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

Manual

Document #: 9610-20-2253
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 of Terms

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<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bearing Race</td>
<td>A steel ring in the Tool plate that is engaged by the locking balls during the coupling of the Tool Changer or Utility Coupler.</td>
</tr>
<tr>
<td>Cam</td>
<td>A multi tapered sliding cylinder attached to the piston that forces the locking balls outward during the locking process.</td>
</tr>
<tr>
<td>Coupling</td>
<td>The physical action of the locking the Master and Tool plates together. See Lock</td>
</tr>
<tr>
<td>Detection Shaft</td>
<td>Threaded stem inserted into the robot side of the piston, functions as a target to actuate the lock and unlock sensors.</td>
</tr>
<tr>
<td>EIP</td>
<td>End-effector Interface Plate – interface plate between the Tool plate and the customer’s end-effector (tooling). Allows customized mounting to the end-effector.</td>
</tr>
<tr>
<td>Electrical Module</td>
<td>Any of a wide variety of utility modules that pass electrical power and signals through the Master and Tool modules to the end-effector.</td>
</tr>
<tr>
<td>End-Effector</td>
<td>Tool used by the robot to perform a particular operation or function.</td>
</tr>
<tr>
<td>Fluid Module</td>
<td>Any of a wide variety of utility modules that pass fluids through the Master and Tool modules to the end-effector.</td>
</tr>
<tr>
<td>High Current Module</td>
<td>Any of a wide variety of utility modules that pass electrical power through the Master and Tool modules to the end-effector.</td>
</tr>
<tr>
<td>Interface Plate (IP)</td>
<td>Optional customized component used to adapt a Tool Changer or Utility Coupler to the user’s robot or tooling.</td>
</tr>
<tr>
<td>Lock</td>
<td>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.</td>
</tr>
<tr>
<td>Lock Port</td>
<td>Pneumatic port on the Master plate through which air pressure is supplied to Lock the Master plate to the Tool plate.</td>
</tr>
<tr>
<td>Lock Sensor</td>
<td>A proximity sensor that detects the position of the pneumatically actuated piston when it is in the locked or missed tool position.</td>
</tr>
<tr>
<td>Locked</td>
<td>An output signal provided by a proximity sensor, indicating that the coupling mechanism is in the Locked position.</td>
</tr>
<tr>
<td>Locking Balls</td>
<td>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.</td>
</tr>
<tr>
<td>Locking Mechanism</td>
<td>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.</td>
</tr>
<tr>
<td>Lock and Unlock</td>
<td>Lock and Unlock sensing capability enables the customer to determine the state of the master assembly locking mechanism.</td>
</tr>
<tr>
<td>Master plate</td>
<td>The half of the Tool Changer that is mounted to a robot. The Master plate contains the locking mechanism.</td>
</tr>
<tr>
<td>Moment</td>
<td>The applied force multiplied by the distance it is from a point.</td>
</tr>
<tr>
<td>No-Touch™</td>
<td>Design feature of all ATI Tool Changer products that allows coupling the Master plate and Tool plate without physical contact prior to locking.</td>
</tr>
<tr>
<td>Piston</td>
<td>Cylinder located in the Master plate that actuates the locking mechanism.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>-----------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Pneumatic Module</td>
<td>Any of a wide variety of utility modules that pass air or vacuum through the Master and Tool modules to the end-effector.</td>
</tr>
<tr>
<td>Sensor Plate</td>
<td>Cover plate for the back side of the Master plate, seals the pneumatic chamber and provides mounting points for the Lock and Unlock switches.</td>
</tr>
<tr>
<td>Servo Module</td>
<td>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.</td>
</tr>
<tr>
<td>SIP</td>
<td>Sensor Interface Plate 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.</td>
</tr>
<tr>
<td>Tool plate</td>
<td>The half of the Tool Changer to which various tools or end-effectors are mounted.</td>
</tr>
<tr>
<td>Tool Stand</td>
<td>Stand that holds Tools not being used by the robot.</td>
</tr>
<tr>
<td>Trip Dog</td>
<td>A physical device used to activate a mechanical switch, use in the tool stand Interlock circuit.</td>
</tr>
<tr>
<td>Uncoupling</td>
<td>The physical action of the unlocking the Master and Tool plates. See Unlock.</td>
</tr>
<tr>
<td>Unlatch</td>
<td>The output supplied to the ATI Master module to uncouple the Tool Changer.</td>
</tr>
<tr>
<td>Unlock</td>
<td>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.</td>
</tr>
<tr>
<td>Unlocked</td>
<td>An output signal provided by a proximity sensor, indicating that the coupling mechanism is in the Unlocked position.</td>
</tr>
<tr>
<td>Unlock Port</td>
<td>Pneumatic port on the Master plate through which air pressure is supplied to Unlock the Master plate from the Tool plate.</td>
</tr>
<tr>
<td>Unlock Sensor</td>
<td>A proximity sensor that detects the position of the pneumatically actuated piston when it is in the unlocked position.</td>
</tr>
</tbody>
</table>
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. More specific notifications are imbedded within the sections of the manual where they apply.

