Quick-Change

High-Precision Robotic Tool Changer

Installation and Operation Manual

Basic Information for all Models

Document #: 9610-20-1000-15
July 2012
Foreword

This manual contains basic information applicable to all ATI Quick-Change robotic Tool Changers. Certain Quick-Change 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.

Information contained in this document is the property of ATI Industrial Automation, Inc. (ATI) and shall not be reproduced in whole or in part without prior written approval of ATI. The information herein is subject to change without notice. This manual is periodically revised to reflect and incorporate changes made to the product.

The information contained herein is confidential and reserved exclusively for the customers and authorized agents of ATI Industrial Automation and may not be divulged to any third party without prior written consent from ATI. No warranty including implied warranties is made with regard to accuracy of this document or fitness of this device for a particular application. ATI Industrial Automation shall not be liable for any errors contained in this document or for any incidental or consequential damages caused thereby. ATI Industrial Automation also reserves the right to make changes to this manual at any time without prior notice.

ATI assumes no responsibility for any errors or omissions in this document. Users’ critical evaluation of this document is welcomed.

©Copyright by ATI Industrial Automation. All rights reserved.

How to Reach Us

Sales, Service and Information about ATI products:

**ATI Industrial Automation**
1031 Goodworth Drive
Apex, NC 27539 USA
www.ati-ia.com
Tel: 919.772.0115
Fax: 919.772.8259
E-mail: info@ati-ia.com

Technical support and questions:

**Application Engineering**
Tel: 919.772.0115, Option 2, option 2
Fax: 919.772.8259
E-mail: mech_support@ati-ia.com
# Table of Contents

1. Safety .................................................................................................................................5
   1.1 Explanation of Warnings .................................................................................................5
   1.2 Precautions ....................................................................................................................5

2. Product Overview ................................................................................................................7
   2.1 Introduction ....................................................................................................................7
   2.2 Master Plate/Tool Plate Coupling Mechanism .............................................................7

3. Specifications .......................................................................................................................7

4. Installation ............................................................................................................................8
   4.1 Typical Installation .........................................................................................................8
   4.2 Interface Plate Design and Mounting ............................................................................9
   4.3 Lock/Unlock Pneumatic Connections and Valving .......................................................10
      4.3.1 Air Requirements ..................................................................................................10
      4.3.2 Valve Requirements and Connections .................................................................10

5. Operational Considerations ...............................................................................................12
   5.1 Coupling and Uncoupling .........................................................................................12
      5.1.1 Coupling Sequence ...............................................................................................12
      5.1.2 Uncoupling Sequence .........................................................................................12
      5.1.3 QC-5 Notes ..........................................................................................................13
      5.1.4 Tool Identification ...............................................................................................13
   5.2 Tool Stand Design .........................................................................................................13
      5.2.1 Tool Locating Features .......................................................................................15
      5.2.2 Tool Stand Sensors .............................................................................................15

6. Sensor Interface Plate (SIP) Option ..................................................................................16
   6.1 Overview .......................................................................................................................16
   6.2 SIP Operation – Models QC-10 and Larger .................................................................17

7. SIP Troubleshooting .........................................................................................................19

8. Maintenance .......................................................................................................................20
   8.1 General .........................................................................................................................20
   8.2 Lubrication ..................................................................................................................20
      8.2.1 External ................................................................................................................20
      8.2.2 Internal ................................................................................................................20
   8.3 Alignment Pins .............................................................................................................20
   8.4 Rubber Bushings ..........................................................................................................21
   8.5 Preventive Maintenance .............................................................................................21
   8.6 Cleaning, Lubrication, Adjustment and Replacement ................................................23
      8.6.1 Cleaning and Lubrication of the Locking Mechanism and Alignment Pins (Master Plate) 23
      8.6.2 Cleaning the Locking Mechanism and Alignment Pin Bushings (Tool Plate) ..........24

9. Drawings ............................................................................................................................25
   9.1 Typical QC Exploded View ..........................................................................................25
   9.2 Typical QC-5 Exploded View ......................................................................................25
   9.3 QC-11 Hollow-Wrist Mount with A15 Module ............................................................27
   9.4 QC-20 Hollow-Wrist Mount with KF19 Module ...........................................................29
   9.5 QC-21 Hollow-Wrist Mount with KF19 Module ...........................................................31
   9.6 QC-27 Base Tool Changer, BSPP, with IP-6160 ..........................................................33

10. Terms and Conditions .....................................................................................................36
## Glossary of Terms

