pressure grease is applied to the cam, male coupling, ball bearings, and pins to enhance performance and maximize the life of the Master plate assembly. Refer to *Section 5.2—Cleaning and Lubrication of the Locking Mechanism and Alignment Pins* for lubrication instructions. In some models, the Master plate is equipped with tapered alignment pins. Other models, such as the QC-11HM Hollow-Wrist Master plate, have hardened stainless steel alignment bushings.

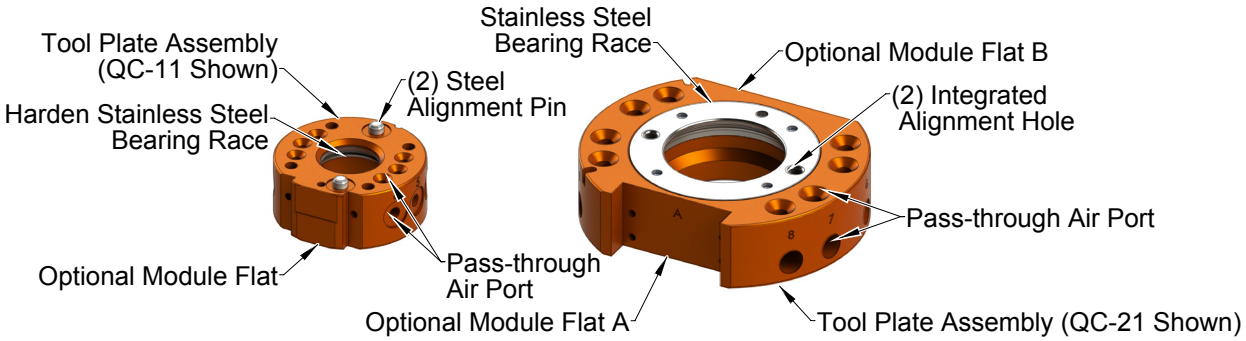
Optional proximity sensors, located in the body of the Master plate, verify the lock and unlock position of the piston and cam. The sensors provide lock and unlock signals. Refer to *Section 2.3—Master Plate/Tool Plate Coupling Mechanism* for more information.

2.2 Tool Plate Assembly

The Tool plate assembly includes an anodized aluminum body and a hardened stainless-steel bearing race. The Tool plate provides one or two flat sides for mounting of optional modules, depending on the model. Optional modules can be arranged to suit the application. In some models, the bearing race or Tool plate body has integrated alignment holes or bushings. Other models, such as the QC-11HM Tool plate, have hardened steel alignment pins.

The Tool plate is equipped with pass-through air ports to supply air to customer tooling.

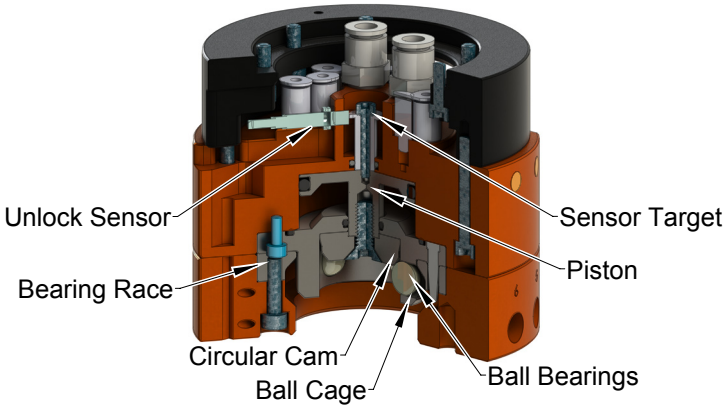
Figure 2.2—Tool Plate Assemblies



2.3 Master Plate/Tool Plate Coupling Mechanism

Coupling the Master and Tool plate is achieved through a patented, 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 three 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 on the cam assures the coupling will not be compromised in case of air loss (fail-safe feature). A secondary angle on the cam 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—Master Plate Assemblies



2.4 Optional Modules

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

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

Table 2.2—Hollow-Wrist Models and Features

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

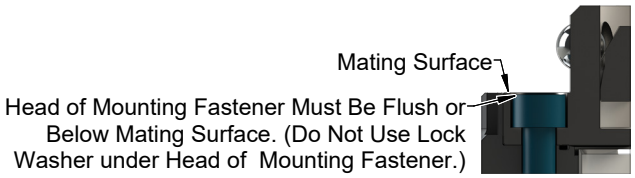
3. Installation

All fasteners used to mount the Tool Changer to the robot and to customer tooling should be tightened to a torque value as indicated. Fasteners should have pre-applied adhesive or be applied with removable (blue) Loctite® as specified in *Table 3.1*. Pneumatic lines and electrical cables are attached, bundled, and must be strain-relieved in a manner that allows for freedom of movement during operation.

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

WARNING: All pneumatic fittings and tubing must be capable of withstanding the repetitive motions of the application without failing. The routing of electrical and pneumatic lines must minimize the possibility of over stressing, pullout, or kinking the lines. Failure to do so can cause critical electrical and/or pneumatic lines to malfunction and might 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 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: Thread locker applied to fasteners must not be used more than once. Fasteners might become loose and cause equipment damage. Always apply new thread locker when reusing fasteners.

CAUTION: Failure to follow the tool interface plate design consideration in *Section 3.3—Tool Interface Plate* may result in loosening of the interface during operation. Follow the guidelines provided when designing an interface plate for the Tool Changer.

Table 3.1—Fastener Size, Class, and Torque Specifications

Mounting Conditions	Fastener Size, Property Class, and Type	Recommended Torque	Thread Locker
QC-11HM Master plate to adapter plate, Supplied Fasteners	M3-30 Class 12.9	10 in-lbs (1.13 Nm)	Pre-applied Adhesive or Loctite 222
QC-20HM QC-21HM and QC-27HM Master plate to adapter plate, Supplied Fasteners	M4-30 Class 12.9	17 in-lbs (1.9 Nm)	
Tool Interface Plate to QC-11 Tool plate Minimum thread engagement of 7.5 mm [1.5X fastener Ø]. *Do not exceed maximum available thread depth of 8 mm as shown in Section 9—Drawings*	M5 x 0.8 Class 12.9	-	
	Socket head cap	45 in-lbs (5.08 Nm)	
	Socket flat head cap	35 in-lbs (3.96 Nm)	
Tool Interface Plate to QC-20, QC-21, and QC-27 Tool plate Minimum thread engagement of 9 mm [1.5X fastener Ø]. *Do not exceed maximum available thread depth of 10 mm as shown in Section 9—Drawings*	M6 x 1.0 Class 12.9	-	Pre-applied Adhesive or Loctite 242
	Socket head cap	90 in-lbs (10.2 Nm)	
	Socket flat head cap	60 in-lbs (6.78 Nm)	

3.1 Master Plate Installation

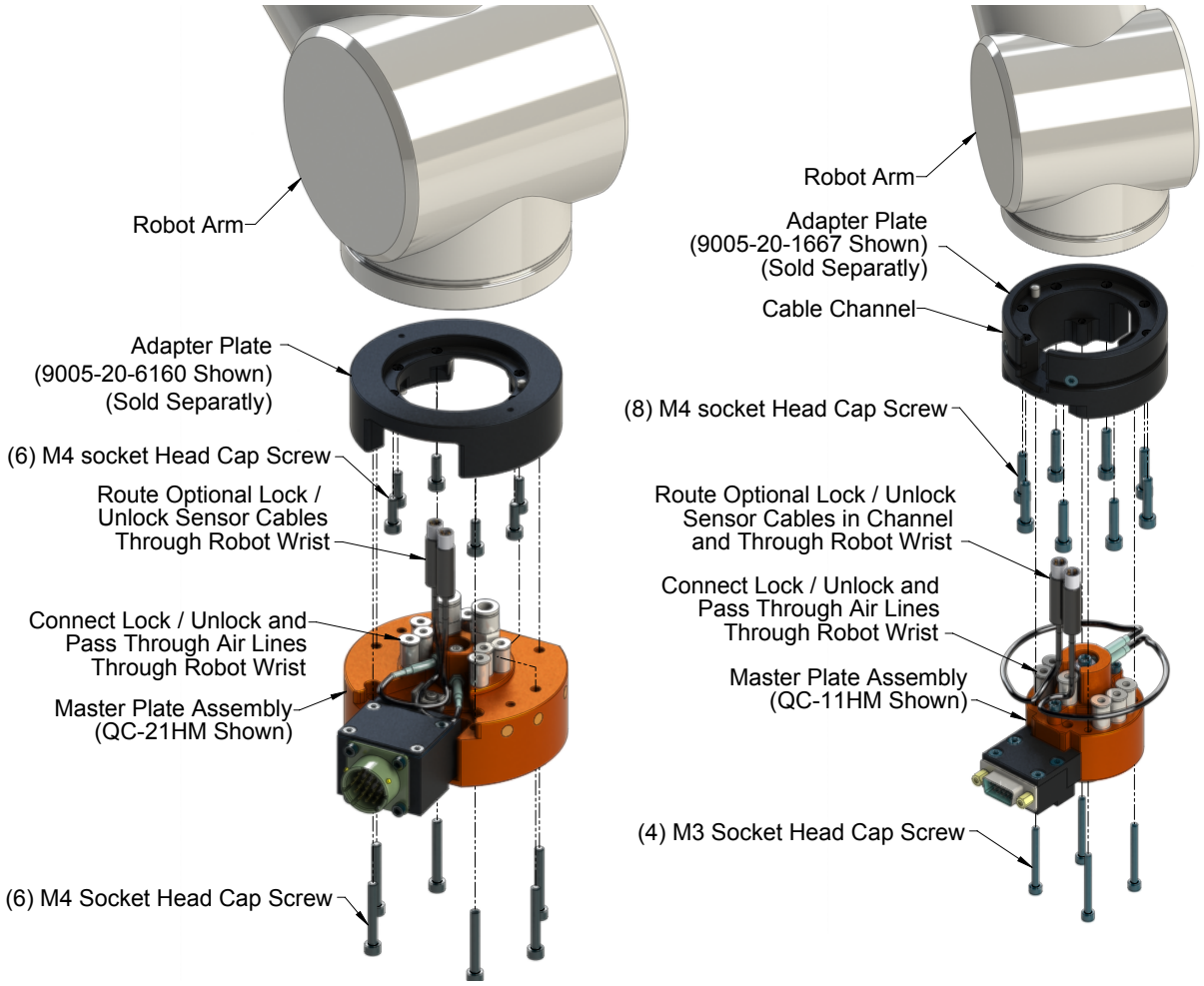
The Master plate is mounted to the robot flange using an adapter plate with a robot mounting hole pattern on one side and a Master plate mounting hole pattern on the other (consult the appropriate drawings for dimensions, fastener, and dowel pin specifics).

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

Supplies required: *Clean rag, Loctite 222*

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits; for example: electrical, air ,water, etc.
4. Wipe down the mounting surfaces with a clean rag.
5. Align the dowel pin in the adapter plate to the corresponding holes in the robot arm and secure with supplied fasteners, refer to *Figure 3.1*. Refer to *Table 3.1* for proper fasteners and torque.
6. Connect all Lock, Unlock, and pass-through air connections through the robot wrist to the connections on the Master plate. For lock and unlock air, refer to *Section 3.7—Lock and Unlock Pneumatic Requirements.*
7. If equipped, connected the lock and unlock sensor cables through the robot wrist. Note: for the QC-11HM Hollow-Wrist Tool Changer, the lock and unlock sensor cables are routed around the channel in the adapter plate and secured using the (2) socket flat head cap screws, refer to *Figure 3.1.*
8. If equipped, connect other utilities to the optional modules on the Master plate.
9. Align the dowel pin in the adapter plate to the corresponding holes in the Master plate and secure with supplied fasteners, refer to *Figure 3.1*. Refer to *Table 3.1* for proper fasteners and torque.
10. Safely resume normal operation.