1.1 Explanation of Notifications

The following notifications 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, 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. Refer to product specifications section in each module of this manual or contact ATI for assistance. Particular attention should be paid to dynamic loads caused by robot acceleration and deceleration. These forces can be many times the value of static forces in high acceleration or deceleration situations.

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

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

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

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

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

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

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

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

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

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

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

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.

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](image)

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](image)
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

<table>
<thead>
<tr>
<th>Hollow-Wrist Model</th>
<th>For the most current list, information, and specifications for compatible Optional Modules click the link below</th>
</tr>
</thead>
<tbody>
<tr>
<td>QC-11HM</td>
<td><a href="#">QC-11 Hollow-Wrist Web Page</a> and select the Compatible modules tab</td>
</tr>
<tr>
<td>QC-20HM</td>
<td><a href="#">QC-20 Hollow-Wrist Web Page</a> and select the Compatible modules tab</td>
</tr>
<tr>
<td>QC-21HM</td>
<td><a href="#">QC-21 Hollow-Wrist Web Page</a> and select the Compatible modules tab</td>
</tr>
<tr>
<td>QC-27HM</td>
<td><a href="#">QC-27 Hollow-Wrist Web Page</a> and select the Compatible modules tab</td>
</tr>
</tbody>
</table>

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 (e.g. electrical, air, water, etc.) are turned off, pressurized connections are purged and power is discharged from circuits in accordance with the customer’s 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.

![Mating Surface](image)

**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

<table>
<thead>
<tr>
<th>Mounting Conditions</th>
<th>Fastener Size, Property Class, and Type</th>
<th>Recommended Torque</th>
<th>Thread Locker</th>
</tr>
</thead>
<tbody>
<tr>
<td>QC-11HM Master plate to adapter plate, Supplied Fasteners</td>
<td>M3-30 Class 12.9</td>
<td>10 in-lbs (1.13 Nm)</td>
<td>Pre-applied Adhesive or Loctite 222</td>
</tr>
<tr>
<td>QC-20HM, QC-21HM and QC-27HM Master plate to adapter plate, Supplied Fasteners</td>
<td>M4-30 Class 12.9</td>
<td>15 in-lbs (1.13 Nm)</td>
<td>Pre-applied Adhesive or Loctite 222</td>
</tr>
<tr>
<td>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</td>
<td>M5 x 0.8 Class 12.9</td>
<td>-</td>
<td>Pre-applied Adhesive or Loctite 222</td>
</tr>
<tr>
<td>Socket head cap</td>
<td>45 in-lbs (5.08 Nm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Socket flat head cap</td>
<td>35 in-lbs (3.96 Nm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>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</td>
<td>M6 x 1.0 Class 12.9</td>
<td>-</td>
<td>Pre-applied Adhesive or Loctite 242</td>
</tr>
<tr>
<td>Socket head cap</td>
<td>90 in-lbs (10.2 Nm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Socket flat head cap</td>
<td>60 in-lbs (6.78 Nm)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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 Allen® wrenches (hex key), torque wrench

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

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits; for example: electrical, air, water, etc.
4. Clean the mounting surfaces.
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. After the procedure is complete, resume normal operation.
3.2 Master Plate Removal

Refer to Figure 3.1 for Master module removal instructions.

**Tools required:** 2.5 mm Allen wrench (hex key)

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits (e.g. electrical, air, water, etc.).
4. Remove the fasteners securing the Master plate to the adapter plate. Refer to Figure 3.1.
5. If equipped, disconnect all utilities (e.g. electrical, air, water, etc.).
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 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 to the equipment. Use dowel pins that will not extend further than allowed by the Tool body.

<table>
<thead>
<tr>
<th>Incorrect Mounting of Tool Plate</th>
<th>Correct Mounting of Tool Plate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boss and two dowel pins as alignment features can be difficult to align and can damage equipment. Dowel pins are too long and cause a gap between interface plate and Tool.</td>
<td>Two dowel pins (or a single dowel pin along with a boss/recess) used as alignment features. Dowel pins are proper size allowing interface plate and Tool Plate to mount flush.</td>
</tr>
</tbody>
</table>

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 Allen wrenches (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. Clean the mounting surfaces.
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. After the procedure is complete, resume normal operation.

