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B. Base Tool Changer

QC-50 Series—Robotic Tool Changer

1. Product Overview

ATI Tool Changers enhance the versatility 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 picks up the customer tooling, a pneumatically-driven locking mechanism couples the (2) plates. The patented, fail-safe locking mechanism utilizes a multi-tapered cam with ball locking technology to ensure the Tool Changer does not uncouple if air pressure falls below 60 psi (4.1 bar) during operation.

The robot can be programmed to select the desired customer tooling by coupling the Master plate to the Tool plate. Electricity, fluid, and other forces of energy transfer to the customer tooling through optional modules that are attached to the Master and Tool plates. Refer to the ATI website for compatible modules or contact an ATI sales representative for more details.

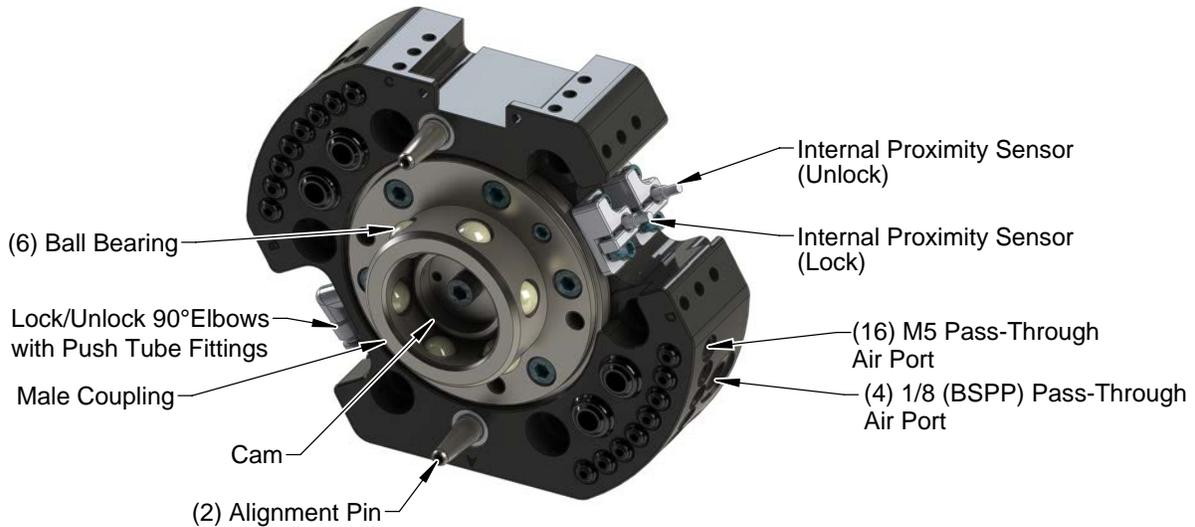
For the most current product information and specifications on the QC-50 Series of Tool Changers, refer to the following ATI web page: [QC-50 Series](#).

1.1 Master Plate Assembly

The Master plate assembly includes an anodized aluminum body, a hardened stainless-steel locking mechanism, and hardened steel alignment pins (see [Figure 1.1](#)). The Master plate has (4) flats for mounting optional modules with a J16 pattern. Flat “C” has a mounting pattern for a K series module. The locking mechanism consists of a cam, a male coupling, and chrome-steel ball bearings. A 100 mm BC mounting pattern is machined into the Master plate for mounting to a robot arm or a interface plate. Refer to [Section 8—Drawings](#) for mounting details.

(2) 90° elbows with push tube fittings are included to supply air pressure for coupling and uncoupling the Tool Changer. The Master plate assembly is equipped with (16) M5 pass-through air ports and (4) G 1/8 (BSPP) pass-through air ports.

Figure 1.1— Master Plate Assembly (9120-050AM-0-0-0-0-SB-E Shown)



Tapered pins, located on the Master plate, mate with bushings in the Tool plate 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.

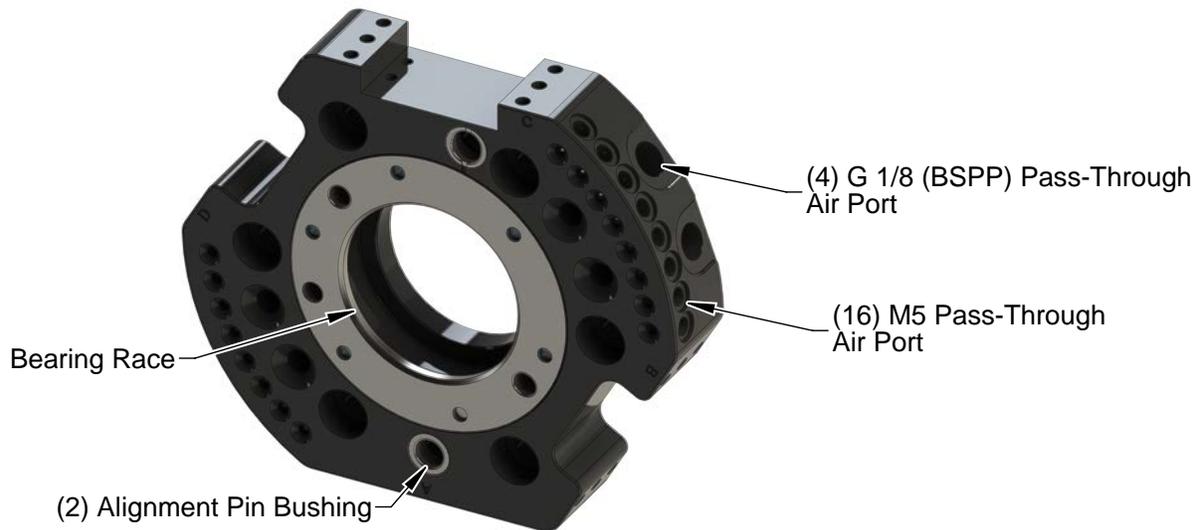
Proximity sensors are designed into the body of the Master plate to detect Lock and Unlock positions of the locking mechanism. The sensors provide “lock” and “unlock” position signals to the customer’s process controller. The sensors can be ordered separately.

1.2 Tool Plate Assembly

The Tool plate assembly includes an anodized aluminum body and a hardened stainless-steel bearing race. The Tool plate has (4) flats for mounting optional modules with a J16 pattern. Flat “C” also has a mounting pattern for a K series module. The Tool plate body also includes a 100 mm BC mounting pattern for direct customer tool mounting. Refer to [Section 8—Drawings](#) for mounting details. Contact ATI for specification.