Figure 3.1—Typical Master Plate Installation



3.2 Master Plate Removal

Refer to *Figure 3.1* for Master module removal instructions.

Tools required: *2.5 mm hex key*

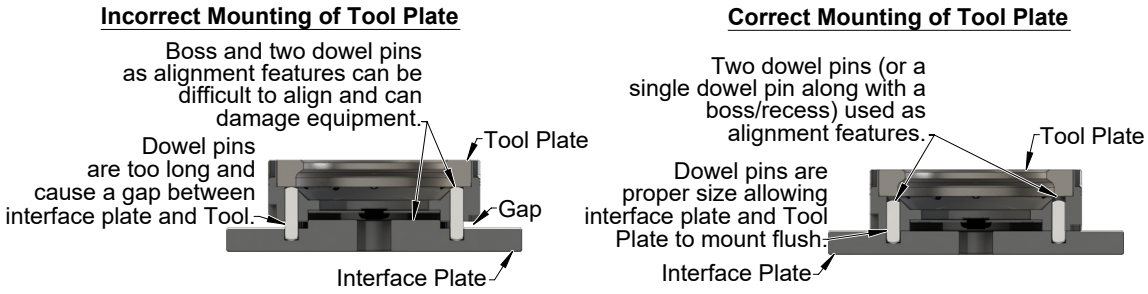
1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits (for example: electrical, pneumatic, and hydraulic circuits).
4. Remove the fasteners securing the Master plate to the adapter plate. Refer to *Figure 3.1*.
5. If equipped, disconnect all utilities (for example: electrical, pneumatic, and hydraulic).
6. If equipped, disconnect the lock and unlock sensor cables.
7. Disconnect the Lock, Unlock, and pass-through air connections.
8. Remove the Master plate.

3.3 Tool Interface Plate

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

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

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



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

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

3.4 Tool Plate Installation

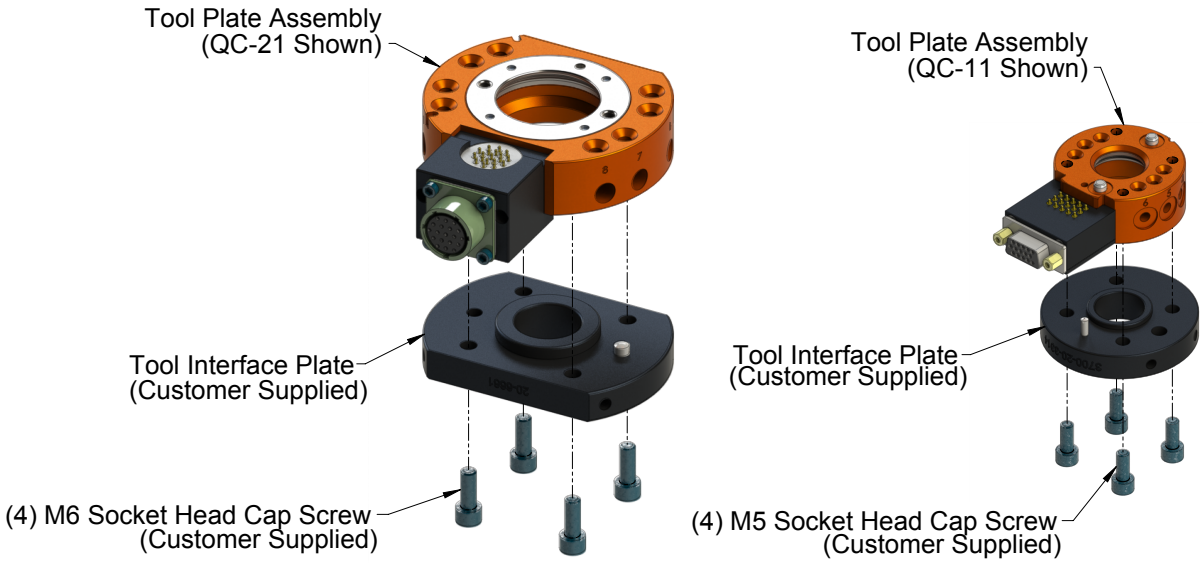
The end-effector is typically attached to the Tool plate with an interface plate designed refer to *Section 3.3—Tool Interface Plate* for specific requirements.

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

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

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, air ,water, etc.
4. Wipe down the mounting surfaces with a clean rag.
5. Align the dowel pins in the tool interface plate or customer tooling to the corresponding holes in the Tool plate and secure with customer supplied mounting fasteners. Apply Loctite to threads or use fasteners with pre-applied adhesive, refer to *Table 3.1* for proper thread engagement, torque and thread locker (Note: Mounting fasteners are supplied with ATI custom tool interface plates.)
6. Connect utilities to the appropriate module and Tool plate connections.
7. Safely resume normal operation.

Figure 3.2—Typical Tool Plate Installation



3.5 Tool Plate Removal

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

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits; for example: electrical, air ,water, etc.
4. Disconnect all utilities (for example: electrical, pneumatic, and hydraulic).
5. Remove the fasteners securing the Tool plate to the tool interface Plate. Refer to *Figure 3.2*.
6. Remove the Tool plate.

3.6 Optional Module Installation

The optional modules are typically installed on Tool Changers by ATI prior to shipment. Installation and removal are outlined in the following section: Tool Changers are compatible with many different types of modules. Some modules will require an adapter plate to be installed to the Tool Changer.

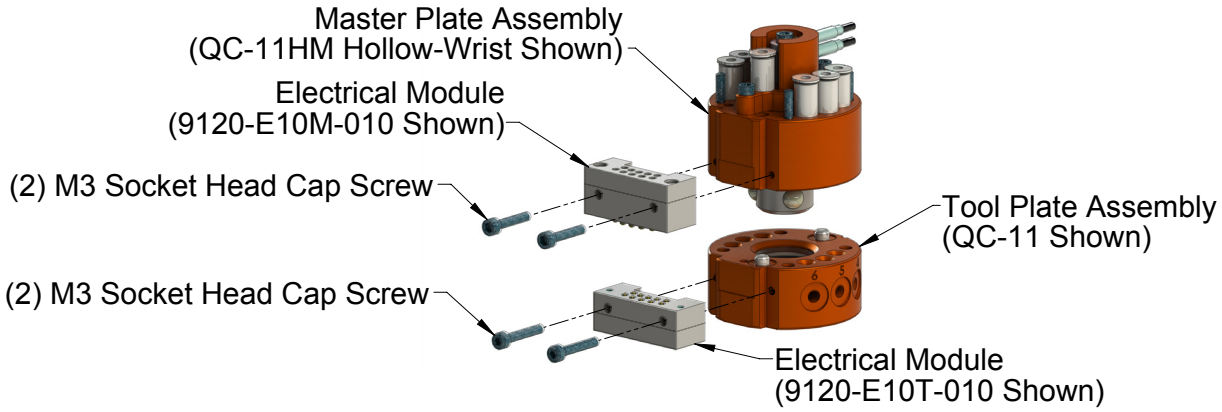
3.6.1 QC-11HM Simple Electrical Module Installation

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

Supplies required: *Clean rag, Loctite 222*

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits; for example: electrical, air ,water, etc.
4. Wipe down the mounting surfaces with a clean rag.
5. If the Tool Changer is in service, place the Tool safely in the tool stand and uncouple the Tool Changer to allow clear access to the Master and Tool plates.
6. Make all soldered connections to the simple electrical module as desired.
7. Make sure mounting surfaces of the Tool plate, Master plate, and modules are clean and free of debris.
8. Align the module to the flat of the Master or Tool plate assembly.
9. Apply Loctite 222 to M3 socket head cap screws.
10. Secure the module with (2) M3 socket head cap screws using a 2.5 mm hex key. Tighten to 24 in-oz (0.17 Nm).
11. Remove all protective caps, plugs, tape, etc from the module prior to operation.
12. Safely resume normal operation.

Figure 3.3—QC-11HM Simple Electrical Module Installation



3.6.2 QC-11HM Simple Electrical Module Removal

Tools required: *2.5 mm hex key*

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

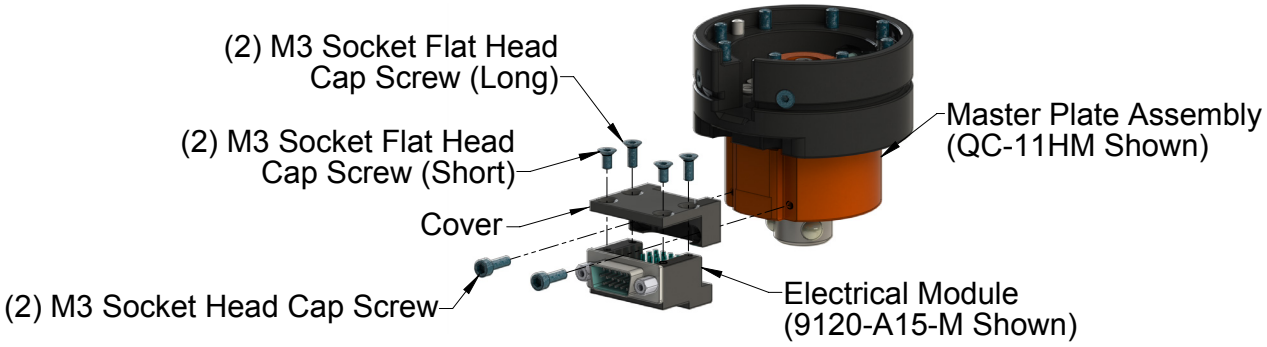
3.6.3 QC-11HM Master Electrical Module Installation

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

Supplies required: *Clean rag, Loctite 222*

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

Figure 3.4—QC-11HM Master Electrical Module Installation



3.6.4 QC-11HM Master Electrical Module Removal

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

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

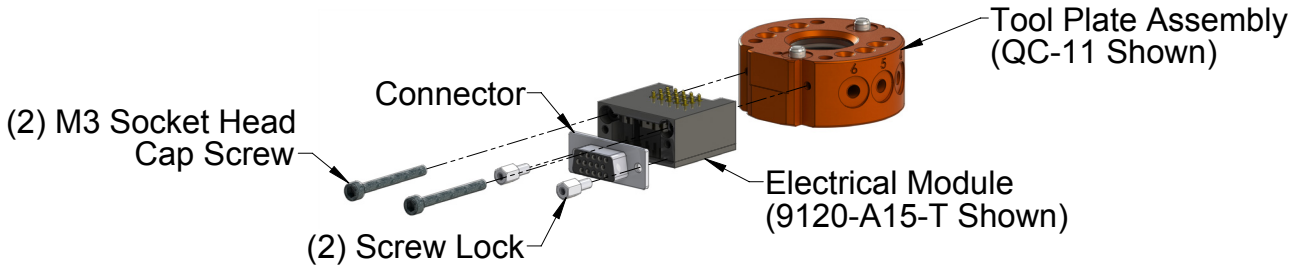
3.6.5 QC-11 Tool Electrical Module Installation

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

Supplies required: *Clean rag, Loctite 222*

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits; for example: electrical, air ,water, etc.
4. Wipe down the mounting surfaces with a clean rag.
5. Remove the (2) screw locks securing the connector to the module.
6. Carefully remove the connector to expose the mounting screws as shown in *Figure 3.5*.
7. Align the module to the QC-11 Tool plate.
8. Apply Loctite 222 to M3 socket head cap screws.
9. Secure the module with (2) M3 socket head cap screws using a 2.5 mm hex key. Tighten to 24 in-oz (0.17 Nm).
10. Apply Loctite 222 to the (2) screw locks.
11. Attach the connector to the module using the (2) screw locks using a 3/16" wrench. Tighten to 24 in-oz (0.17 Nm).
12. Remove all protective caps, plugs, tape, etc from the module prior to operation.
13. Safely resume normal operation.