**Figure 3.2—Typical Tool Plate Installation**

3.5 Tool Plate Removal

**Tools required:** 5 mm, 4 mm, or 3 mm Allen wrenches (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 (e.g. electrical, air, water, etc.).
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. The steps below outline field installation or removal as required. 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 Allen wrench (hex key), torque wrench

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

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits; for example: electrical, air, water, etc.
4. Clean the mounting surfaces.
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 Allen wrench. Tighten to 24 in-oz (0.17 Nm).
11. Remove all protective caps, plugs, tape, etc from the module prior to operation.
12. After the procedure is complete, 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 Allen wrench (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 Allen wrench.
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 Allen wrenches (hex key), torque wrench

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

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits; 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 Allen wrench.
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 Allen wrench. 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 Allen wrench. Tighten to 48 in-oz (0.34 Nm).
10. Remove all protective caps, plugs, tape, etc from the module prior to operation.
11. After the procedure is complete, 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 Allen wrenches (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 Allen wrench.
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 Allen wrench.
8. Remove the cover from the Master plate.
3.6.5 QC-11 Tool Electrical Module Installation

**Tools required:** 2.5 \( \text{mm Allen wrench (hex key), 3/16” wrench, torque wrench} \)

**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. Clean the mounting surfaces.
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 \( \text{mm Allen wrench. Tighten to 24 in-oz (0.17 Nm).} \)
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. After the procedure is complete, resume normal operation.

![Figure 3.5—QC-11 Tool Electrical Module Installation](image)

3.6.6 QC-11 Tool Electrical Module Removal

**Tools required:** 2.5 \( \text{mm Allen wrench (hex key), 3/16” wrench} \)

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 \( \text{mm Allen wrench.} \)
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 Allen wrench (hex key), torque wrench

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

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits; for example: electrical, air, water, etc.
4. Clean the mounting surfaces.
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 Allen wrench. Tighten to 10 in-lbs (1.13 Nm).
8. Remove all protective caps, plugs, tape, etc from the module prior to operation.
9. After the procedure is complete, resume normal operation.

**Figure 3.6—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 Allen wrench (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 Allen wrench. 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 Allen wrenches (hex key), torque wrench

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

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits; for example: electrical, air, water, etc.
4. Clean the mounting surfaces.
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 Allen wrench. 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 Allen wrench. Tighten to 15 in-lbs (1.7 Nm).
11. Remove all protective caps, plugs, tape, etc from the module prior to operation.
12. After the procedure is complete, resume normal operation.

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

![Diagram of QC-21HM Flat B Optional Module Installation](image)

3.6.10 QC-21HM Flat B Optional Module Removal

**Tools required:** 2.5 mm and 3 mm Allen wrenches (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 Allen wrench 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 Allen wrench 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 (i.e., when air is supplied to the lock port, the unlock port must be open to the atmosphere.) Failure to vent trapped air or vacuum on the inactive port will negate the locking force of the 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

Unlock Port

Lock Port

4 or 5-way Valve

Supply Clean, Dry, Non-lubricated Air
60 – 100 psi (4.1 – 6.9 Bar)

Exhaust
Open to Atmosphere

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

Unlock Port

Lock Port

4 or 5-way Valve

Supply Clean, Dry, Non-lubricated Air
60 – 100 psi (4.1 – 6.9 Bar)

Exhaust
Open to Atmosphere

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

Unlock Port

Lock Port

4 or 5-way Valve

Supply Clean, Dry, Non-lubricated Air
60 – 100 psi (4.1 – 6.9 Bar)

Exhaust
Open to Atmosphere

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

Unlock Port

Lock Port

4 or 5-way Valve

Supply Clean, Dry, Non-lubricated Air
60 – 100 psi (4.1 – 6.9 Bar)

Exhaust
Open to Atmosphere
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)

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage Supply Range</td>
<td>10-30 VDC</td>
</tr>
<tr>
<td>Output Current</td>
<td>&lt; 100 mA</td>
</tr>
<tr>
<td>Nominal Sensing Distance Sn</td>
<td>0.8 mm</td>
</tr>
<tr>
<td>Output Circuit</td>
<td>PNP make function (NO)</td>
</tr>
</tbody>
</table>

**Figure 3.12—PNP Type Lock and Unlock Sensors**

#### PNP (Current Sourcing)

![PNP Diagram](image)

#### 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)

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage Supply Range</td>
<td>10-30 VDC</td>
</tr>
<tr>
<td>Output Current</td>
<td>&lt; 100 mA</td>
</tr>
<tr>
<td>Nominal Sensing Distance Sn</td>
<td>0.8 mm</td>
</tr>
<tr>
<td>Output Circuit</td>
<td>NPN make function (NO)</td>
</tr>
</tbody>
</table>