The Tool plate assembly is equipped with (16) M5 pass through air ports and (4) G 1/8 (BSPP) pass-through air ports.

Figure 1.2—Tool Plate Assembly



1.3 Optional Modules

There are (4) flats available on both the Master and Tool for mounting optional modules with a J16 pattern. The J16 mounting is a M4X0.7 thread on an 18 mm x 50 mm rectangular pattern. Flat “C” has a mounting pattern for a K series module to support various utility pass through; such as signal, fluid/air, electric, etc.

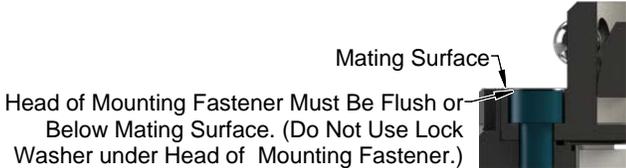
For assistance in choosing the right modules for your particular application, visit the following ATI website [QC-50 Series](#), or contact an ATI sales representative.

2. Installation

All fasteners used to mount the Tool Changer to the robot and to customer's tooling should be tightened to a torque value as indicated in [Table 2.1](#).



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.



Head of Mounting Fastener Must Be Flush or Below Mating Surface. (Do Not Use Lock Washer under Head of Mounting Fastener.)



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 specific safety practices and policies. Injury or equipment damage can occur with the Tool not placed and energized circuits on. Place the Tool in the tool stand, turn off and discharge all energized circuits, purge all pressurized connections, and verify all circuits are de-energized before performing maintenance or repair(s) on the Tool Changer or modules.



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

Table 2.1—Fastener Size, Class, and Torque Specifications			
Mounting conditions	Fastener Size & Property Class	Recommended Torque	Thread Locker
Master plate to Interface plate (6061-T6 aluminum) Minimum thread engagement of 15 mm (0.59") [1.5X fastener Ø]. Confirm available engagement with Robot Manufacturer	M8-1.25 Class 12.9	27 N-m (20 ft-lbs)	Pre-applied Adhesive or Loctite 242
Tool plate (6061-T6 aluminum) to Tool Interface plate (6061-T6 aluminum) Minimum thread engagement of 0.59" (12 mm) [1.5X fastener Ø].	M8-1.25 Class 12.9	27 N-m (20 ft-lbs)	Pre-applied Adhesive or Loctite 242
Optional Module or adapter plate to Master or Tool plate, Supplied Fasteners	M3 x 0.5 Class 12.9		Pre-applied Adhesive or Loctite 222
	Socket head cap	10 in-lbs (1.13 Nm)	
	Socket flat head cap	8 in-lbs (0.9 Nm)	
	M4 x 0.7 Class 12.9		
	Socket head cap	15 in-lbs (1.69 Nm)	
	Socket flat head cap	10 in-lbs (1.13 Nm)	

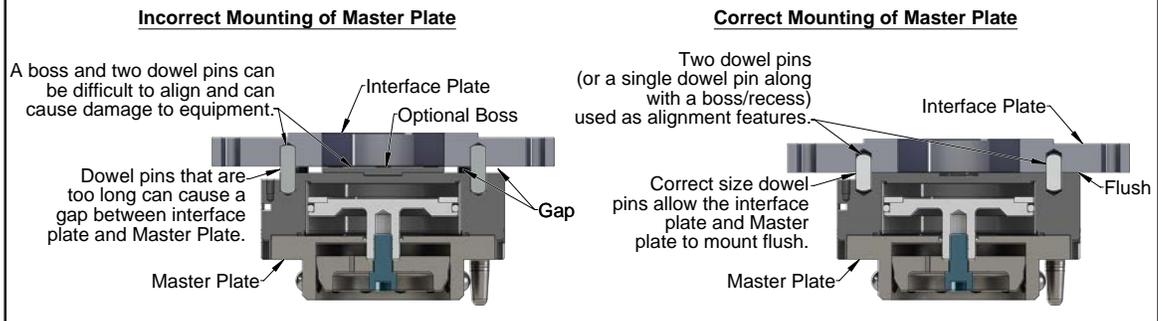
2.1 Master Interface

The Master plate is typically attached to the robot arm. An interface plate can adapt the Master plate to a specific robot arm. Alignment features (dowel holes and bosses) accurately position and bolt holes secure the Master plate to the robot arm or an interface plate. Custom interface plates are available from ATI upon request. (refer to the drawings for technical information on mounting features.)



CAUTION: Do not use more than (2) alignment features when securing a Master plate to an interface plate. Using more than (2) alignment features can cause damage to equipment. Use either (2) dowel pins or a single dowel pin, along with a boss/recess feature to align the Master plate with the interface plate.

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



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

- The interface plate should include bolt holes for mounting and either (2) dowel pins or a dowel pin and a boss for accurate positioning on the robot and Master plate. The dowel and boss features prevent unwanted rotation. Refer to the robot manual for robot mounting features.
- The thickness of the interface plate must be sufficient to provide the necessary thread engagement for the mounting bolts.
- Dowel pins must not extend out from the surface of the interface plate farther than the depth of the dowel holes in the Master plate.
- If a boss is used on the Master plate, a recess of proper depth and diameter must be machined into the interface plate to correspond with the boss on the Master plate.
- Mounting bolts that are too long can create a gap between the interface plate and the Master plate, which can damage equipment.
- The interface plate must provide rigid mounting to the Master plate.
- The interface plate design must account for clearances required for Tool Changer module attachments and accessories.