Figure 3.5—QC-11 Tool Electrical Module Installation



3.6.6 QC-11 Tool Electrical Module Removal

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

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits; for example: electrical, air ,water, etc.
4. Disconnect any cables.
5. Remove the (2) screw locks securing the connector to the module using a 3/16" wrench.
6. Carefully remove the connector to expose the mounting screws as shown in *Figure 3.5*.
7. Remove the (2) M3 socket head cap screws holding the module to the QC-11 Tool plate using a 2.5 mm hex key.
8. Remove the module from the Tool plate.

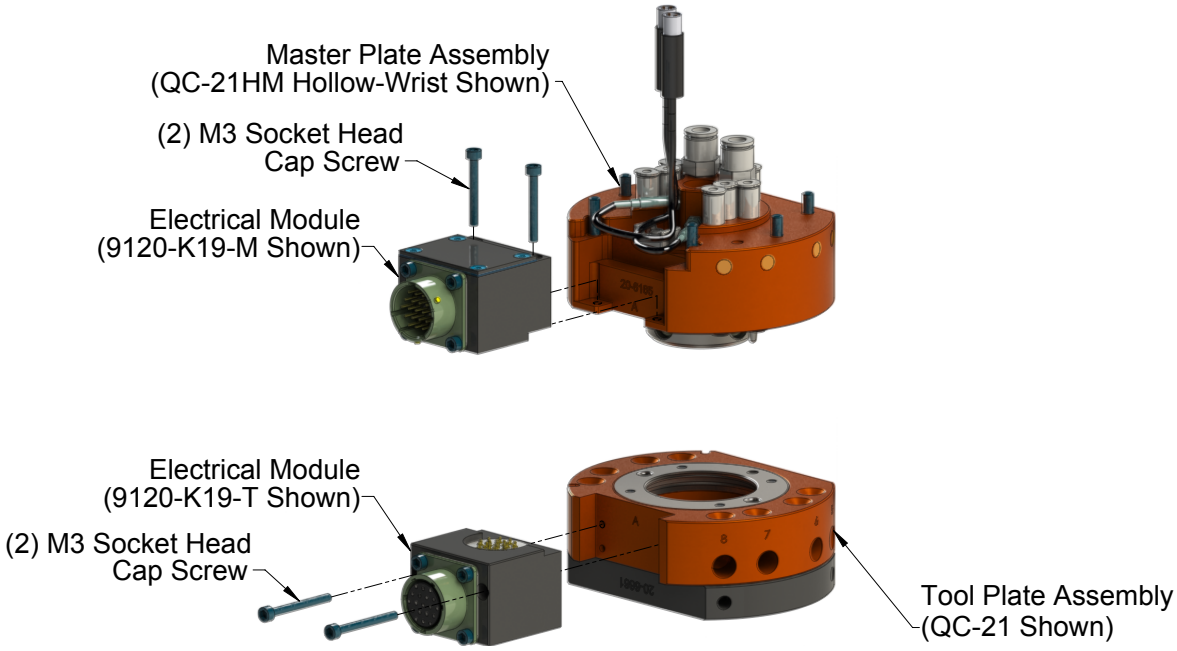
3.6.7 QC-20HM, QC-21HM, and QC-27HM Flat A Optional K Series Module Installation

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

Supplies required: *Clean rag, Loctite 222*

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

Figure 3.6—QC-20HM, and QC-21HM, and QC-22 Flat A Optional K Series Module Installation



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

Tools required: *2.5 mm hex key*

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits; for example: electrical, air ,water, etc.
4. Disconnect any cables, air line, etc.
5. Remove the (2) M3 socket head cap screws securing the module to the Tool changer using a 2.5 mm hex key. Note: For the module on the Master, the Master plate may have to be removed refer to *Section 3.2—Master Plate Removal*.
6. Remove the module from the Master or Tool plate.

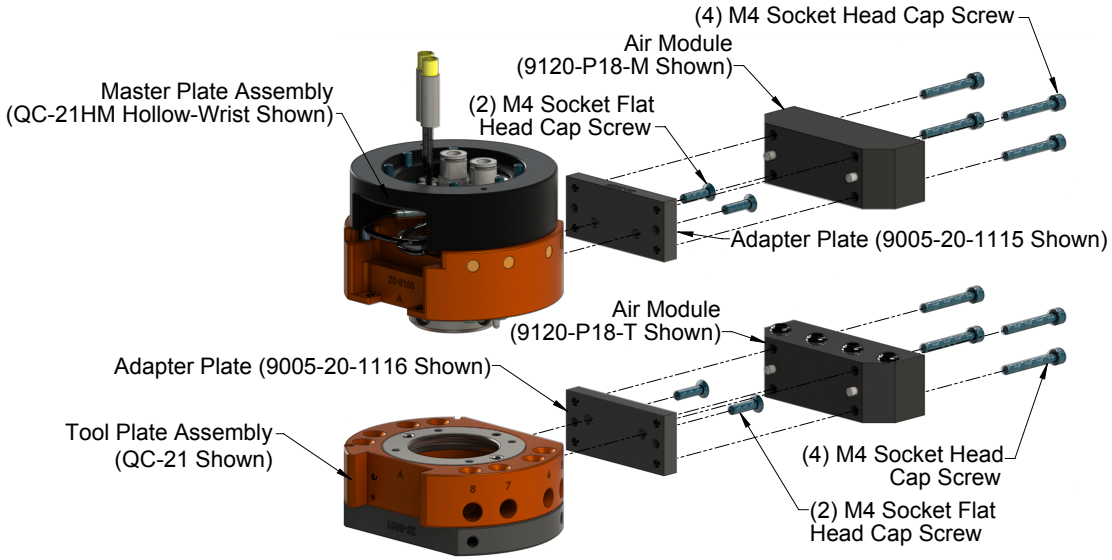
3.6.9 QC-21HM Flat B Optional Module Installation

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

Supplies required: *Clean rag, Loctite 222*

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits; for example: electrical, air ,water, etc.
4. Wipe down the mounting surfaces with a clean rag.
5. Align adapter plate to flat B of the QC-21HM Master or Tool plate as shown in *Figure 3.7*.
6. Apply Loctite 222 to the (2) M4 socket flat head cap screws.
7. Secure adapter plate to the Tool Changer with (2) M4 socket flat head cap screws using a 2.5 mm hex key. Tighten to 10 in-lbs (1.13 Nm).
8. Align optional module on the adapter plate.
9. Apply Loctite 222 to (4) M4 socket head cap screws.
10. Secure module to the adapter plate with (4) M4 socket head cap screws using a 3 mm hex key. Tighten to 15 in-lbs (1.7 Nm).
11. Remove all protective caps, plugs, tape, etc from the module prior to operation.
12. Safely resume normal operation.

Figure 3.7—QC-21HM Flat B Optional Module Installation



3.6.10 QC-21HM Flat B Optional Module Removal

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

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits; for example: electrical, air ,water, etc.
4. Disconnect any cables, air lines, etc.
5. Remove the (4) M4 socket head cap screws using a 3 mm hex key and remove the module from the adapter plate.
6. Remove the (2) M4 socket flat head cap screws securing the adapter plate to the Master or Tool plate using a 2.5 mm hex key and remove the adapter plate.

3.7 Lock and Unlock 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.

3.7.1 Valve Requirements and Connections

As with all pneumatic piston arrangements, smooth operation requires proper porting of the supplied and vented air. It is recommended that a single 4-way valve be used to actuate the locking mechanism in the Master plate. The valve may be of either 4-port or 5-port configuration. 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 will negate the locking force of the mechanism.

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

Figure 3.8—QC-11HM Hollow-Wrist Lock and Unlock Pneumatic Connections

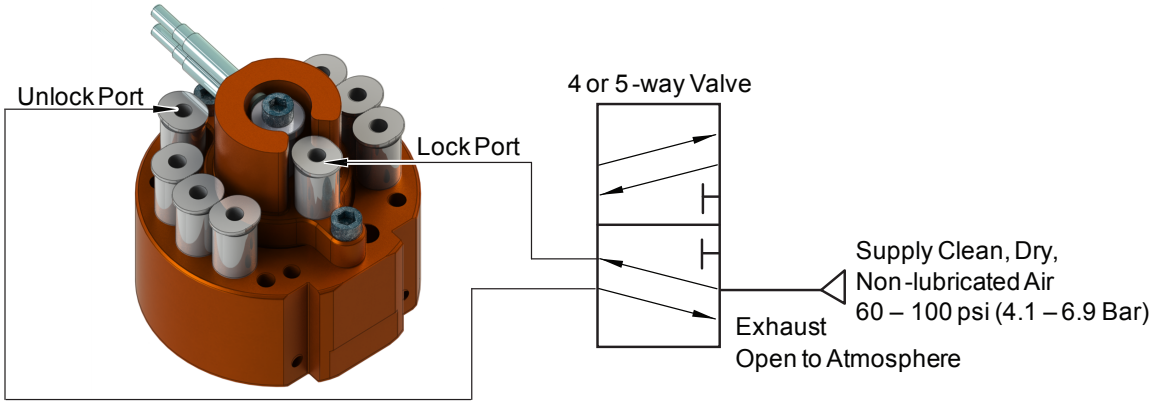


Figure 3.9—QC-20HM Hollow-Wrist Lock and Unlock Pneumatic Connections

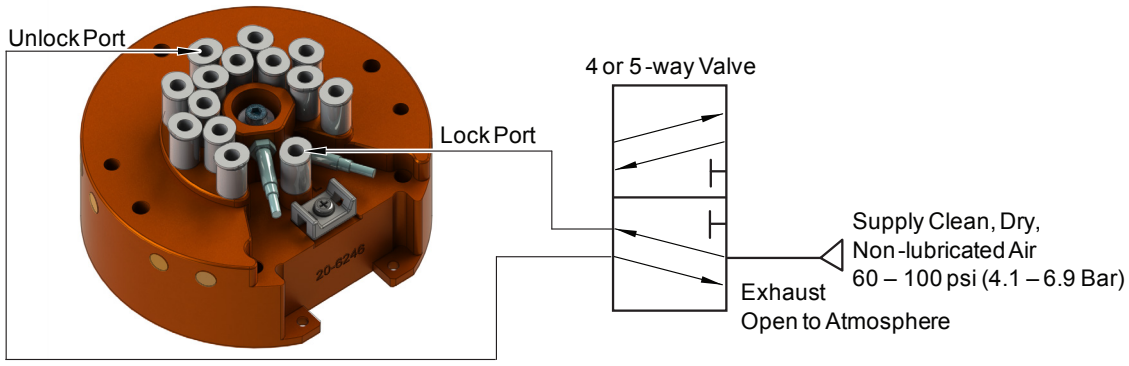


Figure 3.10—QC-21HM Hollow-Wrist Lock and Unlock Pneumatic Connections

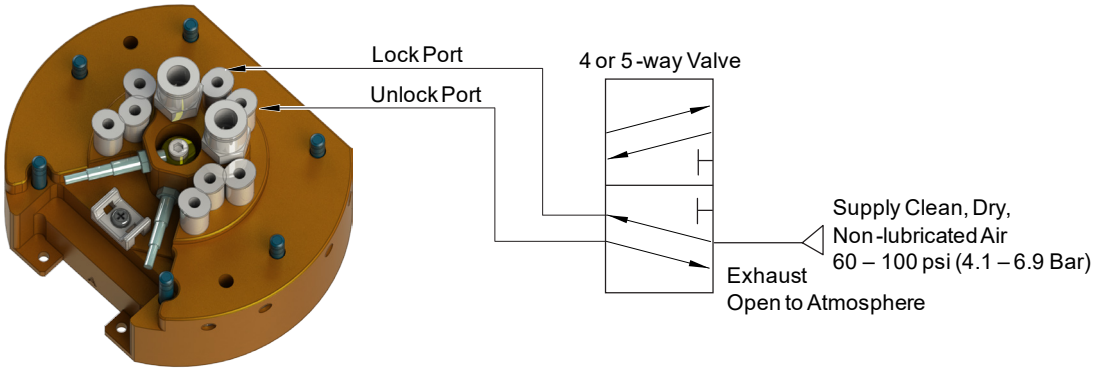
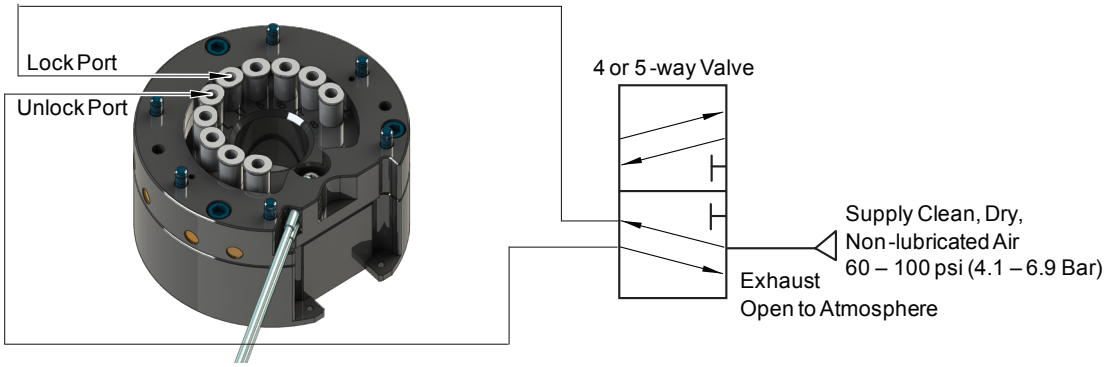