**Figure 3.13—NPN Type Lock and Unlock Sensors**

#### NPN (Current Sinking)

![NPN Diagram](image)
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**

![Offset Definitions Diagram](image)

<table>
<thead>
<tr>
<th>Model</th>
<th>No-Touch Zone Z Offset (Max)</th>
<th>X and Y Offset (Max)</th>
<th>Cocking Offset (Max)</th>
<th>Twisting Offset (Max)</th>
</tr>
</thead>
<tbody>
<tr>
<td>QC-11HM</td>
<td>1.5 mm (0.06&quot;)</td>
<td>±1 mm (0.039&quot;)</td>
<td>±0.8°</td>
<td>±2°</td>
</tr>
<tr>
<td>QC-20HM</td>
<td>2 mm (0.08&quot;)</td>
<td>±1 mm (0.039&quot;)</td>
<td>±0.8°</td>
<td>±2°</td>
</tr>
<tr>
<td>QC-21HM</td>
<td>2 mm (0.08&quot;)</td>
<td>±1 mm (0.039&quot;)</td>
<td>±0.8°</td>
<td>±2°</td>
</tr>
<tr>
<td>QC-27HM</td>
<td>3 mm (0.12&quot;)</td>
<td>±2 mm (0.08&quot;)</td>
<td>±1.0°</td>
<td>±2°</td>
</tr>
</tbody>
</table>

**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 such that there is little or no contact force between the Tool plate and tool stand.

2. Release air on the lock port and apply air to the unlock port (if equipped, the unlock sensor will indicate the Tool Changer is in the Unlocked position).

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

3. A sufficient delay must be programmed between unlocking valve actuation and robot motion so that the unlocking process is complete and the Tool plate is fully released before moving the robot.

4. Move the Master plate axially away from the Tool plate.

5. In automated Tool change applications, it is recommended that a Tool presence sensor(s) be used in the tool stand to verify that the Tool is present and that the Tool remains in place as the robot moves away after the unlocking process.

4.4 Tool Identification

When using multiple Tools, it is good practice to implement a Tool-ID system that identifies each Tool with 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 from ATI, refer to our Web site [http://www.ati-ia.com/products/toolchanger/toolchanger_modules.aspx](http://www.ati-ia.com/products/toolchanger/toolchanger_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 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. Two 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](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 circuits in accordance with the customer’s 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>
<thead>
<tr>
<th>Application(s)</th>
<th>Tool Change Frequency</th>
<th>Inspection Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Usage Material Handling Docking Station</td>
<td>&gt; 1 per minute</td>
<td>Weekly</td>
</tr>
<tr>
<td></td>
<td>&lt; 1 per minute</td>
<td>Monthly</td>
</tr>
<tr>
<td>Welding/Servo/Deburring, Foundry Operations (Dirty Environments)</td>
<td>All</td>
<td>Weekly</td>
</tr>
</tbody>
</table>

### 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 (e.g. electrical, air, water, etc.).
4. Use a clean rag to thoroughly remove any lubricant and debris from the ball bearings, male coupling, cam, and alignment pins.

![Figure 5.1—Cleaning Ball Bearings and Outer Surfaces of Male Coupling](image1)

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](image2)
6. Check each ball bearing to make sure it moves freely in the male coupling. Additional cleaning may be necessary to free up any ball bearings that are sticking in place.

Figure 5.3—Check Ball Bearing Movement

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

Figure 5.4—Apply Lubricant to Locking Mechanism

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

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

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

Figure 5.5—Clean Tool Plate Surfaces of locking Mechanism
5.3 Optional Electrical Module Pin Block Inspection and Cleaning

**Tools required:** Nylon Brush (ATI Part Number 3690-0000064-60)

1. Place the tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits (e.g. electrical, air, water, etc.).
4. Inspect the Master and Tool pin blocks for any debris or darkened pins.

**Figure 5.6—Inspect Master and Tool Pin Blocks**

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

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

**Figure 5.7—Clean Pin Blocks with a Nylon Brush**

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

**Figure 5.8—Stuck Pin and Pin Block Damage**

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

The following section provides troubleshooting 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 (e.g., electrical, air, water, etc.) are turned off, pressurized connections are purged and power is discharged from circuits in accordance with the customer’s 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:

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Cause</th>
<th>Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit cannot lock or unlock</td>
<td>Insufficient or no air pressure supply to lock or unlock ports.</td>
<td>Verify proper air pressure and pneumatic valve are supplied. Refer to Section 3.7—Lock and Unlock Pneumatic Requirements.</td>
</tr>
<tr>
<td></td>
<td>Air pressure trapped in de-energized lock and unlock ports.</td>
<td>Air pressure must be vented to the atmosphere properly, refer to Section 3.7—Lock and Unlock Pneumatic Requirements.</td>
</tr>
<tr>
<td></td>
<td>Pneumatic connections loose or damaged.</td>
<td>Refer to the air/valve adapter manual for more information.</td>
</tr>
<tr>
<td></td>
<td>Debris caught between the Master and Tool plates.</td>
<td>Clean debris from between Master and Tool plates. Verify mounting fasteners are secure and do not protrude above the mating surfaces.</td>
</tr>
<tr>
<td></td>
<td>The ball bearings and/or cam are not moving freely in the male coupling.</td>
<td>Clean and lubricate as needed to restore smooth operation. Refer to Section 5.2—Cleaning and Lubrication of the Locking Mechanism and Alignment Pins.</td>
</tr>
<tr>
<td></td>
<td>The Master plate and Tool plate are not within the specified No-Touch zone when attempting to lock.</td>
<td>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.</td>
</tr>
<tr>
<td>Insufficient air supply to tooling or air leak</td>
<td>Rubber bushings damaged.</td>
<td>Inspect rubber bushings for damage, replace damaged bushings. Refer to Section 6.2.2—Rubber Bushing Inspection and Replacement.</td>
</tr>
</tbody>
</table>

**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 Allen wrench (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 Allen wrench 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. After the procedure is complete, 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. After the procedure is complete, 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. If the seal becomes worn or damaged, it must be replaced.

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits (e.g. electrical, air, water, etc.).
4. To remove the existing seal, pinch the edge of the seal with your fingers and pull the seal away from the pin block on the Master.
5. To install a new seal, stretch the new seal over the shoulder of the pin block.
6. Push the seal hub down against the pin block using your finger tip.
7. After the procedure is complete, resume normal operation.

![Figure 6.4—V-ring Seal Replacement](image)

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 Allen wrenches (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 sensor 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 Allen wrench. 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 Allen wrench.

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.

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. After the procedure is complete, 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 Allen wrench (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 sensor 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 Allen wrench. 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.

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.

Figure 6.6—QC-20HM and QC-21HM Replace Lock and Unlock Sensor
**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 Allen wrench. 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. After the procedure is complete, 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 Allen wrench (hex key), 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.

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 sensor 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 Allen wrench.

5. Unscrew the sensor from the QC-27HM Master plate assembly and discard.
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 1/2 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. After the procedure is complete, resume normal operation.
# 7. Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>QC-11HM</th>
<th>QC-20HM</th>
<th>QC-21HM</th>
<th>QC-27HM</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Recommended Max Payload</strong></td>
<td>35 lbs. (16 kg)</td>
<td>55 lbs. (25 kg)</td>
<td>55 lbs. (25 kg)</td>
<td>85 lbs. (25 kg)</td>
</tr>
<tr>
<td><strong>Operating Temperature Range</strong></td>
<td>-20–150°F (-30–66°C)</td>
<td>-20–150°F (-30–66°C)</td>
<td>-20–150°F (-30–66°C)</td>
<td>-20–150°F (-30–66°C)</td>
</tr>
<tr>
<td><strong>Operating Pressure Range (filtered to 50 micron or better)</strong></td>
<td>60–100 psi (4.1–6.9 bar)</td>
<td>60–100 psi (4.1–6.9 bar)</td>
<td>60–100 psi (4.1–6.9 bar)</td>
<td>60–100 psi (4.1–6.9 bar)</td>
</tr>
<tr>
<td><strong>Coupling Force @ 80 psi</strong></td>
<td>240 lbs (1100 N)</td>
<td>520 lbs (2300 N)</td>
<td>520 lbs (2300 N)</td>
<td>780 lbs (3500 N)</td>
</tr>
<tr>
<td><strong>Recommended Max Moment X-Y (Mxy)</strong></td>
<td>220 lbf-in (24.9 Nm)</td>
<td>500 lbf-in (56.5 Nm)</td>
<td>500 lbf-in (56.5 Nm)</td>
<td>750 lbf-in (84.7 Nm)</td>
</tr>
<tr>
<td><strong>Recommended Max Torque about Z (Mz)</strong></td>
<td>300 in-lbs (33.9 Nm)</td>
<td>690 in-lbs (78 Nm)</td>
<td>690 in-lbs (78 Nm)</td>
<td>880 in-lbs (99.4 Nm)</td>
</tr>
<tr>
<td><strong>Positional Repeatability</strong></td>
<td>0.0004&quot; (0.0102 mm)</td>
<td>0.0006&quot; (0.0152 mm)</td>
<td>0.0006&quot; (0.0152 mm)</td>
<td>0.0006&quot; (0.0152 mm)</td>
</tr>
<tr>
<td><strong>Weight (coupled, no access.)</strong></td>
<td>0.54 lbs. (0.245 kg)</td>
<td>2.22 lbs. (1.01 kg)</td>
<td>1.75 lbs. (1.01 kg)</td>
<td>2.95 lbs. (1.34 kg)</td>
</tr>
<tr>
<td><strong>Master Weight</strong></td>
<td>0.36 lbs. (0.163 kg)</td>
<td>1.52 lbs. (0.689 kg)</td>
<td>1.05 lbs. (0.889 kg)</td>
<td>2.3 lbs. (1.04 kg)</td>
</tr>
<tr>
<td><strong>Tool Weight</strong></td>
<td>0.18 lbs. (0.0816 kg)</td>
<td>0.7 lbs. (0.318 kg)</td>
<td>0.7 lbs. (0.318 kg)</td>
<td>0.65 lbs. (0.295 kg)</td>
</tr>
<tr>
<td><strong>Max. Recommended distance between Master and Tool plate</strong></td>
<td>0.06&quot; (1.5 mm)</td>
<td>0.08&quot; (2 mm)</td>
<td>0.08&quot; (2 mm)</td>
<td>0.08&quot; (2.03 mm)</td>
</tr>
<tr>
<td><strong>Pass-through Port, (Qty) Connection Size (Maximum pressure of 100psi (6.9bar))</strong></td>
<td>Master Plate (6) 1/8&quot; tube fittings or (6) 4 mm tube fittings</td>
<td>Master Plate (12) 1/8&quot; tube fittings or (12) 4 mm tube fittings</td>
<td>Master Plate (6) 1/8&quot; tube fittings &amp; (2) 1/4&quot; tube fittings or (6) 4 mm tube fittings &amp; (2) 6 mm tube fittings</td>
<td>Master Plate (8) 4 mm tube fittings</td>
</tr>
<tr>
<td><strong>Pneumatic Lock and Unlock Port Connection size</strong></td>
<td>1/8&quot; tube fittings or 4 mm tube fittings</td>
<td>1/8&quot; tube fittings or 4 mm tube fittings</td>
<td>1/8&quot; tube fittings or 4 mm tube fittings</td>
<td>4 mm tube fittings</td>
</tr>
</tbody>
</table>