2.2 Master Plate Installation

Tools required: 6 mm hex key, torque wrench

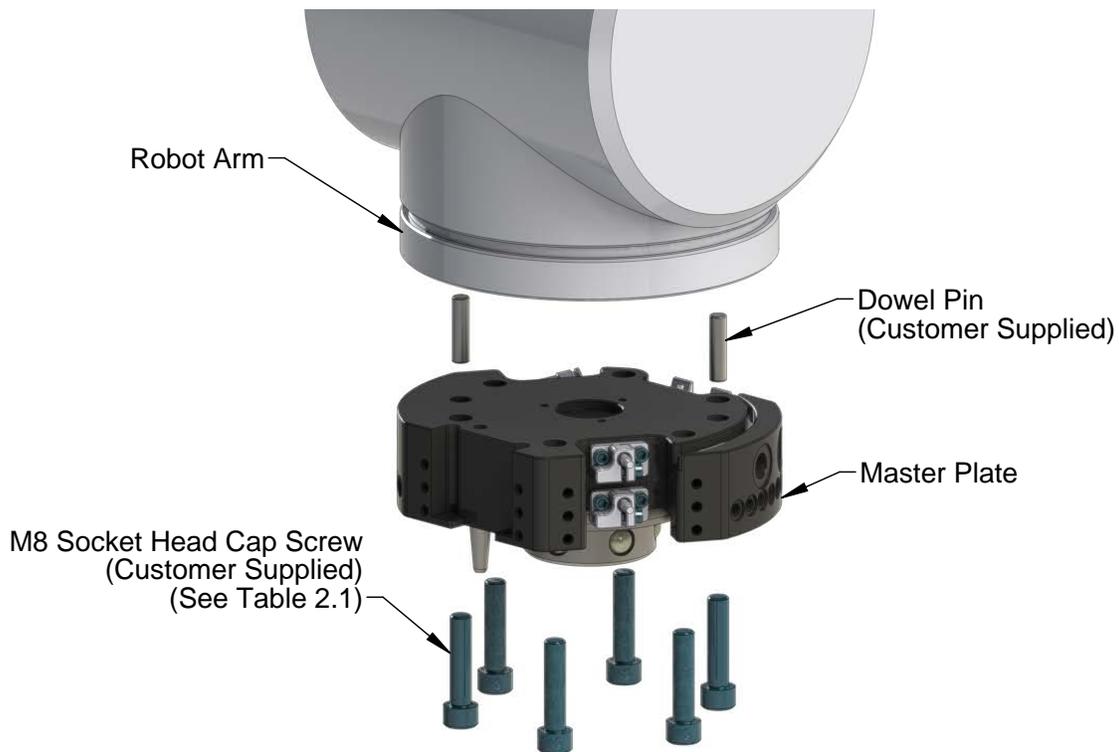
Supplies required: Clean rag, Loctite® 242

1. Clean the mounting surfaces.
2. Align the dowel pins to the corresponding holes in the Master plate. Secure the Master plate to the robot arm or interface plate with customer supplied (6) M8 socket head cap screws using a 6 mm hex key. If not pre-applied, apply Loctite 242 to threads (see [Table 2.1](#) for proper fasteners and torque).

NOTICE: If an ATI interface plate is used, fasteners to mount the Master plate are supplied with the interface plate.

3. Connect utilities to the appropriate module and Master plate connections.
4. Safely resume normal operation.

Figure 2.1—Master Plate Installation



2.3 Master Plate Removal

Tools required: 6 mm hex key

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits; for example, electrical, air, water, etc.
4. Disconnect all utilities.
5. While supporting the Master plate, remove the customer supplied (6) M8 socket head cap screws that connect the Master plate to the robot arm or interface plate using a 6 mm hex key.
6. Remove the Master plate.

2.4 Tool Interface

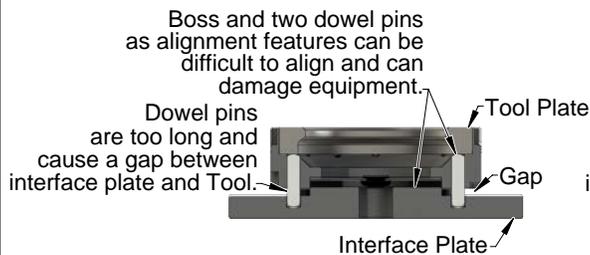
The Tool plate is attached to the customer's tooling. An interface plate can adapt the Tool plate to customer tooling. Alignment features (dowel holes and a recess) accurately position and bolt holes to secure the Tool plate to customer tooling. Custom interface plates can be supplied by ATI (refer to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



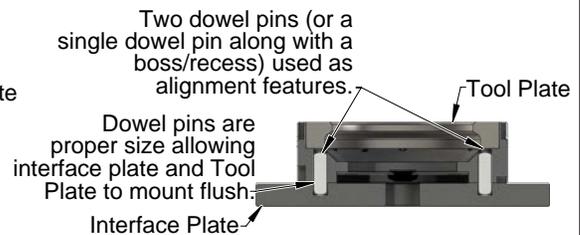
CAUTION: Do not use more than (2) alignment features when securing a Tool plate to an interface plate. Using more than (2) alignment features can cause damage to equipment. Use either (2) dowel pins or a single dowel pin, along with a boss/recess feature to align the Tool plate with the interface plate.

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

Incorrect Mounting of Tool Plate



Correct Mounting of Tool Plate



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 (2) 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.

2.5 Tool Plate Installation

Tools required: 6 mm hex key, torque wrench

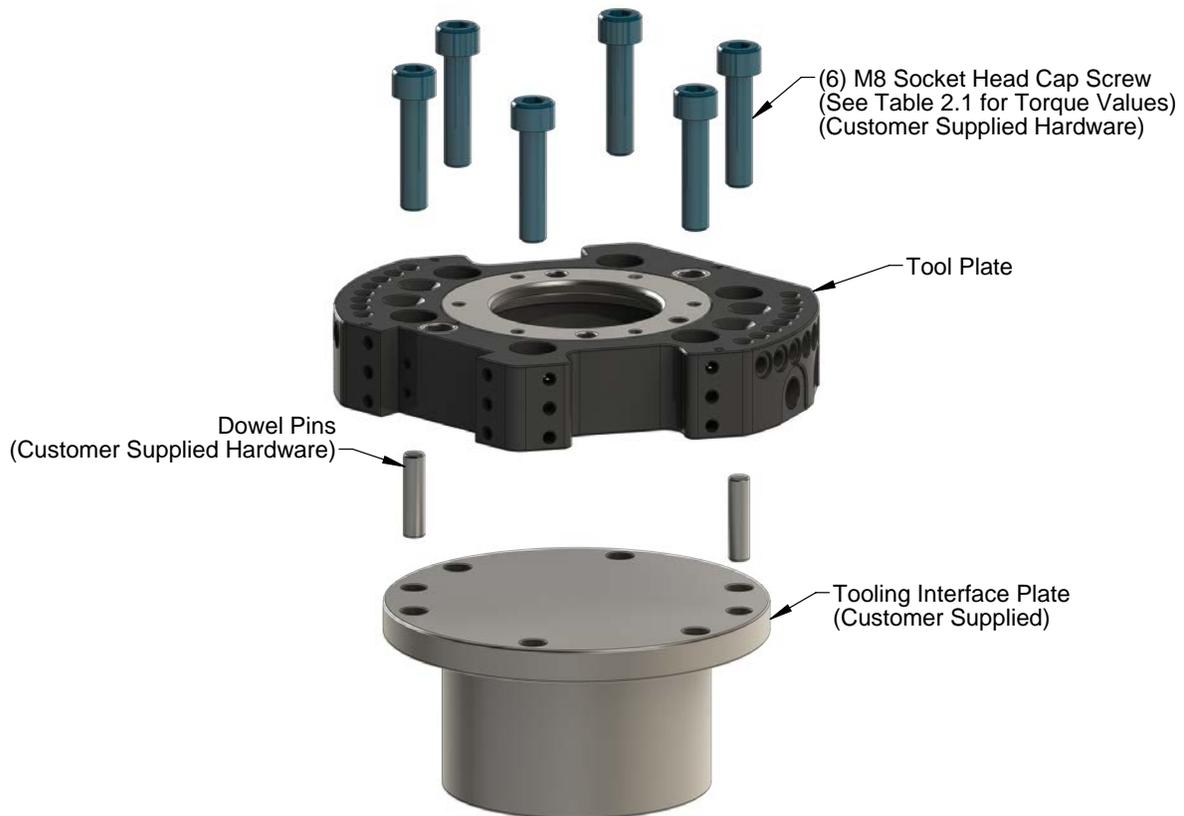
Supplies required: Clean rag, Loctite 242