Figure 3.11—QC-27HM Hollow-Wrist Lock and Unlock Pneumatic Connections



3.8 Electrical Connections

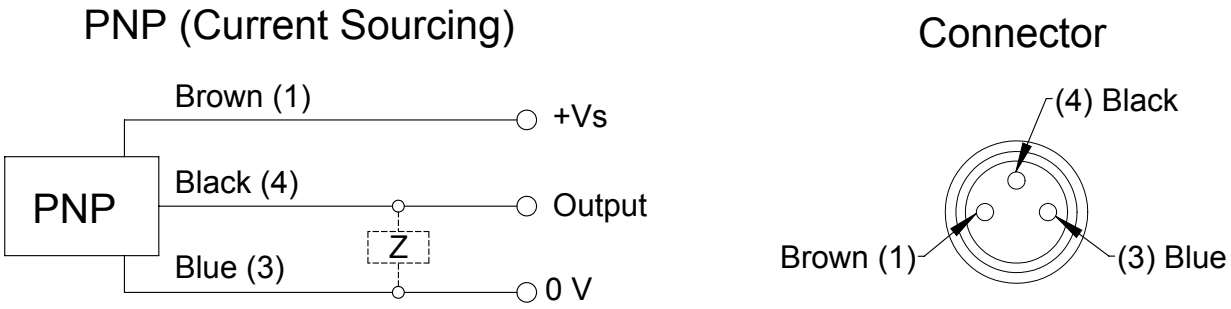
The optional lock and unlock sensors are available in PNP and NPN type.

3.8.1 PNP Type Lock and Unlock Sensors

The PNP lock and unlock sensors are 4 mm cylindrical inductive proximity sensor.

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

Figure 3.12—PNP Type Lock and Unlock Sensors

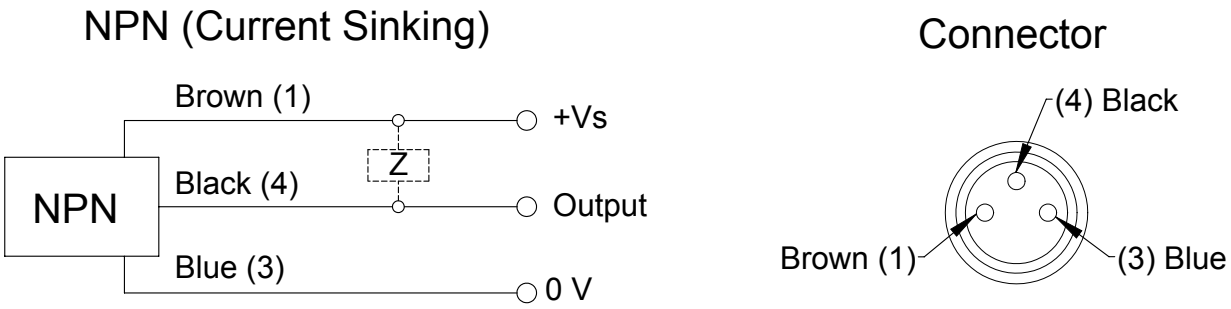


3.8.2 NPN Type Lock and Unlock Sensors

The NPN lock and unlock sensors are 4 mm cylindrical inductive proximity sensor.

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

Figure 3.13—NPN Type Lock and Unlock Sensors



4. Operation

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

CAUTION: Safe, reliable operation of the Tool Changer is dependent on a continuous supply of compressed air at a pressure of 60 to 100 psi. 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 (Refer to *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 be durable and not allow deflection, under uncoupled Tool weight that will take alignment of the Tool Changer plates outside of accepted offsets. See *Figure 4.1* and *Table 4.1* for recommended maximum allowable offsets prior to coupling. In some cases, greater offsets than shown in *Table 4.1* can be accommodated by the Master and Tool plates but will increase wear.

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

Figure 4.1—Offset Definitions

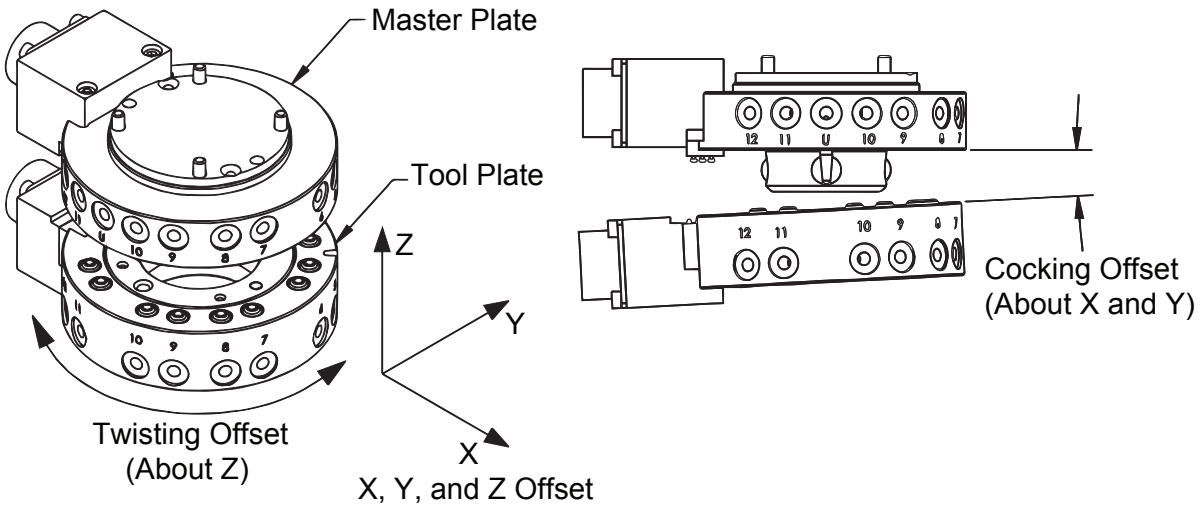


Table 4.1—Maximum Recommended Offsets Prior to Coupling

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

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

4.1 Coupling Sequence

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

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

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

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

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

4.2 Fail-Safe Operation

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

After air pressure is re-established to the Master plate, the locking mechanism will energize and securely lock the Master and Tool plates together. In some cases when the load on the tool changer is significantly off center, it may be necessary to position the load underneath the tool changer or return the tool to the tool storage location to ensure a secure lock condition. If equipped, make sure the lock sensor indicates the Tool Changer is in the locked position before resuming normal operations. Consult 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 so that there is little or no contact force between the Tool plate and tool stand.
2. Release air on the Lock port and apply air to the Unlock Port (if equipped, the Unlock sensor will indicate the Tool Changer is in the Unlocked position).

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

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

4.4 Tool Identification

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

4.5 Tool Storage Considerations

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

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

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

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

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

5. Maintenance

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

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

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 end of arm tooling, the Master and Tool plates, and the modules is necessary. Protective measures include the following:
1) Placement of tool stands away from debris generators.
2) Covers incorporated into the tool stands.
3) Guards, deflectors, air curtains, and similar devices built into the tooling 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 Checklist

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 Table 3.1——Fastener Size, Class, and Torque Specifications.*

Ball Bearings/Alignment Pins/Bushings/Bearing Race

- ☐ Inspect for wear and proper lubrication. MobilGrease XHP222 Special a NLGI #2 lithium complex grease with molybdenum disulfide additive is suggested for locking mechanism and alignment pin lubrication. Over time, lubricants can become contaminated with debris. Therefore, it is recommended to thoroughly clean the existing grease and replace with new as needed. See *Section 5.2—Cleaning and Lubrication of the Locking Mechanism and Alignment Pins*.
- ☐ Inspect for excessive alignment pin/bushing wear, may be an indication of poor robot position during pickup/drop-off. Adjust robot position as needed. Check tool stand for wear and alignment problems.The QC-27HM model has replaceable alignment pins, refer to *Section 6.2.1—QC-27HM 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 and connectors for any damage, cuts, and abrasion. Replace as necessary. Refer to *Section 6.2.4—QC-11HM Lock and Unlock Sensor Adjustment, Test, or Replacement* or *Section 6.2.5—QC-20HM and QC-21HM Lock and Unlock Sensor Adjustment, Test, or Replacement* or *Section 6.2.6—QC-27HM Lock and Unlock Sensor Adjustment, Test, or Replacement.*

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.

Optional Electrical Modules Contacts, Spring Pins and V-ring seals

- ☐ Inspect contacts and spring pins 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 V-ring seals for wear, abrasion, and cuts. Replace damaged V-ring seals as needed. Refer to *Section 6.2.3—Optional Electrical Module Seal Inspection and Replacement.*

Seals Pass-Through Air and Optional Modules

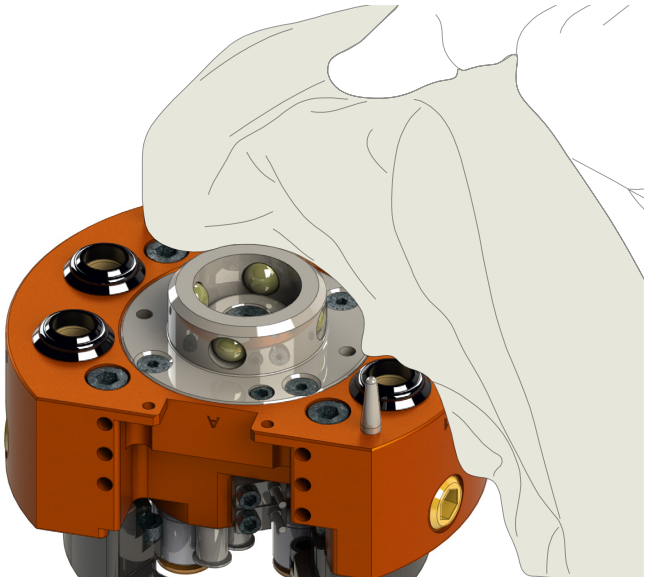
- ☐ Exposed seals and rubber bushings may be subject to damage during normal operation. Inspect for wear, abrasion, and cuts. Replace damaged seals, or rubber bushings as needed. Refer to *Section 6.2.2—Rubber Bushing Inspection and Replacement*