**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

<table>
<thead>
<tr>
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<th>Qty</th>
<th>Part Number</th>
<th>Description</th>
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<tbody>
<tr>
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<td>9120-011HM-000-000-S0</td>
<td>QC-11HM Base Assy w/ No Sensors, Orange Anodized</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9120-011HM-000-000-SQ</td>
<td>QC-11HM Base Assy w/ PNP Sensors, Orange Anodized</td>
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<td>9120-011HM-000-000-SQN</td>
<td>QC-11HM Base Assy with NPN Sensors, Orange Anodized</td>
</tr>
<tr>
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<td></td>
<td>9120-011HM-000-000-S0-E</td>
<td>QC-11HM Base Assy w/ Metric Tube fittings, No Sensors, Black Anodized</td>
</tr>
<tr>
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<td></td>
<td>9120-011HM-000-000-SQ-E</td>
<td>QC-11HM Base Assy w/ Metric Tube fittings, PNP Sensors, Black Anodized</td>
</tr>
<tr>
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<td></td>
<td>9120-011HM-000-000-SQN-E</td>
<td>QC-11HM Base Assy w/ Metric Tube fittings, NPN Sensors, Black Anodized</td>
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<tr>
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<td></td>
<td>9120-011HM-000-000-SQ-M</td>
<td>QC-11HM Base Assy w/ Metric Tube fittings, PNP Sensors, Orange Anodized</td>
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<tr>
<td>2</td>
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<td>4010-0000000-02</td>
<td>M5 Rubber Bushing, Nitrile, Light-5</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>3500-1058030-15</td>
<td>M3X30 socket head cap screws, Class 12.9, Blue dyed Magni-565</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>3500-1258006-15A</td>
<td>M3 x 6mm Socket Flat Head Screw Blue Dyed Magni-565 w/ND Microspheres Epoxy</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>8590-9909999-27</td>
<td>M4-0.5 PNP Sensor with M8 Male Plug</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
<td>3500-1957030-11</td>
<td>Socket Set Screw, M3 x 3, NYLON TIP</td>
</tr>
<tr>
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<td>8590-9909999-78</td>
<td>M4-0.5 NPN Sensor</td>
</tr>
<tr>
<td>6</td>
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<td>3500-1957030-11</td>
<td>Socket Set Screw, M3 x 3, NYLON TIP</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9120-011HM-000-000-(SQN SQN-E)</td>
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<td>7</td>
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<td>QC-11 Tool Assy, no options, Orange Anodized</td>
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<tr>
<td></td>
<td></td>
<td>9120-011T-000-000-B</td>
<td>QC-11 Tool Assy, No Options, Black Anodized</td>
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</table>
8.2 Models QC-20HM Hollow-Wrist Serviceable Parts