1. Clean the mounting surfaces.
2. Align the dowel pins to the corresponding holes in the Tool plate. Secure the Tool plate to the tool interface plate or customer tooling with customer supplied customer supplied (6) M8 socket head cap screws using a 6 mm hex key. If not pre-applied, apply Loctite 242 to threads (see [Table 2.1](#)).

NOTICE: If an ATI Interface Plate is used, fasteners to mount the Tool plate are supplied with the Interface Plate.

3. Connect utilities to the appropriate module and Tool plate connections.
4. Safely resume normal operation.

Figure 2.2—Tool Plate Installation



2.6 Tool Plate Removal

Tools required: 6 mm hex key

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits; for example, electrical, air, water, etc.
4. Disconnect all utilities.
5. Remove the customer supplied (6) M8 socket head cap screws connecting the Tool plate to the tooling or tool interface plate using a 6 mm hex key.
6. Remove the Tool plate.

2.7 Optional Module with J16 Pattern Installation

Tools required: 3 mm hex key, torque wrench

Supplies required: Clean rag, Loctite 222

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits; for example, electrical, air, water, etc. If required, fully disconnect these circuits.
4. Clean the mounting surfaces.
5. Align optional module on the Master or Tool plate as shown in [Figure 2.3](#).
6. If not using fasteners with pre-applied adhesive, apply Loctite 222 to (4) M4 socket head cap screws.
7. Secure the module with (4) M4 mounting fasteners using a 3 mm hex key. Refer to [Table 3.1](#) for proper torque for your specific mounting fasteners.
8. Remove all protective caps, plugs, tape, etc from the module prior to operation.
9. Safely resume normal operation.

Figure 2.3—Optional Module Installation



2.8 Optional Module with J16 Pattern Removal

Tools required: 3 mm hex key

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

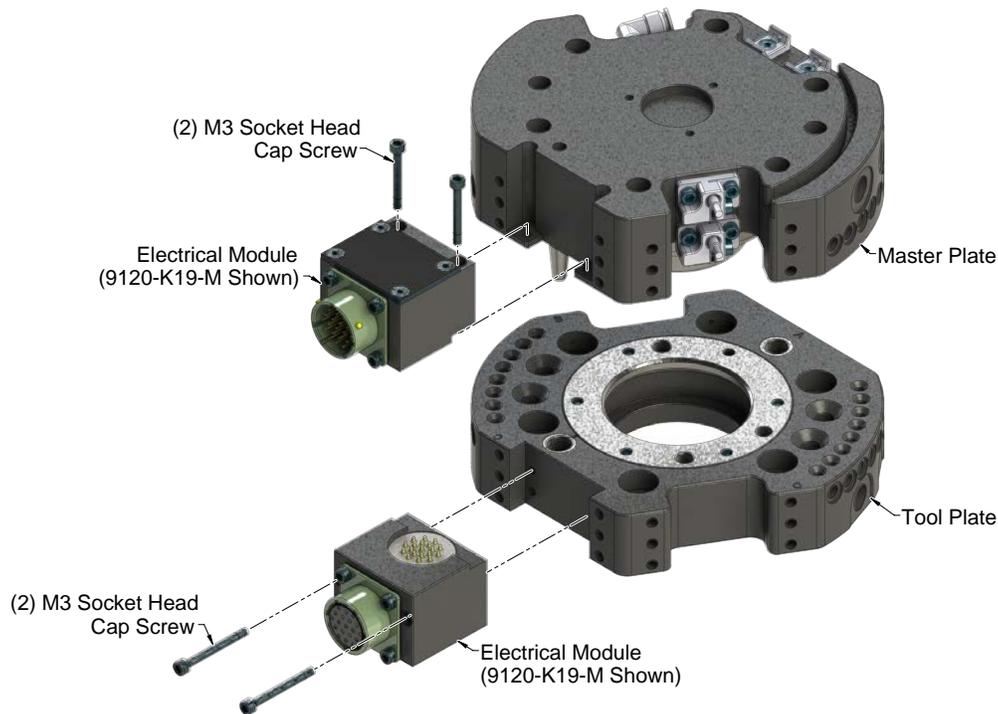
2.9 Optional K Series Module Installation

Tools required: 2.5 mm hex key, torque wrench

Supplies required: Clean rag, Loctite 222

1. If the Tool Changer is in service, 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. If required, fully disconnect these circuits.
4. Clean the mounting surfaces of the Tool plate, Master plate, and modules.
5. Align the optional module on flat “C” of Master or Tool plate assembly.
6. If not using fasteners with pre-applied adhesive, apply Loctite 222 to M3 mounting fasteners. Secure module with (2) M3 mounting fasteners using a 2.5 mm hex key. Refer to [Table 2.1](#) for proper torque for your specific mounting fasteners. Note: To install the module on the Master, the Master plate might have to be removed. Refer to [Section 2.3—Master Plate Removal](#).
7. Remove all protective caps, plugs, tape, etc from the module prior to operation.
8. Safely resume normal operation.

Figure 2.4—Optional Module Installation



2.10 Optional K Series Module Removal

Tools required: 2.5 mm hex key

1. If the Tool Changer is in service, 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. If required, fully disconnect these circuits.
4. Remove the (2) M3 socket head cap screws using a 2.5 mm hex key. Note: To remove the module on the Master, the Master plate might have to be removed. Refer to [Section 2.3—Master Plate Removal](#).
5. Remove the module from the Master and/or Tool plate.