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<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>Tool Plate</td>
<td>The half of the Tool Changer to which various tools or end-effectors are mounted.</td>
</tr>
<tr>
<td>Cover Plate</td>
<td>Simple, blank closure plate on standard Quick-Change Master Plates that closes the pneumatic chamber.</td>
</tr>
<tr>
<td>Piston</td>
<td>Piston located in the Master Plate that actuates the locking mechanism.</td>
</tr>
<tr>
<td>Cam</td>
<td>Circular cam attached to the piston that forces the locking balls outward during the locking process.</td>
</tr>
<tr>
<td>Bearing Race</td>
<td>Hardened steel ring in the Tool Plate that is engaged by the locking balls during the locking process.</td>
</tr>
<tr>
<td>End-Effector</td>
<td>Tool used by the robot to perform a particular function.</td>
</tr>
<tr>
<td>Tool Stand</td>
<td>Stand that holds Tools not being used by the robot. This is usually supplied by the customer and is specific to the application.</td>
</tr>
<tr>
<td>RIP</td>
<td><strong>Robot Interface Plate</strong> – interface plate between the robot flange and Master Plate.</td>
</tr>
<tr>
<td>SIP</td>
<td><strong>Sensor Interface Plate</strong> used to adapt the Quick-Change Master to the customer-supplied robot. The SIP is essentially a Robot Interface Plate that contains sensors that determine the state (locked/unlocked/no Tool) of the Master Plate.</td>
</tr>
<tr>
<td>Electrical Module</td>
<td>Any of a wide variety of modules that pass electrical power through the Master Plate to the Tool Plate and to the end-effector.</td>
</tr>
<tr>
<td>Pneumatic Module</td>
<td>Any of a wide variety of modules that pass pneumatic power through the Master Plate to the Tool Plate and to the end-effector.</td>
</tr>
<tr>
<td>Detection Shaft</td>
<td>Threaded stem inserted into the back side (top) of the Piston, functions as a target to actuate the Lock/Unlock switches.</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/Unlock switches.</td>
</tr>
<tr>
<td>Lock Port</td>
<td>Pneumatic port on the Master Plate to which air is supplied to Lock the Master Plate to the Tool Plate.</td>
</tr>
<tr>
<td>Unlock Port</td>
<td>Pneumatic port on the Master Plate to which air is supplied to Unlock the Master Plate from the Tool Plate.</td>
</tr>
<tr>
<td>No-Touch™</td>
<td>Design feature of all ATI Quick-Change products that allows coupling the Master Plate and Tool Plate without physical contact prior to locking.</td>
</tr>
</tbody>
</table>
1. Safety

1.1 Explanation of Warnings

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

Danger indicates that a situation could result in potentially serious injury or damage to equipment.

Caution indicates that a situation could result in damage to the product and/or the other system components.

1.2 Precautions

**DANGER:** During operation, the area between the Master and Tool must be kept clear.

**DANGER:** 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.
DANGER: Power and air should always be removed prior to maintenance or repair.

CAUTION: The Quick-Change system must not be actuated without being mounted to the robot interface plate. Damage to the cover plate and O-ring may result.

CAUTION: The Quick-Change system is only to be used for intended applications and applications approved by the manufacturer.
2. Product Overview

2.1 Introduction

The Quick-Change Tool Changer consists of two primary parts: The Master Plate and the Tool Plate. The Master Plate is attached to a robot while end-effectors such as grippers, material handlers, etc. are attached to one or more Tool Plates. The Master Plate is typically mounted to the robot with an optional interface plate (SIP or RIP).

An optional Sensor Interface Plate (SIP) plate may also be used for detecting the lock condition of the Tool Changer and/or Tool Plate presence. The use of a SIP is highly recommended for achieving the highest level of safety and reliability. The SIP is a combination robot/Master Plate interface plate and sensor mounting plate.

In operation, the robot can be programmed to select the desired end-effector by coupling the Master Plate to the Tool Plate. Electrical signals, pneumatic power, and fluids can be transferred to the end-effector(s) through the Master Plate and Tool Plate by optional modules and ports. See the respective manuals for these options for more details on their operation.

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.

Hollow-Wrist Tool Changers are also available for internal routing of cables and air lines in hollow-wrist robots. The axial air ports utilized on these Tool Changers 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. See Section 9—Drawings for more information. The ATI Tool Changer has been designed to provide extremely long life with little or no maintenance.

2.2 Master Plate/Tool Plate Coupling Mechanism

The coupling of the Master Plate and the Tool Plate is achieved through a patented, high-strength, high-repeatability, 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 assures the coupling will not be compromised in case of air loss (fail-safe feature), and the secondary angle provides rigid coupling during normal operation. The balls engage a bearing race (or “locking ring”) in the Tool Plate and lock the Master Plate and Tool Plate tightly together.

⚠️ CAUTION: Do not use the Tool Changer in the fail-safe condition for extended periods of time. Do not transport the Tool Changer in the fail-safe condition. Possible damage to the locking mechanism could occur.

3. Specifications

Specifications such as payload, moment capacity, repeatability, and weight for each model may be found in the product catalog and on our website. Drawings may also be found in the product catalog and on our website. 2-D and 3-D models are also available on our website.