5.2 Cleaning and Lubrication of the Locking Mechanism and Alignment Pins

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

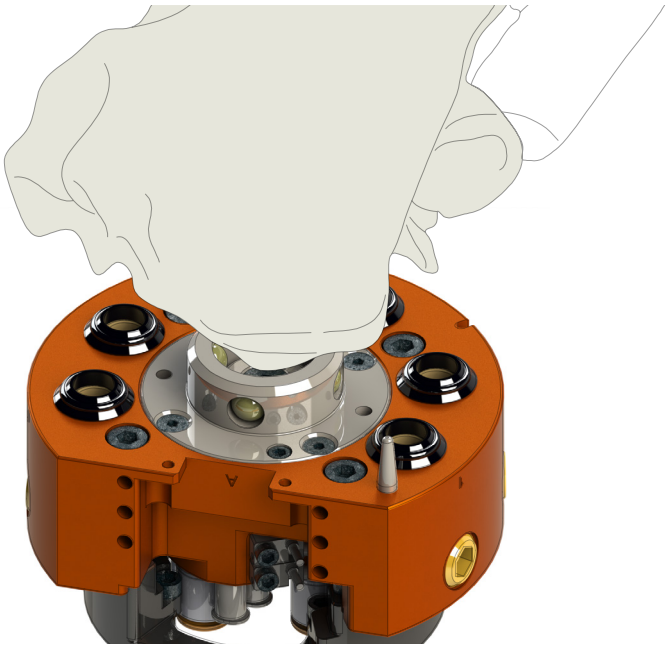
1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits (for example: electrical, pneumatic, and hydraulic circuits).
4. Use a clean rag to thoroughly remove any lubricant and debris from the ball bearings, male coupling, cam,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

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



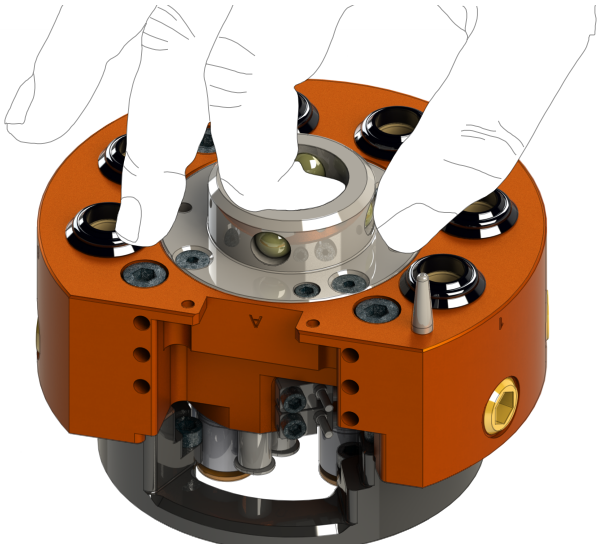
5. Use a clean rag to thoroughly remove any lubricant and debris from the inner surface of the male coupling and cam.

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



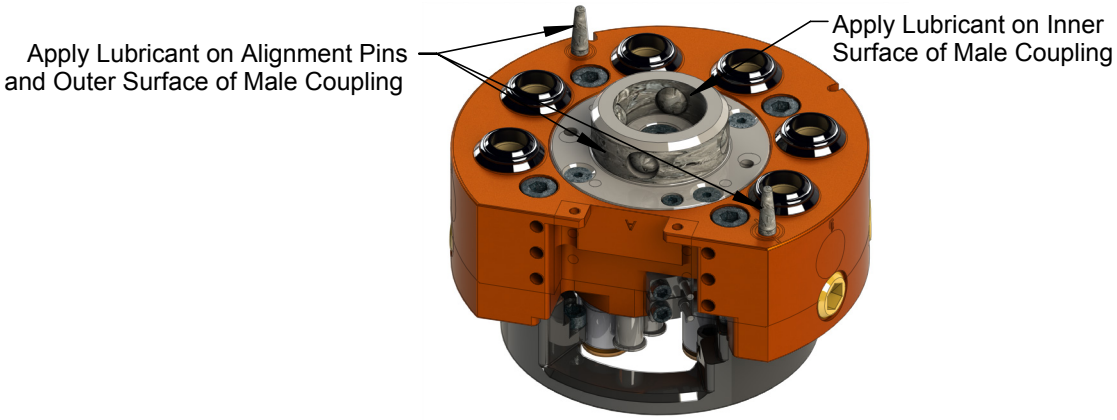
6. Check each ball bearing to make sure it moves freely in the male coupling. Additional cleaning may be necessary to free up any ball bearings that are sticking in place.

Figure 5.3—Check Ball Bearing Movement



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

Figure 5.4—Apply Lubricant to Locking Mechanism

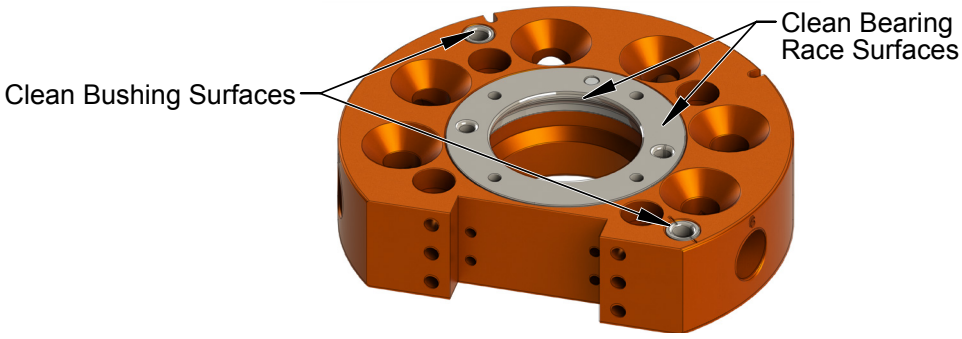


8. Use a clean rag to thoroughly remove any lubricant and debris from the Tool plate bearing race and bushings.

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

9. Safely resume normal operation.

Figure 5.5—Clean Tool Plate Surfaces of locking Mechanism



5.3 Optional Electrical Module Pin Block Inspection and Cleaning

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

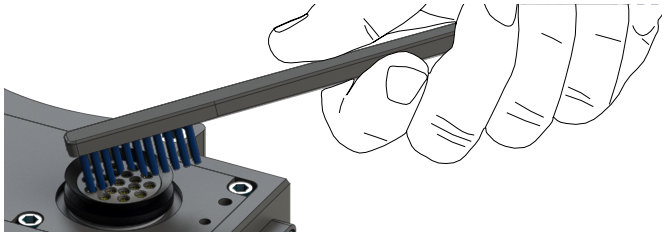
1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits (for example: electrical, pneumatic, and hydraulic circuits).
4. Inspect the Master and Tool pin blocks for debris or darkened pins.

Figure 5.6—Inspect Master and Tool Pin Blocks

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

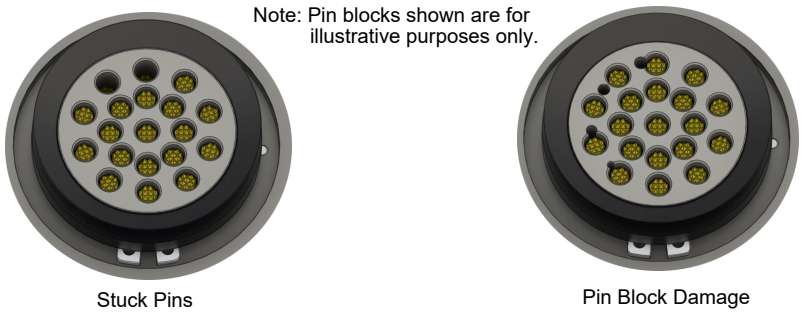
NOTICE: Do not use an abrasive media and/or cleaners or solvents to clean the contact pins. Using abrasive media and/or cleaners or solvents will cause damage to the contact surface or cause pins to stick. Clean contact surfaces with a vacuum or non-abrasive media such as a nylon brush (ATI part number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

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

6. Troubleshooting and Service Procedures

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

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

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

6.1 Troubleshooting

Refer to the following table for troubleshooting information:

Figure 6.1—Troubleshooting

Symptom	Cause	Resolution
Unit cannot lock or unlock	Insufficient or no air pressure supply to lock or unlock ports.	Verify proper air pressure and pneumatic valve are supplied. Refer to *Section 3.7—Lock and Unlock Pneumatic Requirements*.
	Air pressure trapped in de-energized lock and unlock ports.	Air pressure must be vented to the atmosphere properly, refer to *Section 3.7—Lock and Unlock Pneumatic Requirements*.
	Pneumatic connections loose or damaged.	Refer to the air/valve adapter manual for more information.
	Debris caught between the Master and Tool plates	Clean debris from between Master and Tool plates. Verify mounting fasteners are secure and do not protrude above the mating surfaces.
	The ball bearings and/or cam are not moving freely in the male coupling.	Clean and lubricate as needed to restore smooth operation. Refer to *Section 5.2—Cleaning and Lubrication of the Locking Mechanism and Alignment Pins.*
	The Master plate and Tool plate are not within the specified No-Touch zone when attempting to lock.	Check that the Tool is properly seated in the tool stand. Refer to *Section 4—Operation.* Re-teach the robot to bring the Master plate and Tool plate closer together prior to attempting to lock.
Insufficient air supply to tooling or air leak	Rubber bushings damaged.	Inspect rubber bushings for damage, replace damaged bushings. Refer to *Section 6.2.2—Rubber Bushing Inspection and Replacement*.
Units Equipped with Electrical Modules		
Loss of communication	Contamination in electrical contacts.	Inspect and clean contact pins, refer to *Section 5.3—Optional Electrical Module Pin Block Inspection and Cleaning*.
		Inspect V-ring seal for damage, replace damaged seal. Refer to *Section 6.2.3—Optional Electrical Module Seal Inspection and Replacement.*
Units Equipped with and Sensor Interface Plate		
Unit is locked but lock signal does not read “on” (true) or unit is unlocked but unlock signal does not read “on” (true)	Lock or unlock sensor/cable is damaged. Sensor is loose or not adjusted properly.	Verify cable continuity, replace if necessary.
		Replace the lock sensor assembly as necessary. Refer to *Section 6.2.4—QC-11HM Lock and Unlock Sensor Adjustment, Test, or Replacement,* or *Section 6.2.5—QC-20HM and QC-21HM Lock and Unlock Sensor Adjustment, Test, or Replacement* or *Section 6.2.6—QC-27HM Lock and Unlock Sensor Adjustment, Test, or Replacement.*

6.2 Service Procedures

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

6.2.1 QC-27HM Alignment Pin Replacement

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. If necessary replace the alignment pins.