Table 8.2—QC-20HM Hollow-Wrist Master Plate

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Qty</th>
<th>Part Number</th>
<th>Description</th>
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<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>9120-020HM-000-PM5-S0</td>
<td>QC-20HM Base Assy w/ No Sensors, Orange Anodized</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9120-020HM-000-PM5-SQ</td>
<td>QC-20HM Base Assy w/ PNP Sensors, Orange Anodized</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9120-020HM-000-PM5-SQ-E</td>
<td>QC-20HM Base Assy w/ Metric Tube fittings, PNP Sensors, Black Anodized</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9120-020HM-000-PM5-SQ-M</td>
<td>QC-20HM Base Assy w/ Metric Tube fittings, PNP Sensors, Orange Anodized</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>3500-1062030-15A</td>
<td>M4 x 30 Socket Head Cap Screws, Class 12.9, Blue Dyed Magni-565, ND Microspheres Epoxy, Yellow.</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>8590-9909999-27</td>
<td>M4-0.5 PNP Sensor with M8 Male Plug</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9120-020T-000-PM5</td>
<td>QC-20 Tool, 12 air ports, no options</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9120-020T-000-PM5-B</td>
<td>QC-20 Tool, 12 air ports, no options, Black Anodized</td>
</tr>
<tr>
<td>4</td>
<td>8</td>
<td>4010-0000014-02</td>
<td>M5 Rubber Bushing, Nitrile</td>
</tr>
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</table>
8.3 Models QC-21HM Hollow-Wrist Serviceable Parts

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Qty</th>
<th>Part Number</th>
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<tbody>
<tr>
<td>1</td>
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<td>9120-021HM-000-000-S0</td>
<td>QC-21HM Base Assembly w/ no sensors, Orange Anodized</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9120-021HM-000-000-SQ</td>
<td>QC-21HM Base Assembly w/ PNP sensors, Orange Anodized</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9120-021HM-000-000-S0-E</td>
<td>QC-21HM Base Assy w/ Metric Tube fittings, No Sensors, Black Anodized</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9120-021HM-000-000-SQ-E</td>
<td>QC-21HM Base Assy w/ Metric Tube fittings, PNP Sensors, Black Anodized</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9120-021HM-000-000-SQ-M</td>
<td>QC-21HM Base Assy w/ Metric Tube fittings, PNP Sensors, Orange Anodized</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>3500-1062030-15A</td>
<td>M4 x 30 Socket Head Cap Screws, Class 12.9, Blue Dyed Magni-565, ND Microspheres Epoxy, Yellow.</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>4010-0000013-01</td>
<td>1/8&quot; NPT Rubber Bushing, Nitrile</td>
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<tr>
<td>4</td>
<td>2</td>
<td>8590-9909999-27</td>
<td>M4-0.5 PNP Sensor with M8 Male Plug</td>
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**9120-021HM-000-000-(SQ, SQ-E, SQ-M)**

**QC-21 Tool Plate**

<table>
<thead>
<tr>
<th>Item No.</th>
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<tr>
<td>5</td>
<td>1</td>
<td>9120-021T-000-000</td>
<td>QC-21 Tool Assy, no options, 1/8&quot; NPT Ports, Orange Anodized</td>
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<tr>
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<td></td>
<td>9120-021T-000-000-E</td>
<td>QC-21 Tool Assy, no options, 1/8 G BSPP ports, Black Anodized</td>
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<tr>
<td></td>
<td></td>
<td>9120-021T-000-000-R</td>
<td>QC-21 Tool Assy, no options, 1/8 Rc BSPT ports, Orange Anodized</td>
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</table>
### 8.4 Models QC-27HM Hollow-Wrist Serviceable Parts

#### Table 8.4—QC-27HM Hollow-Wrist Master Plate

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

9.1 QC-11HM Hollow-Wrist Tool Changer with A15 Module

[Diagram of QC-11HM Hollow-Wrist Tool Changer with A15 Module]
9.2 QC-20HM Hollow-Wrist Tool Changer with KF19 Module

**Master Side**
- Dimensions and notes for the master side of the QC-20HM tool changer, including options and tolerances.
- Notes 1, 2, 3, 4, 5, and 6 provide additional details about the tool changer's features and specifications.

**Tool Side**
- Dimensions and notes for the tool side of the QC-20HM tool changer, including options and tolerances.
- Notes 3, 4, 5, and 6 provide additional details about the tool changer's features and specifications.