Contact ATI for specific information and drawings regarding your installation. We encourage you to use our applications department to review your designs and answer your questions.
4. Installation

4.1 Typical Installation

The Master Plate is mounted to the robot flange (refer to Figure 4.1) using a custom interface 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).

The end-effector is typically attached to the Tool Plate with an interface plate designed and provided by the user (consult the appropriate drawings for dimensions, fastener, and dowel pin specifics).

Removable thread locker should be used for all mounting bolts.

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

**DANGER:** 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 pullout, kinking, rupture, etc. Failure of some critical electrical and/or pneumatic lines to function properly may result in injury to personnel and equipment.

**CAUTION:** Fasteners used to mount the Master Plate to the robot flange or custom interface plate must not extend above the surface of the male coupling when installed. If the Master and Tool Plates do not contact when coupled, the fail-safe function can be compromised.

---

**Figure 4.1—Typical Installation**

Robot Arm

Interface Plate
(optional or supplied by user)

Piston Cover Plate
(not necessary if sealing is provided by interface plate; see drawing for more info.)

O-ring

Master Plate Mounting Screws
(provided)

Master Plate

Tool Plate

Interface Plate for End-effector
(supplied by user)
4.2 Interface Plate Design and Mounting

Refer to Figure 4.2.

All interface plates should be designed using two locating features per interface.

The Tool Plate/end-effector interface should utilize the diameter of the Tool Plate and a dowel pin for location.

The Master Plate/robot interface should utilize the external diameter of the Master Plate boss and one dowel pin (two dowel pins for some models).

A piston cover plate is provided with each Quick-Change Master Plate. If the robot interface plate provides sealing for the piston cylinder, then the cover plate is optional in the installation.

Be careful when installing the O-ring. If the O-ring is not properly seated in the groove, it can be cut or damaged, resulting in a bad seal and air leakage. This can cause improper and/or unsafe operation.

The robot interface plate must be properly designed to provide rigid mounting on the boss surfaces. The interface plate should not contact the Master body outside of the boss. The recommended dimensions for the interface plate bore, with and without the cover plate, are given on the respective Quick-Change print for each model.

The mating diameters must provide sufficient clearance so that mating corner radii do not interfere.

---

**CAUTION:** Failure to follow this advice when designing the robot interface plate may result in cover plate O-ring damage or loosening of the interface during operation.

**CAUTION:** Removable thread locker should be used for all mounting bolts. Failure to do so may cause vibration to loosen bolts over time.

**CAUTION:** Be careful when installing the O-ring. If the O-ring is not properly seated in the groove it can be cut or damaged, resulting in a bad seal.

---

![Diagram of Master Plate Mounting](image)
4.3 Lock/Unlock Pneumatic Connections and Valving

DANGER: Failure to use a 4-way valve and properly vent to atmosphere may cause the locking mechanism to operate incorrectly and may cause the Quick-Change to not lock or unlock as expected. This could result in damage to the product, attached tooling, or personnel.

Air must be supplied to the “Lock” air port on the Master Plate (robot-side) to move the internal piston, which moves the cam, and forces the locking balls outward. The locking balls move outward until they contact the bearing race on the mating Tool Plate. This will rigidly engage the Master Plate and Tool Plate providing high load capacity and positional accuracy. The patented cam profile prevents the Tool Plate from becoming disengaged in the event that there is a loss of air in the locked state.

To unlock the Tool Plate from the Master Plate, lock air must be vented and air supplied to the “Unlock” air port on the Master Plate.

4.3.1 Air Requirements

For proper operation of the Quick-Change system, the Master Plate must be supplied with clean, dry, non-lubricated air supplied between 65 and 100 psi (4.5–6.9 Bar) and filtered at 20 microns or better.

Flow requirements are negligible, typically no more than 1/3 CFM at 70 PSI when cycled continuously.

CAUTION: Do not use the Tool Changer in the fail-safe condition for extended periods of time. Do not transport the Tool Changer in the fail-safe condition. Possible damage to the locking mechanism could occur.

4.3.2 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 Quick-Change mechanism.

DANGER: The Quick-Change 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.
Quick-Change Installation and Operation Manual

ATI Quick-Change Pneumatic Connection

Lock Port
Unlock Port

4-Way Valve

Supply Clean, Dry, Non-Lubricated Air
65 - 100 psi (4.3 - 6.9 Bar)

Exhaust
Open to Atmosphere

Typical Master Plate
(Shown Unlocked)

Figure 4.3—Pneumatic Connections
5. Operational Considerations

**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.

**ATTENTION:** All Tool Changers are initially lubricated using MobilGrease® XHP222 Special grease. The end-user must apply additional lubricant to the locking mechanism components and alignment pins prior to start of service (see Section 8.2). 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.