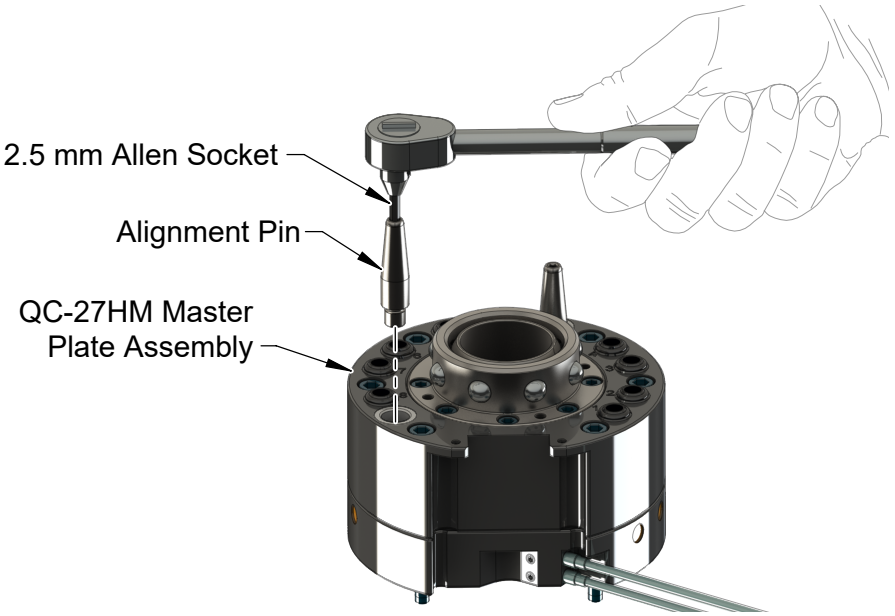
Tools required: *2.5 mm hex key, torque wrench*

Parts required: *Refer to Section 8.4—Models QC-27HM Hollow-Wrist Serviceable Parts*

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

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

Figure 6.2—QC-27HM Alignment Pin Replacement



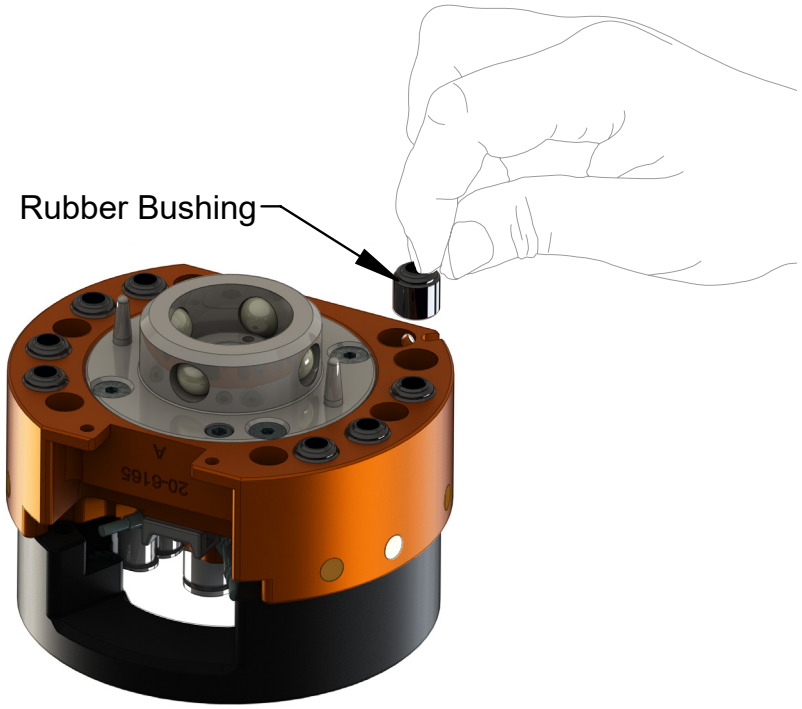
6.2.2 Rubber Bushing Inspection and Replacement

The rubber bushings seal the air passage from the Master plate to the Tool plate. If the bushings are cut or damaged, replace them.

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

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits; for example: electrical, air ,water, etc.
4. Remove damaged rubber bushing by grasping with fingers and pulling the bushing out of the body.
5. Dip new bushing in water to aid in installation.
6. Insert the beveled (chamfered) end of the rubber bushing into the bore, leaving ribbed end of the bushing facing outward.
7. Press the bushing in by hand until it is seated completely in the bore. If necessary, use a plastic or rubber soft-faced mallet to tap the bushings into place.
8. Safely resume normal operation.

Figure 6.3—QC-11HM, QC-20HM, and QC-21HM Rubber Bushing Replacement

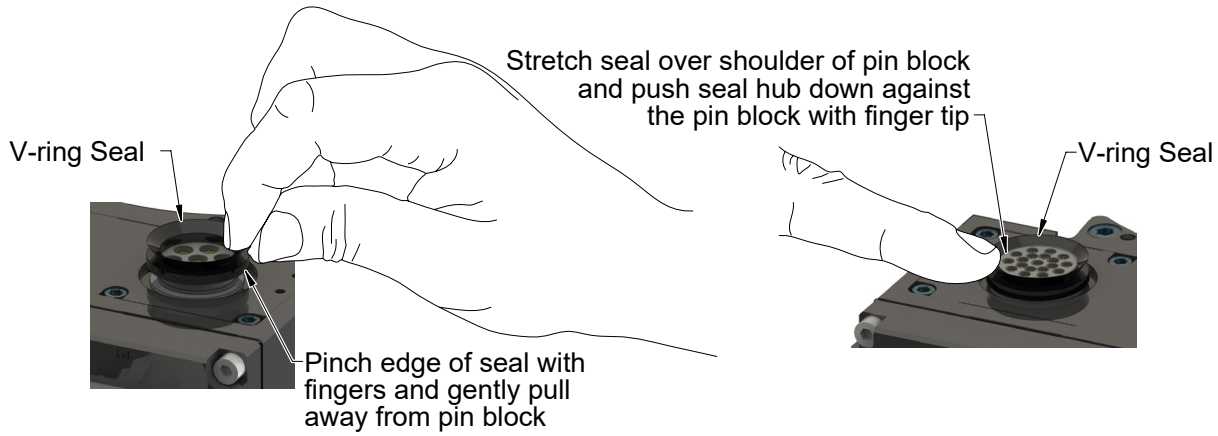


6.2.3 Optional Electrical Module Seal Inspection and Replacement

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

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

Figure 6.4—V-ring Seal Replacement



6.2.4 QC-11HM Lock and Unlock Sensor Adjustment, Test, or Replacement

The lock and unlock 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.

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

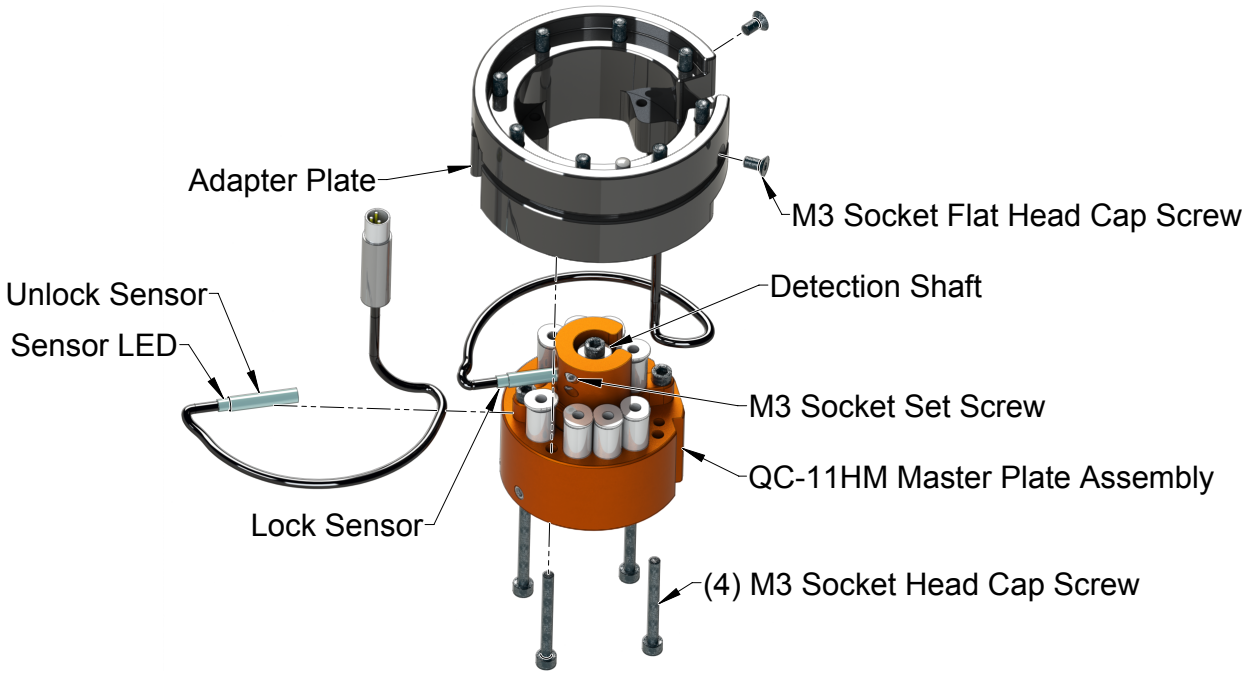
Parts required: *Refer to Section 8.1—Models QC-11HM Hollow-Wrist Serviceable Parts*

Supplies required: *Loctite 222*

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. If you are testing the lock sensor make sure the Tool Changer is in the locked position, if you are testing the unlock sensor make sure the Tool Changer is in the unlocked position. Check to see the signal is ON and the sensor LED is illuminated for the senor being tested. If sensor are not functioning replace.
4. Turn off and de-energize all energized circuits; for example: electrical, air ,water, etc.
5. Remove the (2) M3 socket flat head cap screw retaining the sensor cable in the adapter plate groove using 2 mm hex key. Refer to *Figure 6.5.*
6. Ensure there is sufficient slack in the sensor cable to remove the QC-11HM Master plate assembly from the adapter plate.

7. Remove the (4) M3 socket head cap screws securing the QC-11HM Master plate assembly to the adapter plate using a 2.5 mm hex key.
8. Disconnect any cables, sensor cables, air line, etc. if required.
9. Loosen the M3 socket set screw and unscrew the sensor from the QC-11HM Master plate assembly. Discard the old sensor.

Figure 6.5—QC-11HM Replace Lock and Unlock Sensor



10. Thread the new sensor into the QC-11HM Master plate assembly until it touches the detection shaft, then back the sensor off 1/2 turn.
11. Holding the sensor in position, connect the sensor cable. The sensor LED should be illuminated.

> **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. Apply Loctite 222 to the M3 socket set screws.
13. Holding the sensor in position, turn the M3 socket set screw until it contacts the sensor and tighten 1/4 turn more.

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

14. Connect any cables and air line, etc. as required.
15. Attach the QC-11HM Master plate to the adapter plate using the (4) M3 socket head cap screws. Tighten to 10 in-lbs (1.13 Nm).
16. Route sensor cable in groove around adapter plate, secure with M3 socket flat head cap screw. Tighten to 8 in-lbs (0.90 Nm).
17. Confirm the operation of the replaced sensor by applying air pressure to the lock or unlock port on the Master and then checking to see that corresponding sensor LED in the replaced sensor body is on.
18. Safely resume normal operation.

6.2.5 QC-20HM and QC-21HM Lock and Unlock Sensor Adjustment, Test, or Replacement

The lock and unlock 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

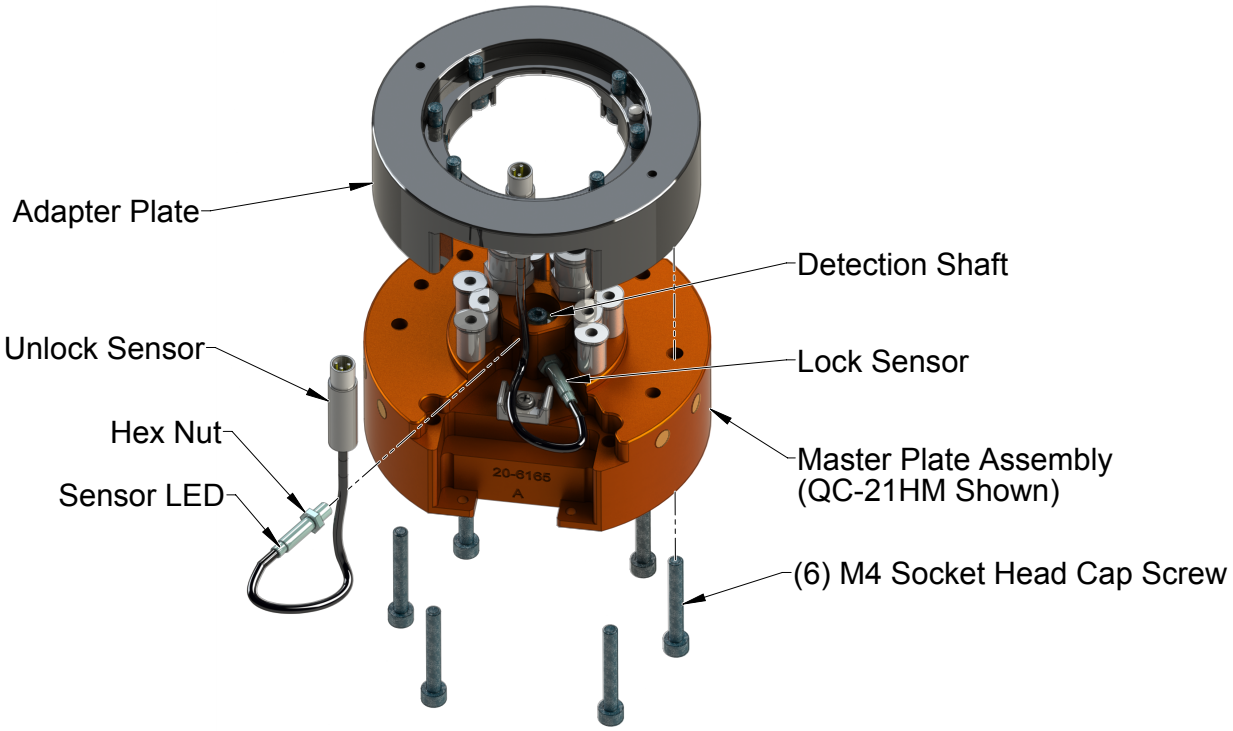
Tools required: *3 mm hex key, 6 mm wrench, torque wrench*