2.11 Pneumatic Connections and Valve Requirements

The air supply used for coupling and uncoupling the Tool Changer should be clean, dry, and non-lubricated. A supply pressure in the range of 60 to 100 psi is acceptable for operation of the locking mechanism, with a setting of 80 psi suggested. The air should be filtered 40 micron or better.



CAUTION: Do not use the Tool Changer in a fail-safe condition. Do not transport the Tool Changer in a fail-safe condition. Possible damage to the locking mechanism could occur. Re-establish air pressure to Tool Changer before returning to normal operations.

2.11.1 Valve Requirements and Connections for the Locking Mechanism

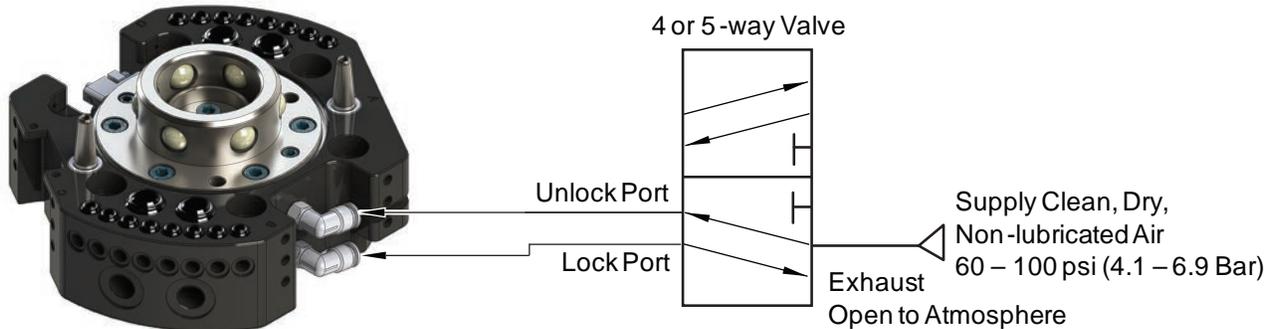
NOTICE: No valve is required when using a valve adapter module. The valve adapter module has an integrated solenoid valve and only requires the customer to supply a single air source to the valve adapter.

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



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

Figure 2.5— Lock and Unlock Pneumatic Connections



2.12 Electrical Connections

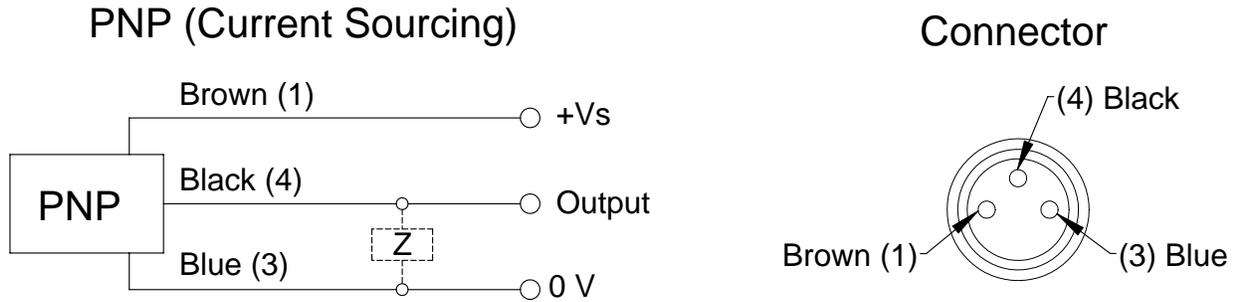
The Tool Changer is available with integrated lock/unlock sensors. If sensors are not required, plugs are provided to seal the locking mechanism.

2.12.1 PNP Type Lock and Unlock Sensors

These sensors are used on 9120-050AM-0-0-0-0-SB-E and 9120-050AM-0-0-0-0-SB1.

Table 2.2—PNP (Current Sourcing)	
Description	Value
Voltage Supply Range	10-30 VDC
Output Circuit	PNP make function (NO)

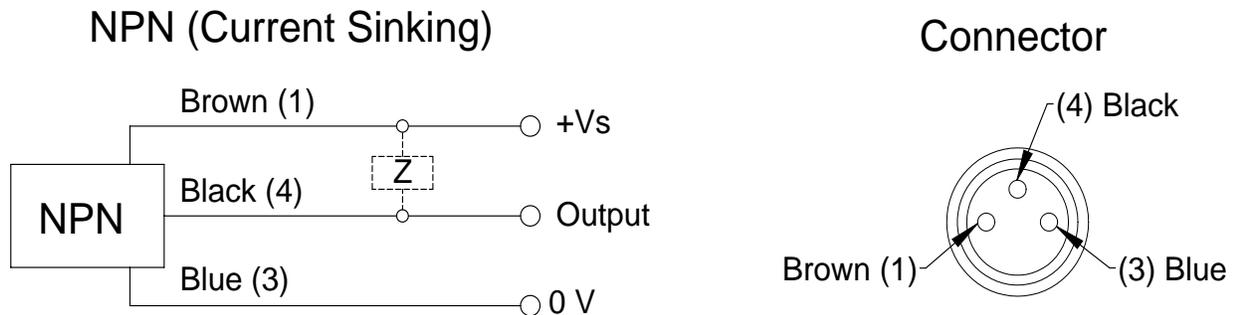
Figure 2.6—PNP Type Lock, Unlock and RTL Sensors



2.12.2 NPN Type Lock and Unlock Sensors

Table 2.3—NPN (Current Sinking)	
Description	Value
Voltage Supply Range	10-30 VDC
Output Circuit	NPN make function (NO)

Figure 2.7—NPN Type Lock, Unlock and RTL Sensors



3. Operation

The Master plate locking mechanism is pneumatically driven to couple and uncouple with the Tool plate bearing race.



CAUTION: Operation of the Tool Changer is dependent on maintaining an air pressure of 60 to 100 psi (4.1 - 6.9 bar). Damage to the locking mechanism could occur. Robot motion must be halted if the air supply pressure drops below 60 psi (4.1 bar).

NOTICE: All Tool Changers are lubricated prior to shipment. The customer must apply additional lubricant to the locking mechanism components and alignment pins prior to operation. Tubes of lubricant for this purpose are shipped with every Tool Changer. Standard Tool Changers require MobilGrease XHP222 Special (a NLGI #2 lithium complex grease with molybdenum disulfide). For custom applications, such as food grade or surgical applications, specialized lubricants might be required.

Coupling should occur with the Master plate in the No-Touch™ locking zone. As coupling occurs, the Master plate should pull the Tool plate into the locked position.

Program the robot to minimize misalignment during coupling and uncoupling. Greater offsets can be accommodated by the Master and Tool plates but will increase wear. Misalignments can be caused by improper tool stand design. Refer to Tool Storage Considerations section.