5.1 Coupling and Uncoupling

**DANGER:** During operation, the area between the Master Plate and Tool must be kept clear.

**CAUTION:** Before attempting to couple or uncouple, ensure that pass-through air pressure and electrical signals are off.

5.1.1 Coupling Sequence

Prior to coupling and with air supplied to the Unlock Port, position the Master Plate above the Tool Plate. Move the Master Plate toward the Tool Plate so that the two Master Plate alignment pins enter the alignment holes on the Tool Plate. Take care to 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.

When the two 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 will be drawn toward the Master Plate and coupled. Air must be maintained on the Lock Port during operation to assure rigid coupling.

A sufficient delay must be programmed between locking valve actuation and robot motion so that the locking process is complete before moving the robot.

ATT’s patented fail-safe design prevents the Tool Plate from being released in the event of air-pressure loss to the Lock port, thereby increasing safety and reliability. Positional accuracy may not be maintained during air loss, but will be regained once air pressure is re-established to the Lock port.

A Sensor Interface Plate (SIP) option is available for all models except the QC-5. The SIP provides positive sensing of the locking mechanism in locked and unlocked positions, thereby increasing reliability and safety of the application in automated situations (see Section 6—Sensor Interface Plate (SIP) Option regarding this option).

5.1.2 Uncoupling Sequence

Position the Tool Plate in the Tool Stand such that there is little or no contact force between the Tool Plate and Tool Stand. Release air on the Lock port and apply air to the Unlock Port. 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. (Note: Tool weight assists in uncoupling if the Tool
is released in the vertical position only). Move the Master Plate axially away from the Tool Plate.

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.

In automated Tool change applications, it is recommended that the Sensor Interface Plate (SIP) option be used to sense that the locking mechanism has fully released before robot motion (see Section 6—Sensor Interface Plate (SIP) Option regarding this option). It is also recommended that a Tool presence sensor(s) be used in the Tool Stand to verify that the Tool is present and to verify that the Tool remains in place as the robot moves away after the unlocking process.

CAUTION: The use of the Sensor Interface Plate (SIP) option and Tool Stand proximity sensors is highly recommended to verify that the coupling and uncoupling process occurs as expected.

5.1.3 QC-5 Notes

The QC-5 incorporates a positive uncoupling feature. The Master Plate is pushed away from the Tool Plate during unlocking. Due to this feature, a gap of 1.5mm to 3mm must be maintained between the Master Plate and Tool Plate during coupling and between the Tool Plate and stand during uncoupling. Failure to provide the proper clearance will result in coupling/uncoupling problems.

5.1.4 Tool Identification

When using multiple Tools, it is good practice to implement a Tool-ID system that identifies each Tool with a unique code. This can be used to verify that the robot has picked up the proper Tool. This may be accomplished by using an optional electrical module (for power and signal pass-through) and uniquely jumpering pins on the Tool-side of the module. See electrical module documentation for more information. DeviceNet Tool-ID modules are also available.

5.2 Tool Stand Design

CAUTION: During coupling and lock-up, the Tool Stand must allow for movement (float) in a plane parallel to the mating surfaces of the Master Plate and Tool Plates, and in a direction perpendicular to this plane, towards the Master Plate.

In most cases, the Tools are stored in a Tool Stand when not being used by the robot. During coupling and lock-up, the Tool Stand must allow for movement (float) in a plane parallel with the mating surfaces of the Master Plate and Tool Plates (X and Y), and also in a direction towards the Master Plate (Z). Even slight misalignment between the Master Plate and Tool Plate can generate high forces during lock-up if the Tool Plate is not allowed to float into place during lock-up. These high forces can cause excessive wear and even jamming of the end effector and robot. The degree of float required depends on the accuracy of the robot’s positioning and the repeatability of the Tool location in the Tool Stand during lock-up. See Figure 5.1 and Table 5.1 for recommended maximum allowable float (offsets) prior to coupling. The Tool Stand should be designed to minimize misalignment during coupling and uncoupling. In some cases, greater offsets than shown in Table 5.1 can be accommodated by the Master and Tool Plates, but will increase wear.

Ideally, the Tool should be hanging vertically in the Tool Stand so that gravity acts 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 care must be taken that the necessary compliance is 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.

Lock-up should occur with the Master Plate in the No-Touch™ locking zone (see Table 5.1), but not touching the Tool Plate. As locking occurs, the Master Plate should draw the Tool Plate into the locked position.

CAUTION: Tool Stand design is critical to proper operation of the Tool Changer. Improperly designed Tool Stands can cause misalignments that will cause jamming and/or excessive wear of Tool Changer components.

Tool Stands may also need to incorporate means for covering Tools and electrical modules to protect them in dirty environments, such as grinding or welding.