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

Supplies required: *Loctite 222*

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. If you are testing the lock sensor make sure the Tool Changer is in the locked position, if you are testing the unlock sensor make sure the Tool Changer is in the unlocked position. Check to see the signal is ON and the sensor LED is illuminated for the senor being tested. If sensor are not functioning replace.
4. Turn off and de-energize all energized circuits; for example: electrical, air ,water, etc.
5. Make sure there is enough slack in the sensor cable to remove the Master plate assembly from the adapter plate.
6. Remove the (6) M4 socket head cap screws securing the Master plate assembly to the adapter plate using a 3 mm hex key. Refer to *Figure 6.6.*
7. Disconnect any cables, sensor cables, air line, etc. if required.
8. Loosen the hex nut and unscrew the sensor from the Master plate assembly. Discard the old sensor.

Figure 6.6—QC-20HM and QC-21HM Replace Lock and Unlock Sensor



9. On the new sensor, back the hex nut to the cable end of the sensor.
10. Thread the 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.

11. Holding the sensor in position, connect the sensor cable. The sensor LED should be illuminated.
12. Holding the sensor in position apply Loctite 222 to the sensor threads between the hex nut and the Master plate assembly. Tighten the hex nut using a 6 mm wrench. Torque to 8 in-lbs (0.90 Nm).
13. Connect any cables and air line, etc. as required
14. Attach the Master plate to the adapter plate with the (6) M4 socket head cap screws using a 3 mm hex key. Tighten to 15 in-lbs (1.7 Nm).
15. Confirm the operation of the replaced sensor by applying air pressure to the lock or unlock port on the Master and then checking to see that corresponding sensor LED in the replaced sensor body is on.
16. Safely resume normal operation.

6.2.6 QC-27HM Lock and Unlock Sensor Adjustment, Test, or Replacement

The lock and unlock 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.

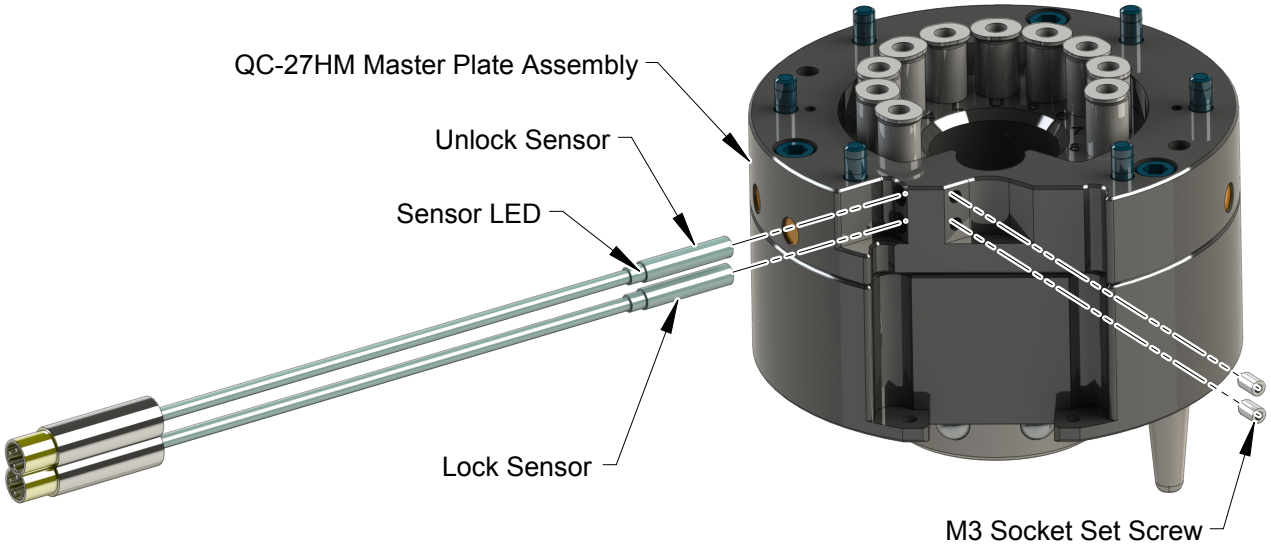
Tools required: *2 mm hex key, torque wrench*

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

Supplies required: *Loctite 222*

1. Place the Tool in a secure location.
1. Uncouple the Master and Tool plates.
2. If you are testing the lock sensor , make sure the Tool Changer is in the locked position. If you are testing the unlock sensor make sure the Tool Changer is in the unlocked position. Check to see the signal is ON and the sensor LED is illuminated for the senor being tested. If sensors are not functioning, replace them.
3. Turn off and de-energize all energized circuits; for example: electrical, air ,water, etc.
4. Loosen the M3 socket set screw using a 2 mm hex key.
5. Unscrew the sensor from the QC-27HM Master plate assembly and discard.

Figure 6.7—QC-27HM Replace Lock and Unlock Sensor



6. Thread the sensor into the QC-27HM Master plate assembly until it touches the detection shaft, then back the sensor off 1/2 turn.
7. Holding the sensor in position, connect the sensor cable. The lock or unlock sensor LED should be illuminated.

> **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.

8. Apply Loctite 222 to the M3 socket set screws.
9. Holding the sensor in position, turn the M3 socket set screw until it contacts the sensor and tighten 1/4 turn more.

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

10. Confirm the operation of the replaced sensor by applying air pressure to the lock or unlock port on the Master and then checking to see that corresponding sensor LED in the replaced sensor body is on.
11. Safely resume normal operation.

7. Specifications

Table 7.1—Tool Changer Specifications

Specification	Tool Changer Model			
	QC-11HM	**QC-20HM**	**QC-21HM**	**QC-27HM**
Recommended Max Payload	35 lbs. (16 kg)	55 lbs. (25 kg)	55 lbs. (25 kg)	83 lbs. (38 kg)
Operating Temperature Range	-20–150°F (-30–66°C)	-20–150°F (-30–66°C)	-20–150°F (-30–66°C)	-20–150°F (-30–66°C)
Operating Pressure Range (filtered to 50 micron or better)	60–100 psi (4.1–6.9 bar)	60–100 psi (4.1–6.9 bar)	60–100 psi (4.1–6.9 bar)	60–100 psi (4.1–6.9 bar)
Coupling Force @ 80 psi	240 lbs (1100 N)	520 lbs (2300 N)	520 lbs (2300 N)	780 lbs (3500 N)
Recommended Max Moment X-Y (Mxy)	180 lbf-in (20.3 Nm)	500 lbf-in (56.5 Nm)	500 lbf-in (56.5 Nm)	750 lbf-in (84.7 Nm)
Recommended Max Torque about Z (Mz)	110 in-lbs (12.4 Nm)	310 in-lbs (35 Nm)	310 in-lbs (35 Nm)	880 in-lbs (99.4 Nm)
Positional Repeatability	0.0004” (0.0102 mm)	0.0006” (0.0152 mm)	0.0006” (0.0152 mm)	0.0006” (0.0152 mm)
Weight (coupled, no access.)	0.83 lbs. (0.376 kg)	2.2 lbs. (0.998 kg)	2.25 lbs. (1.02 kg)	2.95 lbs. (1.34 kg)
Master Weight	0.65 lbs. (0.295 kg)	1.5 lbs. (0.68 kg)	1.55 lbs. (0.703 kg)	2.3 lbs. (1.04 kg)
Tool Weight	0.18 lbs. (0.0816 kg)	0.7 lbs. (0.318 kg)	0.7 lbs. (0.318 kg)	0.65 lbs. (0.295 kg)
Max. Recommended distance between Master and Tool plate	0.06” (1.5 mm)	0.08” (2 mm)	0.08” (2 mm)	0.08” (2.03 mm)
Pass-through Port, (Qty) Connection Size (Maximum pressure of 100psi (6.9bar))	**Master Plate** (6) 1/8” tube fittings or (6) 4 mm tube fittings Tool Plate (6) M5 X 8[1]	**Master Plate** (12) 1/8” tube fittings or (12) 4 mm tube fittings Tool Plate (12) M5 X 8[1]	**Master Plate** (6) 1/8” tube fittings & (2) 1/4” tube fittings or (6) 4 mm tube fittings & (2) 6 mm tube fittings **Tool Plate** (8) 1/8” NPT or (8) 1/8 Rc BSPT or (8) G 1/8 BSPP	**Master Plate** (8) 4 mm tube fittings **Tool Plate** (8) G 1/8 BSPP
Pneumatic Lock and Unlock Port Connection size	1/8” tube fittings or 4 mm tube fittings	1/8” tube fittings or 4 mm tube fittings	1/8” tube fittings or 4 mm tube fittings	4 mm tube fittings
Mounting/Customer Interface	Refer to *Section 9—Drawings*			

Notes:

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

8. Serviceable Parts

The following items are commonly used as spare parts for the Hollow-Wrist Tool Changers.

8.1 Models QC-11HM Hollow-Wrist Serviceable Parts

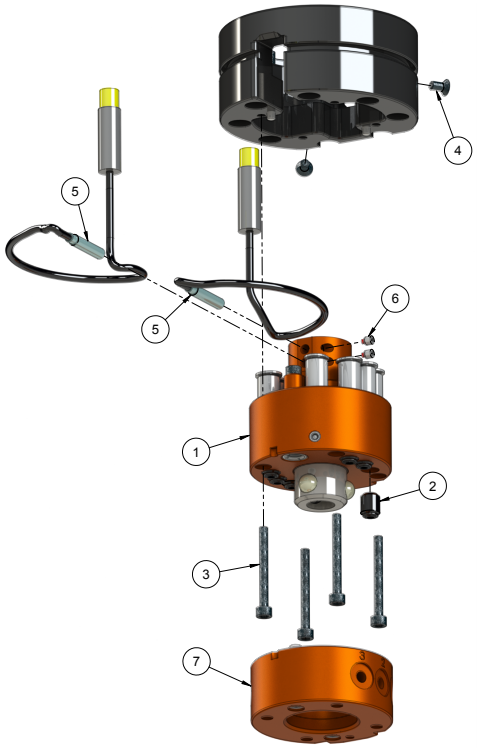


Table 8.1—QC-11HM Hollow-Wrist Master Plate			
Item No.	**Qty**	**Part Number**	**Description**
1	1	9120-011HM-000-000-S0	QC-11HM Base Assy w/ No Sensors, Orange Anodized
		9120-011HM-000-000-SQ	QC-11HM Base Assy w/ PNP Sensors, Orange Anodized
		9120-011HM-000-000-SQN	QC-11HM Base Assy with NPN Sensors, Orange Anodized
		9120-011HM-000-000-S0-E	QC-11HM Base Assy w/ Metric Tube fittings, No Sensors, Black Anodized
		9120-011HM-000-000-SQ-E	QC-11HM Base Assy w/ Metric Tube fittings, PNP Sensors, Black Anodized
		9120-011HM-000-000-SQN-E	QC-11HM Base Assy w/ Metric Tube fittings, NPN Sensors, Black Anodized
2	6	4010-0000009-02	M5 Rubber Bushing, Nitrile, Light-5
3	4	3500-1058030-15	M3X30 socket head cap screws, Class 12.9, Blue dyed Magni-565
4	2	3500-1258006-15A	M3 x 6 mm Socket Flat Head Screw Blue Dyed Magni-565 w/ND Microspheres Epoxy
9120-011HM-000-000-(SQ, SQ-E)			
5	2	8590-9909999-27	M4-0.5 PNP Sensor with M8 Male Plug
6	2	3500-1957030-11	Socket Set Screw, M3 x 3, NYLON TIP
9120-011HM-000-000-(SQN SQN-E)			
5	2	8590-9909999-78	M4-0.5 NPN Sensor
6	2	3500-1957030-11	Socket Set Screw, M3 x 3, NYLON TIP
QC-11 Tool plate			
7	1	9120-011T-000-000	QC-11 Tool Assy, no options, Orange Anodized
		9120-011T-000-000-B	QC-11 Tool Assy, No Options, Black Anodized