---

**Table of Parts**

<table>
<thead>
<tr>
<th>ITEM</th>
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<td>9120-020HM-000-PM5-SQ-6247</td>
<td>QC-20 Hollow Wrist Mount Master, with KF19 Module</td>
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<td>QC-20 Tool Assembly, 12 Port No Options</td>
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<td>3</td>
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<td>9120-KF19-M</td>
<td>9120-KF19-M Master Module</td>
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<tr>
<td>4</td>
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<td>1</td>
<td>9120-KF19-T</td>
<td>9120-KF19-T Tool Module</td>
</tr>
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</table>

---

**Notes:**
- UNLOCK Air Supply
- LOCK Air Supply
- (6) M4 x 0.7 SHCS
- (12) AIR PASS THRU Fittings for 1/8" Tube (See Sheet 2)
- 56 Typ 45° H7 Recess, 5.1mm Dowel Slip Fit, 5.1mm
- 90° 4.5mm Dowel HT
- Equally Spaced (Optional)

---

**Drawing Information:**
- Drawing shows a master side assembly for direct mount to Hollow Wrist Robots.
- Dimensions indicate the perimeter for pneumatic fittings.
- Tube fitting connection to Master Tool Changer body: M6x1.0 Tap 7.62.
- Notes 2, 3, 4, and 5 provide additional details about the tool changer's features and specifications.

---

**Title:**
- Manual, Hollow-Wrist Robotic Tool Changer, QC-11HM through QC-27HM
- Document #9610-20-2253-06
Master-Tool Coupling Side

Optional Unlock Status Prox Sensor

Optional Lock Status Prox Sensor

Cable will be secured here for strain relief

Unlock Air (1/8" Tube)

Lock Air (1/8" Tube)

Port #1 (1/8" Tube)

Port #2 (1/8" Tube)

Port #3 (1/8" Tube)

Port #4 (1/8" Tube)

Port #5 (1/8" Tube)

Port #6 (1/8" Tube)

Port #7 (1/8" Tube)

Port #8 (1/8" Tube)

Port #9 (1/8" Tube)

Port #10 (1/8" Tube)

Port #11 (1/8" Tube)

Port #12 (1/8" Tube)

Robot Mounting Side

Optional Lock Sensor (Optional)

Optional Unlock Sensor (Optional)

Port #7

Port #8

Port #9

Port #10

Port #11

Port #12

Port #1

Port #2

Port #3

Port #4

Port #5

Port #6

AIR LINE CONNECTION DIAGRAM

EXPLODED VIEW
9.3 QC-21HM Hollow-Wrist Tool Changer with KF19 Module

NOTES:
1. Mounting Hardware included on Master Side.
2. Tool Side QC-21 is a standard product.
3. Dimension indicates the perimeter for pneumatic fitting connections.
4. Tube fitting connection to Master Tool Changer body: M6 x 1.0 tap 7/62.
5. Tube fitting connection to Master Tool Changer body: 1/8 NPT.
6. 4mm Dowel, Slip Fit, 5.1mm Opening for Wire Routing Access Through Robot Wrist.

TOOL SIDE

SIDE VIEW

MASTER SIDE
9.4 QC-27HM Hollow-Wrist Tool Changer

### Manual, Hollow-Wrist Robotic Tool Changer, QC-11HM through QC-27HM

**Document #9610-20-2253-06**

**Manual, Hollow-Wrist Robotic Tool Changer, QC-11HM through QC-27HM**

**Document #9610-20-2253-06**

**Pinnacle Park • 1031 Goodworth Drive • Apex, NC 27539 • USA • Tel: 919.772.0115 • Fax: 919.772.8259 • www.ati-ia.com • Email: info@ati-ia.com**
9.5 QC-27HM Hollow-Wrist Tool Changer with KM14 Module
<table>
<thead>
<tr>
<th>Rev.</th>
<th>Description</th>
<th>Initiator</th>
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<tbody>
<tr>
<td>-</td>
<td>See Sheet1</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

### Notes
- Unless otherwise specified, do not scale drawing. Drawn in SolidWorks. All dimensions are in millimeters.
- 3rd Angle Projection

**Drawing by:**
M. Gala, 4/26/10

**Checked by:**
D. Norton, 4/27/10

**Title:**
QC-27 M/T with Utility Body (Demo unit) and KM14

**Scale:**
1:1.5

**Drawing Number:**
9230-20-3165

**Revision:**
03

**Weight:**
3.66 lbs

**Drawing Status:**
At sheet 1, rev. 07

**Product Title:**
A00310-2 (v0.4.1)
10. Terms and Conditions of Sale

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

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

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

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