![Diagram of Tool Stands and Offsets](image)

**Table 5.1—Maximum Recommended Offsets Prior to Coupling**

<table>
<thead>
<tr>
<th>Model</th>
<th>No-Touch™ Zone Z Offset (Max)* (mm)</th>
<th>X and Y Offset (Max)† (mm)</th>
<th>Cocking Offset (Max) (degrees)</th>
<th>Twisting Offset (Max) (degrees)</th>
</tr>
</thead>
<tbody>
<tr>
<td>QC-5</td>
<td>+3</td>
<td>±1</td>
<td>±1.1</td>
<td>±2</td>
</tr>
<tr>
<td>QC-11</td>
<td>+3</td>
<td>±1</td>
<td>±0.8</td>
<td>±2</td>
</tr>
<tr>
<td>QC-20</td>
<td>+3</td>
<td>±1</td>
<td>±1.0</td>
<td>±2</td>
</tr>
<tr>
<td>QC-21</td>
<td>+3</td>
<td>±2</td>
<td>±0.6</td>
<td>±1</td>
</tr>
<tr>
<td>QC-40</td>
<td>+3</td>
<td>±2</td>
<td>±1.0</td>
<td>±2</td>
</tr>
<tr>
<td>QC-41</td>
<td>+3</td>
<td>±2</td>
<td>±0.6</td>
<td>±1</td>
</tr>
<tr>
<td>QC-60</td>
<td>+3</td>
<td>±2</td>
<td>±0.6</td>
<td>±1</td>
</tr>
<tr>
<td>QC-71</td>
<td>+3</td>
<td>±2</td>
<td>±0.7</td>
<td>±1</td>
</tr>
<tr>
<td>QC-100</td>
<td>+2.5</td>
<td>±3</td>
<td>±0.6</td>
<td>±1</td>
</tr>
<tr>
<td>QC-150</td>
<td>+2.5</td>
<td>±3</td>
<td>±0.6</td>
<td>±1</td>
</tr>
<tr>
<td>QC-300</td>
<td>+2.5</td>
<td>±3</td>
<td>±0.6</td>
<td>±1</td>
</tr>
</tbody>
</table>

Notes: * Maximum values shown. Decreasing actual values will minimize wear during coupling/uncoupling.
† Actual allowable values may be higher in some cases, but higher offsets will increase wear during coupling.
5.2.1 Tool Locating Features

The Tool must be positively located in the Tool Stand. A variety of methods may be used to accomplish this. Whatever method is chosen, it is important that the required compliance or “float” be built into the locating system. A common method is to use tapered dowel pins in holes. As the Tool Plate is lifted during the locking action, the taper allows the Tool to float into its locked position even with small deviations in robot position.

Other Tool locating feature methods include balls and detents, dowel pins in notched V-grooves, etc. Please consult ATI for recommendations or assistance with locating feature design for your particular tooling.

Cylindrical (not tapered) dowel pins should not be used as they provide too much surface engagement. During coupling and uncoupling, the Tool can bind on these straight (cylindrical) pins due to misalignment of the Master and Tool Plates.

Robot programming and locational repeatability are important in Tool pick-up and drop-off.

5.2.2 Tool Stand Sensors

It is suggested that the customer provide a sensor that detects the presence of a properly seated Tool in the Tool Stand. 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. This provides a fail-safe measure in the event that a Tool should become jammed in the stand or if the Tool should fail to release properly from the robot.

Proximity sensors should be located so that the sensing face is vertical to prevent swarf or other debris from falling on the sensor and creating false readings.
6. Sensor Interface Plate (SIP) Option

6.1 Overview

The Sensor Interface Plate (SIP) system provides a method of providing locking mechanism position signals to the customer’s process controller. These signals will indicate two possible conditions for the Quick-Change Master Plate: Unlocked or Locked.

The SIP system utilizes switches to detect the position of the pneumatically-actuated piston in the Master Plate. These switches are available in various configurations (PNP, NPN, AC, and dry-contact) depending on customer requirements, Quick-Change model, and sensor availability.

The SIP system consists of a SIP Plate (which is actually the interface plate between the Tool Plate and the robot), a Detection Shaft, a Sensor Plate, Proximity Switches, and an O-Ring (see the figures below).

The Sensor Plate provides mounting locations for the Proximity Switches and seals the pneumatic chamber of the Master Plate. The SIP plate provides mounting holes for attaching the Master Plate to the customer’s application and retains the Sensor Plate.
6.2 SIP Operation – Models QC-10 and Larger

The SIP system for these models utilizes 2- or 3-wire proximity switches, available in NPN, PNP, and 125 VAC configurations. Figures 6.1 and 6.2 show the position of the locking mechanism piston and Detection Shaft relative to the proximity switches for various conditions. See Figure 6.3 for physical connection information and Figure 6.4 for wiring information.

Contact ATI if adjustment of the proximity switches is necessary.

Master Plate in the unlocked position. The unlock sensor is activated by the Detection Shaft.