8.2 Models QC-20HM Hollow-Wrist Serviceable Parts

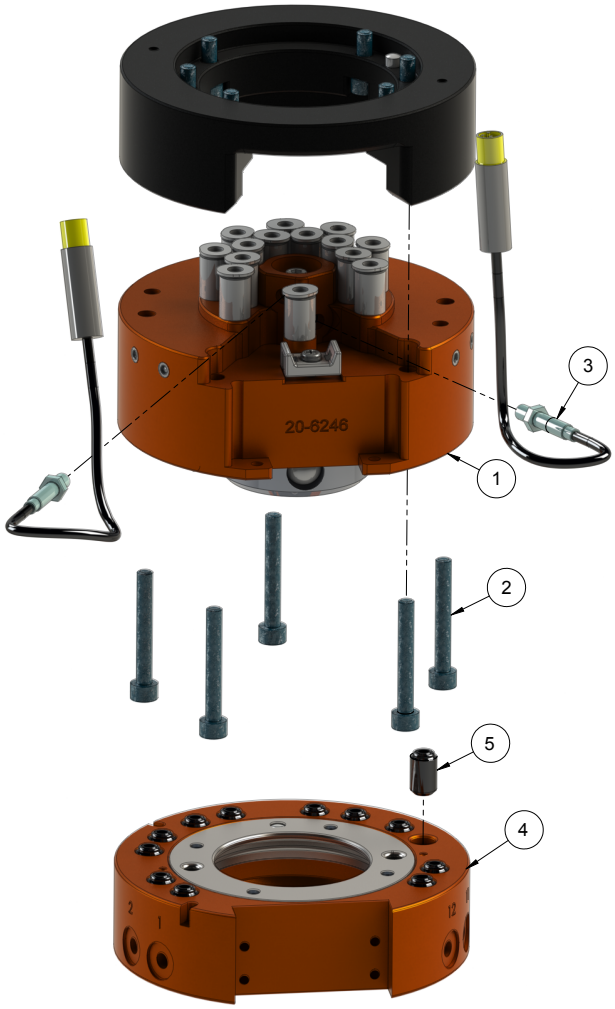


Table 8.2—QC-20HM Hollow-Wrist Master Plate			
Item No.	**Qty**	**Part Number**	**Description**
1	1	9120-020HM-000-PM5-S0	QC-20HM Base Assy w/ No Sensors, Orange Anodized
		9120-020HM-000-PM5-SQ	QC-20HM Base Assy w/ PNP Sensors, Orange Anodized
		9120-020HM-000-PM5-SQ-E	QC-20HM Base Assy w/ Metric Tube fittings, PNP Sensors, Black Anodized
		9120-020HM-000-PM5-SQ-M	QC-20HM Base Assy w/ Metric Tube fittings, PNP Sensors, Orange Anodized
		9120-020HM-000-PM5-SQN	QC-20 Hollow Wrist Base Assembly with NPN Sensors
2	6	3500-1062030-15A	M4 x 30 Socket Head Cap Screws, Class 12.9, Blue Dyed Magni-565, ND Microspheres Epoxy, Yellow.
9120-020HM-000-000-(SQ, SQ-E, SQ-M)			
3	2	8590-9909999-27	M4-0.5 PNP Sensor with M8 Male Plug
		8590-9909999-78	M4 NPN Prox Sensor
QC-20 Tool Plate			
4	1	9120-020T-000-PM5	QC-20 Tool, 12 air ports, no options
		9120-020T-000-PM5-B	QC-20 Tool, 12 air ports, no options, Black Anodized
5	8	4010-0000014-02	M5 Rubber Bushing, Nitrile

8.3 Models QC-21HM Hollow-Wrist Serviceable Parts

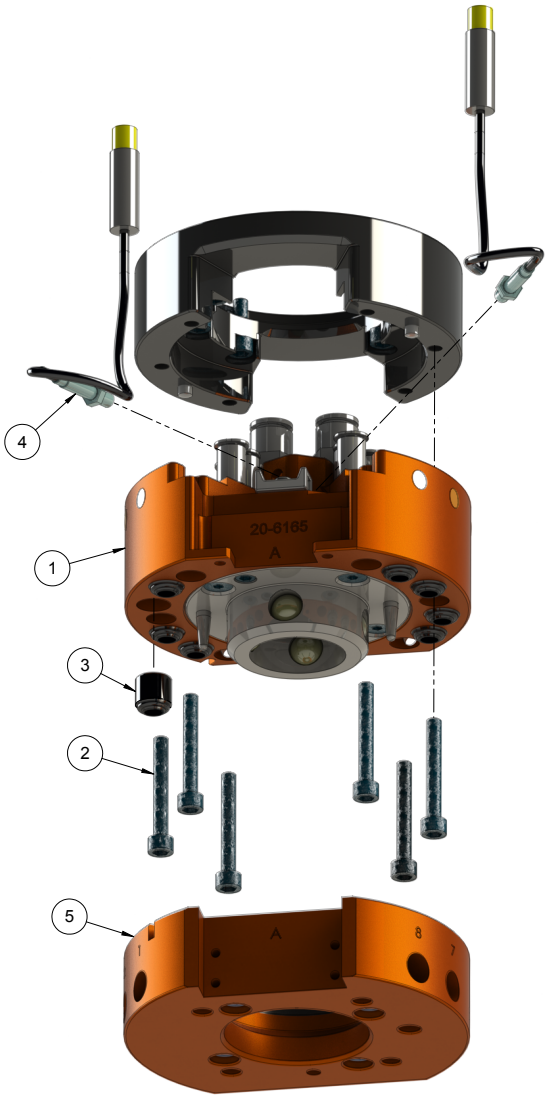


Table 8.3—QC-21HM Hollow-Wrist Master Plate			
Item No.	**Qty**	**Part Number**	**Description**
1	1	9120-021HM-000-000-S0	QC-21HM Base Assembly w/ no sensors, Orange Anodized
		9120-021HM-000-000-SQ	QC-21HM Base Assembly w/ PNP sensors, Orange Anodized
		9120-021HM-000-000-S0-E	QC-21HM Base Assy w/ Metric Tube fittings, No Sensors, Black Anodized
		9120-021HM-000-000-SQ-E	QC-21HM Base Assy w/ Metric Tube fittings, PNP Sensors, Black Anodized
		9120-021HM-000-000-SQ-M	QC-21HM Base Assy w/ Metric Tube fittings, PNP Sensors, Orange Anodized
2	6	3500-1062030-15A	M4 x 30 Socket Head Cap Screws, Class 12.9, Blue Dyed Magni-565, ND Microspheres Epoxy, Yellow.
3	8	4010-0000013-01	1/8” NPT Rubber Bushing, Nitrile
9120-021HM-000-000-(SQ, SQ-E, SQ-M)			
4	2	8590-9909999-27	M4-0.5 PNP Sensor with M8 Male Plug
QC-21 Tool Plate			
5	1	9120-021T-000-000	QC-21 Tool Assy, no options, 1/8” NPT Ports, Orange Anodized
		9120-021T-000-000-E	QC-21 Tool Assy, no options, 1/8 G BSPP ports, Black Anodized
		9120-021T-000-000-R	QC-21 Tool Assy, no options, 1/8 Rc BSPT ports, Orange Anodized

8.4 Models QC-27HM Hollow-Wrist Serviceable Parts

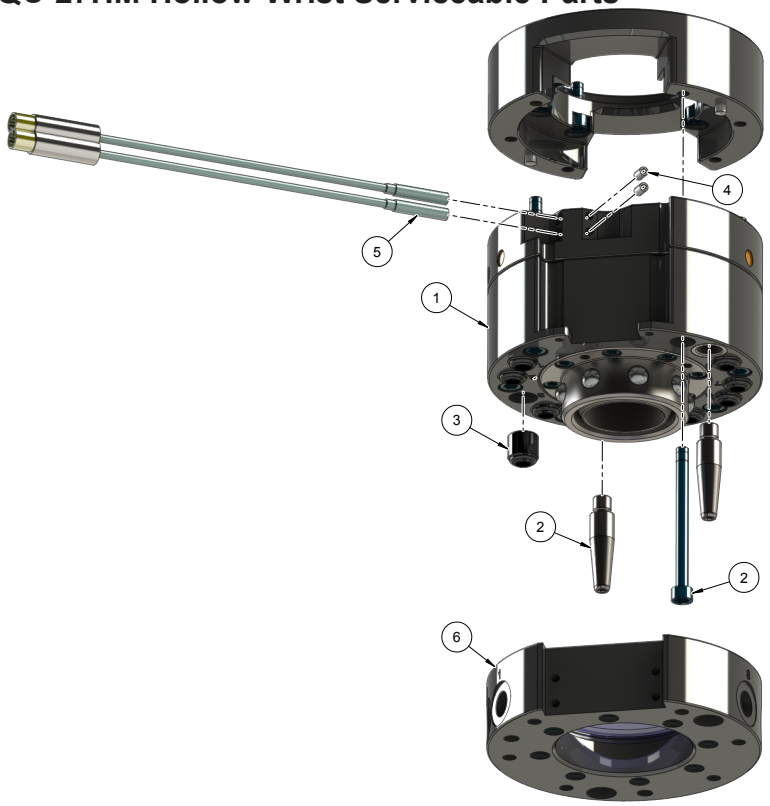


Table 8.4—QC-27HM Hollow-Wrist Master Plate			
Item No.	**Qty**	**Part Number**	**Description**
1	1	9120-027HM-000-000-S0-E	QC-27HM Base Assy w/ Metric Tube fittings, no sensors, Black Anodized
		9120-027HM-000-000-S01-E	QC-27HM Base Assy w/ Metric Tube fittings, detection shaft no sensors, Black Anodized
		9120-027HM-000-000-SQ-E	QC-27HM Base Assy w/ Metric Tube fittings, PNP sensors, Black Anodized
		9120-027HM-000-000-SQ1-E	QC-27HM Base Assy w/ Metric Tube fittings, PNP sensors flying leads, Black Anodized
2	6	3500-1062050-15A	M4 x 50 mm Socket Head Cap Screws Blue Dyed Magni-565 w/ Microspheres
3	8	4010-0000013-01	1/8” NPT Rubber Bushing, Nitrile
9120-027HM-000-000-SQ-E			
4	2	3500-1958005-32	M3 x 5 mm Lg Nylon Tip Set Screw SST
5	2	8590-9909999-27	M4-0.5 PNP Sensor with M8 Male Plug
9120-027HM-000-000-SQ1-E			
4	2	3500-1958005-32	M3 x 5 mm Lg Nylon Tip Set Screw SST
5	2	8590-9909999-97	PNP proximity sensor, M4-0.5, 2 m long, no conn.
QC-27 Tool Plate			
6	1	9120-027T-000-000-E	QC-27 Tool, Black, with 8 1/8” G Pass-through Ports

9. Drawings

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