See [Figure 3.1](#) and [Table 3.1](#) for recommended maximum allowable offsets prior to coupling. In some cases, greater offsets than shown in [Table 3.1](#) can be accommodated by the Master and Tool plates but will increase wear.

Figure 3.1— Offset Definitions

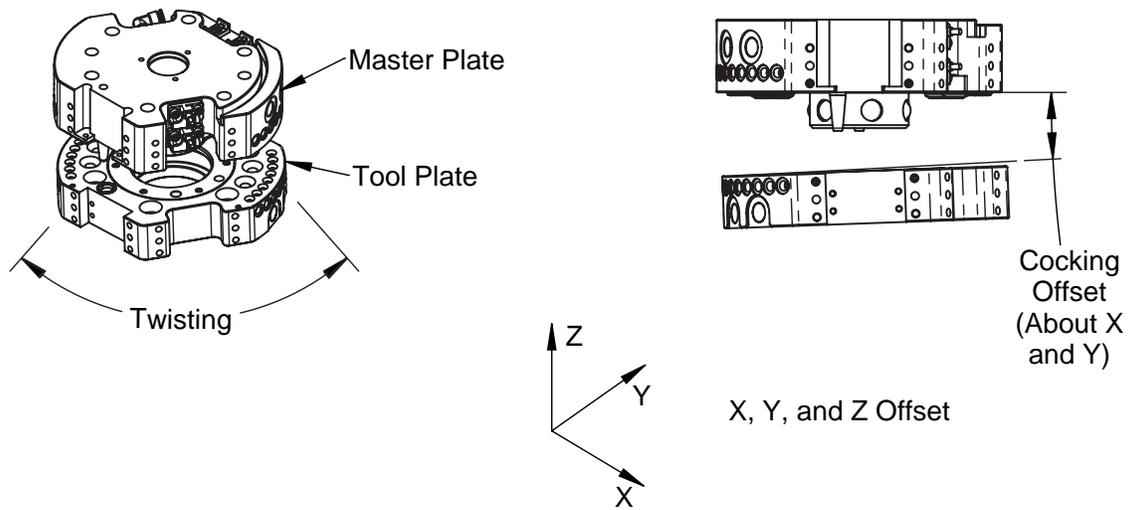


Table 3.1—Maximum Recommended Offsets Prior to Coupling

Model	No-Touch Zone Z Offset (Max) ¹	X and Y Offset (Max) ²	Cocking Offset (Max)	Twisting Offset (Max)
QC-50	0.1" (2.5 mm)	±0.08" (2 mm)	±1°	±2°

Notes:

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

3.1 Conditions for Coupling

The following conditions should be considered when operating the Tool Changer. For more details about programming the robot, refer to the Operation section of the Control/Signal Module Manual.



CAUTION: Do not attempt to couple the Tool Changer when in locked position. 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. Always unlock the Master prior to coupling to a Tool.

1. Unlock the Tool Changer by removing air pressure from the lock port and supplying air pressure to the unlock port (if equipped, the unlock sensor indicates the Tool Changer is unlocked).

NOTICE: For Tool Changers with a control/signal module and air/valve adapters with a double solenoid valve, turn the Unlatch output ON and turn the Latch output OFF. For Tool Changers with a control/signal module and air/valve adapters with a single solenoid valve, turn the Unlatch output ON. Some control/signal modules prevent the Tool Changer from being unlocked unless the Master and Tool are coupled and nested properly in the tool stand, a manual override procedure is required to unlock the Tool Changer. Refer to your Control/Signal Module Manual for instructions.

2. Position the Master above the Tool and move the Master into ready to lock position. The mating surfaces of the Master and Tool should be parallel and not touching. Make sure that the tapered alignment pins from the Master enter the alignment holes on the Tool. The alignment pins should be relatively concentric with the alignment bushings with no contact between the two.
3. It is recommended that the mating faces of the Master and Tool not be touching but be within the No-Touch distance of each other when coupling to minimize stress and wear on the locking mechanism. The locking mechanism allows the Master to “pull up” the Tool with gaps between the (2) sides.



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

4. The RTL (Ready-To-Lock) sensor and target that are built into the Tool Changer must be positioned within approximately 0.05” (1.5 mm) of each other for the sensors to detect Tool presence. RTL signals are not required to couple the Tool Changer but are recommended as a confirmation of coupling prior to removing the Tool from the tool stand.

NOTICE: At this point, communication is initiated with the ATI Tool and downstream nodes. If equipped, Tool-ID and communications become available. Depending on the type of control/signal module, additional notifications such as RTL, TSRV, TSIV, Tool Present, Unlatch Enabled, and other notifications can provide verification of properly functioning system components.

5. Couple the Tool Changer by releasing the air pressure from the unlock port and supplying air pressure to the lock port. 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).

NOTICE: For Tool Changers with a control/signal module and air/valve adapters with a double solenoid valve, turn the Unlatch output OFF and turn the Latch output ON. For Tool Changers with a control/signal module and air/valve adapters with a single solenoid valve, turn the Unlatch output OFF.

6. A sufficient delay must be programmed between locking valve actuation and robot motion so that the locking process is complete before moving the robot. If equipped with Lock and Unlock sensors, the Lock signal should read “ON” (true) and the Unlock signal should read “OFF” (false).

NOTICE: If the locking mechanism has been actuated and both the Lock and Unlock signals are OFF, then a “missed tool” condition has occurred (for example, the Tool is not in the stand or is not positioned properly). **In this case an error should be generated and the robot program halted.** The situation requires manual inspection to determine the cause of the problem. Some configurations will require a manual unlock of the Master plate before attempting coupling, refer to the Control/Signal Module Manual for instructions.

NOTICE: The locking mechanism must be in the unlock state before another attempt is made to couple or damage could occur to the robot and/or the Tool Changer.

3.2 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.

3.3 Conditions for Uncoupling

Refer to your Air/Valve Adapter and/or Control/Signal Module Manual's Operation section for operation during coupling/uncoupling.

1. Move the robot to position the Tool plate in the tool stand. The position for coupling and uncoupling are the same.

NOTICE: Depending on the type of control/signal module, additional notifications such as TSRV, TSIV, and other notifications can provide verification of properly functioning system components.

2. Unlock the Tool Changer by releasing the air pressure from the lock port and supplying air pressure to the unlock port. The Tool Changer locking mechanism moves to the unlocked position and the Tool plate releases from the Master plate. (If equipped, the unlock sensor indicates the Tool Changer is unlocked).