![Figure 6.1—Unlocked Condition](image)

Master Plate in the locked position with a Tool Plate in place. The Lock sensor is activated by the Detection Shaft.

![Figure 6.2—Locked Condition](image)
Figure 6.3—Proximity Switches and Connections for Larger Models

The SIP Proximity Switches may be specified as NPN, PNP, or 125VAC configurations.

Figure 6.4—Proximity Switch Wiring for Larger Models
7. SIP Troubleshooting

The SIP contains few components and provides trouble-free operation once properly installed. The following table is provided to assist with troubleshooting the SIP.

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Possible Cause / Correction</th>
</tr>
</thead>
</table>
| Check the following conditions prior to any further troubleshooting. | - Ensure that the switch is wired properly and is receiving power.  
- Ensure that the Quick-Change has proper pneumatic connections, air is supplied at a minimum of 70 psi (4.8 bar), and that no air or vacuum can be trapped in a de-energized lock or Unlock Port (pressure must be vented to atmosphere.) |
| Unlock Switch fails to operate.      | - Ensure that air is supplied at a minimum of 70 psi (4.8 bar) to the Quick-Change Unlock (U) port.  
- Ensure that the Master Plate cam is fully retracted and that there is no air trapped in the Lock (L) air port. |
| Lock Switch fails to operate.        | - Ensure that air is supplied at a minimum of 70 psi (4.8 bar) to the Quick-Change lock (L) port.  
- Ensure that the Tool Plate is securely held to the Master Plate, that nothing is trapped between their surfaces, and that there is no air trapped in the unlock (U) air port. |
8. Maintenance

ATTENTION: The cleanliness of the work environment strongly influences the trouble-free operation of the changer. The dirtier the environment, the greater the need for protection against debris. Protection of the entire EOAT, the Master, the Tool and all of the modules may be necessary. Protective measures include the following: 1) placement of Tools Stands away from debris generators, 2) covers incorporated into the Tool Stands, guards, deflectors, air curtains, and similar devices built into the EOAT and the Tool Stand (see Section 5.2—Tool Stands).

8.1 General

Under normal conditions, no special maintenance is necessary, however it is recommended that periodic inspections be performed to assure long-lasting performance and to assure that unexpected damage has not occurred.

The following items should be visually inspected at regular intervals:

- Ball bearings
- Bearing race
- Electrical contacts and modules
- Rubber bushings
- Alignment Pins

Spare parts are available from ATI. Please call for recommendations.

CAUTION: Locking mechanism components are subject to corrosion from water. If these components get wet, they must be dried and regreased immediately. In wet or humid environments, inspect components and regrease weekly.

8.2 Lubrication

8.2.1 External

The Quick-Change is factory-lubricated. For many applications this lubrication is sufficient for the life of the product. In some high-cycle applications or applications subject to moisture, the Tool Changer locking mechanism wear and oxidation can be reduced by applying a thin film of anti-seize compound (molybdenum disulfide grease) to the locking balls, cam, and bearing race at periodic intervals (e.g., every 250,000 cycles).

In some extremely dirty applications, the locking balls and cam can pick up grit and debris if grease is present. In these cases, it is recommended that the locking mechanism be covered and/or moved to a less-dirty location when a Tool Plate is not locked in place. Also, the elimination of grease is a possible solution in these cases.

8.2.2 Internal

The internal piston and O-ring do not need lubrication unless the unit is disassembled. In this case, a Teflon-based lubricant such as Magnalube® is recommended.

8.3 Alignment Pins

Alignment pins are the tapered pins located on the face of the Master Plate that guide the Master Plate and Tool Plate together during the locking process. In heavy-duty applications, alignment (locating) pins (See Section 9—Drawings) may need to be replaced due to wear. When replacing alignment pins always use original ATI parts.
Large QC models such as the QC-100, QC-150, and QC-151 use front-replaceable screw-type alignment pins. Use Loctite 242® on alignment pin threads and tighten to 60 lb-in of torque using a torque wrench. Be careful not to over-tighten alignment pins.

## 8.4 Rubber Bushings

If one or more pneumatic pass-through rubber bushings should become cut or damaged in such a way that the seal when coupled is hindered, the bushing(s) require replacement. Follow these steps for field removal and installation of the rubber bushings.

For models with small ports (1/8 and M5):

- Remove damaged rubber bushing by grasping with a pair of needle-nosed pliers and pulling the bushing out of the body.
- Dip new bushing in water to aid in installation.
- Insert the beveled (chamfered) end of the rubber bushing into the bore, leaving ribbed end of the bushing facing outward.
- 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.

For larger models with 3/8” ports, the rubber bushings require a brass sleeve to retain the bushings in the body.

1. Remove damaged rubber bushing by grasping with a pair of needle-nosed pliers and pulling the bushing out of the body.
2. Upon removal of the rubber bushings, remove the brass sleeve from the damaged bushing.
3. Install the rubber bushings as previously described in steps 2–4 for the smaller ports.
4. Insert the beveled end of the brass sleeve into the rubber bushing.
5. Using one end of a 10mm Allen wrench, press the brass sleeve into the rubber bushing until it contacts the body. Press the sleeve only until solid contact is felt and stop.
6. Do not use excessive force when pressing in the brass sleeve; too much force can damage the body.
7. Inspect the bore and remove any rubber slivers that may have resulted from installation of the brass sleeve.

### CAUTION: For QC-21 models, the rubber bushings must be installed with Loctite 454® or similar adhesive (super-glue). A thin film of adhesive should be applied around the diameter of the counter bore in the body prior to installation; do not apply the adhesive to the bushing itself. The dry rubber bushing should then be installed by hand or utilizing soft-faced mallet, if necessary, as described in steps 3 and 4.

For larger models with 3/8” ports, the rubber bushings require a brass sleeve to retain the bushings in the body.

1. Remove damaged rubber bushing by grasping with a pair of needle-nosed pliers and pulling the bushing out of the body.
2. Upon removal of the rubber bushings, remove the brass sleeve from the damaged bushing.
3. Install the rubber bushings as previously described in steps 2–4 for the smaller ports.
4. Insert the beveled end of the brass sleeve into the rubber bushing.
5. Using one end of a 10mm Allen wrench, press the brass sleeve into the rubber bushing until it contacts the body. Press the sleeve only until solid contact is felt and stop.
6. Do not use excessive force when pressing in the brass sleeve; too much force can damage the body.
7. Inspect the bore and remove any rubber slivers that may have resulted from installation of the brass sleeve.

## 8.5 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 table below depending upon the application.

Detailed assembly drawings are provided in Section 9—Drawings of this manual.
ATTENTION: All Tool Changers are initially lubricated using MobilGrease® XHP222 Special grease. The end-user must apply additional lubricant to the locking mechanism components and alignment pins prior to start of service (See Section 8.2). 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.

<table>
<thead>
<tr>
<th>Application(s)</th>
<th>Tool Change Frequency</th>
<th>Inspection Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Usage</td>
<td>&gt; 1 per minute</td>
<td>Weekly</td>
</tr>
<tr>
<td>Material Handling</td>
<td>&lt; 1 per minute</td>
<td>Monthly</td>
</tr>
<tr>
<td>Docking Station</td>
<td>All</td>
<td>Weekly</td>
</tr>
<tr>
<td>Welding/Servo/Deburring, Foundry Operations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Dirty Environments)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Checklist**

**Balls/Alignment Pins/Holes/Bearing Race**
- Inspect for lubrication and wear. A NLGI #2, lithium-based grease with molybdenum disulfide additive is suggested for locking mechanism and alignment pin lubrication. Over time, lubricants can become contaminated with process debris. Therefore, it is recommended to thoroughly clean the existing grease and replace with new as needed. See Section 8.2—Lubrication.
- 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.
- Wear on the balls/bearing race could be an indication of excessive loading.

**Mounting Hardware/Interface Connections**
- Inspect for proper torque and interference or wear, abrasions, cuts of hoses, and electrical cables. Tighten and correct as required.

**O-rings/Rubber Bushings**
- Inspect for wear, abrasion, and cuts.
- Exposed o-rings and rubber bushings may be subject to damage during normal operation. Replace damaged o-rings and rubber bushings as needed.

**Electrical Contacts**
- Inspect for wear and abrasion.
- Exposed contacts may be subject to damage during normal operation.
- Clear debris from the area of the contacts using compressed air.
- Do not directly clean contacts as abrasion may occur and the performance of the contact may be compromised.
8.6 Cleaning, Lubrication, Adjustment and Replacement

8.6.1 Cleaning and Lubrication of the Locking Mechanism and Alignment Pins (Master Plate)

1. The locking mechanism must be in the Unlock state before cleaning.
2. Use a clean rag to thoroughly remove the existing lubricant and debris from the balls, the male coupling, the cam, and the alignment pins.

3. Check each ball to make sure it moves freely in the male coupling. Additional cleaning may be necessary to free up any balls that are sticking in place.
4. Apply a liberal coating of lubricant to the balls, the male coupling (inside and out), and the alignment pins.