NOTICE: For Tool Changers with a control/signal module and air/valve adapters with a double solenoid valve, turn the Unlatch output ON and turn the Latch output OFF. For Tool Changers with a control/signal module and air/valve adapters with a single solenoid valve, turn the Unlatch output ON.



CAUTION: This Tool Changer may be equipped with a tool stand Interlock (TSI) feature that physically breaks the Unlatch solenoid circuit. Proper use of the TSI prevents unwanted Unlock software commands from being recognized until the circuit is made. Make sure the Tool Changer is positioned properly to trip actuate the TSI switch when the Tool is in the tool stand.

3. A sufficient delay must be programmed between unlocking valve actuation and robot motion so that the unlocking process is complete before moving the robot. If equipped with lock and unlock sensors, the Unlock signal should read "on" (true) and the Lock signal should read "off" (false). **Any other condition indicates a problem and the robot program should be halted.** Once the Lock and Unlock signals in the proper state, the Master plate may be moved away from the Tool plate in the axial direction.

The robot and Master plate can now proceed to another Tool plate for coupling and subsequent operations.

3.4 Tool Identification

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

3.5 Tool Storage Considerations

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

Tool plates with customer tooling attached may be stored in a tool stand. ATI provides compatible tool stands designed for durability, longevity, and maximum adaptability to fit most customers' applications. The ATI TSM (Tool Stand Medium) system is compatible with ATI Tool Changer sizes QC-20 to QC-110. The TSM systems can be equipped with horizontal modules, clamp modules, and different types of tool sensing. Visit the ATI Web Site <http://www.ati-ia.com/products/toolchanger/toolstand/medium/MediumStand.aspx> for products available, or contact ATI for assistance.

If the customer is supplying the tool stand, it must provide a fixed, repeatable, level, and stable position for tool pick-up and drop-off. The tool stand must support the weight of the Tool Changer Tool plate, tool interface plate, optional modules, cables, hoses, and customer tooling without allowing deflection in excess of the offsets specified.

Ideally, the tool should be hanging vertically in the tool stand so that gravity assists to uncouple the Tool plate from the Master plate during unlocking. It is possible to design tool stands that hold tools in the horizontal position, but the necessary compliance must be provided during coupling and uncoupling. In general, "horizontal-position" tool stands cause more wear on the locking mechanism and locating features of the Tool and tool stand.

A variety of methods may be used to position the Tool in the tool stand. A common method is to use tapered alignment pins and bushings. Robot programming and positional repeatability are vital in tool pick-up and drop-off.

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

Proximity sensors should be positioned so that the sensing face is vertical to prevent metal shavings, weld spatter, or other debris from falling on the sensor and creating false readings.

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

4. Maintenance



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

NOTICE: The cleanliness of the work environment strongly influences the trouble free operation of the Tool Changer. The dirtier the environment, the greater the need for protection against debris. Protection of the entire EOAT, the Master, the Tool and all of the modules may be necessary. Protective measures include the following:

Placement of the tool stands away from the debris generators.

- Covers incorporated into the tool stands.
- Guards, deflectors, air curtains, and similar devices built into the EOAT and the tool stand.

4.1 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. Detailed assembly drawings are provided in *Section 8—Drawings* of this manual. Refer to module sections for detailed preventive maintenance steps for all utility modules.

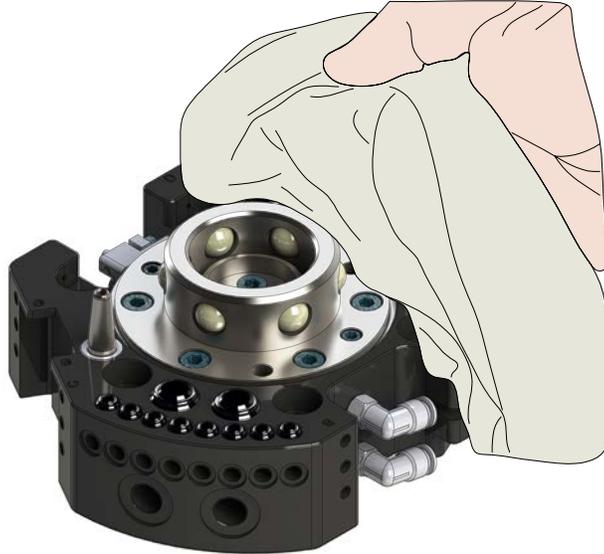
Table 4.1—Maintenance		
Application(s)	Tool Change Frequency	Inspection Schedule
General Usage Material Handling Docking Station	> 1 per minute	Weekly
	< 1 per minute	Monthly
Welding/Servo/Deburring, Foundry Operations (Dirty Environments)	All	Weekly
Checklist		
Mounting Fasteners		
<input type="checkbox"/> Inspect fasteners for proper torque, interferences, and wear. Tighten and correct as required. Refer to <i>“Table 2.1—Fastener Size, Class, and Torque Specifications”</i> .		
Ball Bearings/Alignment Pins/Bushings/Bearing Race		
<input type="checkbox"/> 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 <i>Section 4.2—Cleaning and Lubrication of the Locking Mechanism and Alignment Pins</i> .		
<input type="checkbox"/> 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.		
<input type="checkbox"/> Inspect for wear on the ball bearings/bearing race, may be an indication of excessive loading.		
Sensors and Cables		
<input type="checkbox"/> Inspect sensor cable connectors for tightness, if loose tighten connections.		
<input type="checkbox"/> Inspect sensor cables for any damage, cuts, and abrasion. Replace as necessary. Refer to <i>Section 5.2.1—Lock and Unlock Sensor Replacement</i> .		
Hoses		
<input type="checkbox"/> Inspect hose connection for tightness and leaks. If leaking or loose secure hose connection.		
<input type="checkbox"/> Inspect hoses for interferences, abrasions, cuts, and leaks. Replace as required.		
Electrical Contacts/Pin Block (Modules)		
<input type="checkbox"/> Inspect for damage, debris, and stuck/burnt pins. Clean pin blocks as required, Refer to <i>Section 4.3—Pin Block Inspection and Cleaning</i> .		
Seals (Modules)		
<input type="checkbox"/> Inspect for wear, abrasion, and cuts. Refer to <i>Section 5.2.3—Seal Inspection and Replacement and Section 5.2.3—Seal Inspection and Replacement</i> .		