(QC-210 shown)

8.6.2 Cleaning the Locking Mechanism and Alignment Pin Bushings (Tool Plate)

1. Use a clean rag to thoroughly remove the any lubricant and debris from the bearing race and the bushings.
2. No re-lubrication is necessary on the Tool Plate components.
9. Drawings

9.1 Typical QC Exploded View
9.2 Typical QC-5 Exploded View
9.3 QC-11 Hollow-Wrist Mount with A15 Module

**Master Side**

- 9 x (A15 M (Optional))
- 9 / (2 x A15 M)
- 9 / (2 x A15 M)
- 9 / (2 x A15 M)

**Tool Side**

- Tool Side
- 9 / (2 x A15 M)
- 9 / (2 x A15 M)
- 9 / (2 x A15 M)

**Dimensions**

- 31.6
- 23.8
- 20.6
- 12.5
- 10.0
- 7.5

**Notes**

- Design is subject to change.
- Mounting hardware included on Master Side.
- Not for direct mount to Robotic Arm.
- Dimensions indicate the position for pneumatic flange.
- Complement will be delivered with PIP 3.
- Tool Side Assembly by M10, 1 Tap, 4.45

**Table**

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>QTY</th>
<th>PART NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>9920-A11HM050G6-004-100</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>9920-A111T000-S00</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>9920-A15</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>9920-A15A</td>
</tr>
</tbody>
</table>

**Vendor P/N**

- 9920-A11HM050G6-004-100
- 9920-A111T000-S00
- 9920-A15
- 9920-A15A

**Contact Information**

Pinnacle Park • 1031 Goodworth Drive • Apex, NC 27539 • Tel: 919.772.0115 • Fax: 919.772.8259 • www.ati-ia.com • Email: info@ati-ia.com
**Quick-Change Installation and Operation Manual**

**Document: 9610-20-1000-15**

---

**Air Line Connection Diagram**

- **Port 1** (1/8" Tube)
- **Port 2** (1/8" Tube)
- **Port 3** (1/8" Tube)
- **Port #2 (1/8" Tube)**
- **Port #5 (1/8" Tube)**
- **Port #6 (1/8" Tube)**
- **Port #4 (1/8" Tube)**

---

**Master Assy Top View**

- **Optional Unflect Status Prox Sensor**
- **Module Mounting Flange**

---

**Exploded View**

- **GC-11 Tool Side**
- **A15 Tool Electrical Module** (Optional)
- **GC-11 Hollow Shaft**
- **GC-11 Hollow Shaft Master / Adapter Ring**

---

**Flush-Mount Fitting**

- **GC-11 Upper Flange**
- **GC-11 Lower Flange**

---

**References**

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

---

28
9.4 QC-20 Hollow-Wrist Mount with KF19 Module

Quick-Change Installation and Operation Manual

Document: 9610-20-1000-15

Pinnacle Park • 1031 Goodworth Drive • Apex, NC 27539 • Tel: 919.772.0115 • Fax: 919.772.8259 • www.ati-ia.com • Email: info@ati-ia.com
9.5 QC-21 Hollow-Wrist Mount with KF19 Module

NOTES:
1. Mounting hardware included on Master Side.
2. Tooling Stud QC-21 is standard and provided for direct mount to Hollow Wrist Robots.
3.德语转成英文
4.德语转成英文
5.德语转成英文
6.德语转成英文

ITEM NO.  | PART NUMBER  | DESCRIPTION |
-----------|-------------|-------------|
1          | 9100-0100-000 | QC-21 Hollow Wrist Mount with KF19 Module |
2          | 9100-0100-000 | QC-21 Hollow Wrist Mount with KF19 Module |
3          | 9100-0100-000 | QC-21 Hollow Wrist Mount with KF19 Module |

Pinnacle Park • 1031 Goodworth Drive • Apex, NC 27539 • Tel: 919.772.0115 • Fax: 919.772.8259 • www.ati-ia.com • Email: info@ati-ia.com
9.6 QC-27 Base Tool Changer, BSPP, with IP-6160

NOTES:
1. Mounting Hardware Included on Master Side.
2. Drawing shows a master side assembly with interface plate for direct mount to Fanuc M10iA and M20iA Hollow Wrist Robots. Other versions available upon request.
3. Tool side fittings not supplied.
QC-27 Tool Assembly
10. Terms and Conditions

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.

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

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

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

In the course of supplying products and services hereunder, ATI may provide or disclose to Purchaser confidential and proprietary information of ATI relating to the design, operation or other aspects of ATI’s products. As between ATI and Purchaser, ownership of such information, including without limitation any computer software provided to Purchaser by ATI, shall remain in ATI and such information is licensed to Purchaser only for Purchaser’s use in operating the products supplied by ATI hereunder in Purchaser’s internal business operations.

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

Purchaser will not be liable hereunder with respect to disclosure or use of information which: (a) is in the public domain when received from ATI; (b) is thereafter published or otherwise enters the public domain through no fault of Purchaser; (c) is in Purchaser’s possession prior to receipt from ATI; (d) is lawfully obtained by Purchaser from a third party entitled to disclose it; or (f) is required to be disclosed by judicial order or other governmental authority, provided that, with respect to such required disclosures, Purchaser gives ATI prior notice thereof and uses all legally available means to maintain the confidentiality of such information.