4.2 Cleaning and Lubrication of the Locking Mechanism and Alignment Pins

Supplies required: Clean rag, MobilGrease® XHP222 Special Grease

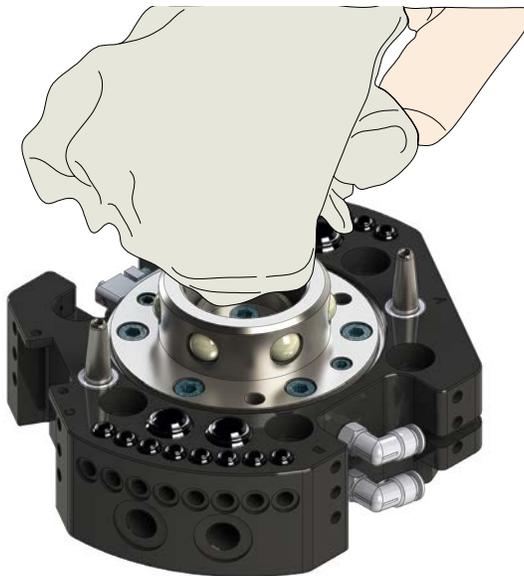
1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits (e.g. electrical, air, water, etc.).
4. Use a clean rag to thoroughly remove any lubricant and debris from the ball bearings, male coupling, cam, and alignment pins.

Figure 4.1—Cleaning Ball Bearings and Outer Surfaces of Male Coupling



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

Figure 4.2—Cleaning Ball Bearings, Cam and Inner Surfaces of Male Coupling



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

Figure 4.3—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 4.4—Apply Lubricant to Locking Mechanism

Apply lubricant on Alignment Pins
and Outer Surface of Male Coupling



Apply Lubricant on Inner
Surface of Male Coupling

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

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

9. Safely resume normal operation.

Figure 4.5—Clean Tool Plate Surfaces of locking Mechanism

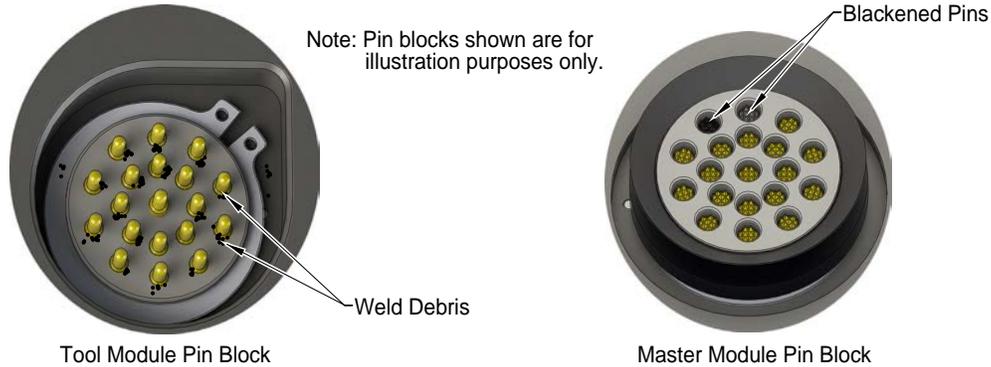


4.3 Pin Block Inspection and Cleaning

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 debris or darkened pins.

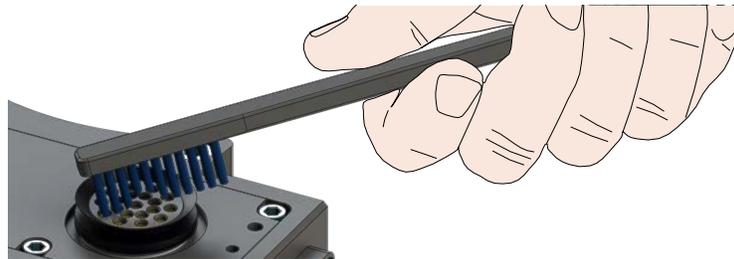
Figure 4.6—Inspect Master and Tool Pin Blocks



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

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

Figure 4.7—Clean Pin Blocks with a Nylon Brush



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

Figure 4.8—Stuck Pin and Pin Block Damage



7. If there are stuck pins or pin block damage, contact ATI for either a possible pin replacement procedure or module replacement.
8. Safely resume normal operation.

5. Troubleshooting and Service Procedures

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



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

5.1 Troubleshooting Procedures

The troubleshooting table is provided to assist in diagnosing issues that may cause the Tool Changer to malfunction.

Table 5.1—Troubleshooting		
Symptom	Cause	Resolution
Tool Changer cannot lock and/or unlock (or Lock sensor does not indicate Tool Changer is locked).	Debris caught between the Master and Tool plates.	Clean debris from between Master and Tool plates. Verify mounting fasteners are secure and do not protrude above the mating surfaces.
	Insufficient or no air pressure supply to the lock or unlock ports.	Verify proper air pressure and pneumatic valve is supplied. Refer to Section 2.11—Pneumatic Connections and Valve Requirements .
	Air pressure trapped in de-energized Lock or Unlock ports.	Air pressure must be vented to the atmosphere properly, refer to Section 2.11—Pneumatic Connections and Valve Requirements or refer to the troubleshooting section of the air/valve adapter manual for more information.
	Pneumatic connections loose or damaged, solenoid cable damaged.	Refer to the air/valve adapter manual for more information.
	The ball bearings and/or cam are not moving freely in the male coupling.	Clean and lubricate as needed to restore smooth operation. See Section 4.2—Cleaning and Lubrication of the Locking Mechanism and Alignment Pins .
	The Master plate and Tool plate are not within the specified No-Touch zone when attempting to lock.	Check that the Tool is properly seated in the tool stand. Refer to Section 3.5—Tool Storage Considerations . Re-teach the robot to bring the Master plate and Tool plate within the specified No-Touch zone prior to attempting to lock.
Unit is locked, but Lock signal does not read “on”.	Lock sensor/cable is damaged.	Replace the lock sensor assembly as necessary. Refer to Section 5.2.1—Lock and Unlock Sensor Replacement .
Unit is unlocked, but Unlock signal does not read “on.”	Unlock sensor/cable is damaged.	Replace the unlock sensor assembly as necessary. Refer to Section 5.2.1—Lock and Unlock Sensor Replacement .
Units Equipped with Electrical/Servo/Control/Signal Modules		
Loss of Communication.	Debris in and around contact pins. Contact pin worn or damaged.	Inspect V-ring seal for damage, replace damaged seal. Refer to Section 4.3—Pin Block Inspection and Cleaning
	Cable connections loose or cables damaged	Check that cable connection are secure and cables are not damaged.

5.2 Service Procedures

Component replacement procedures are provided in the following section.

5.2.1 Lock and Unlock Sensor Replacement

Parts required: Refer to [Section 6—Serviceable Parts](#)

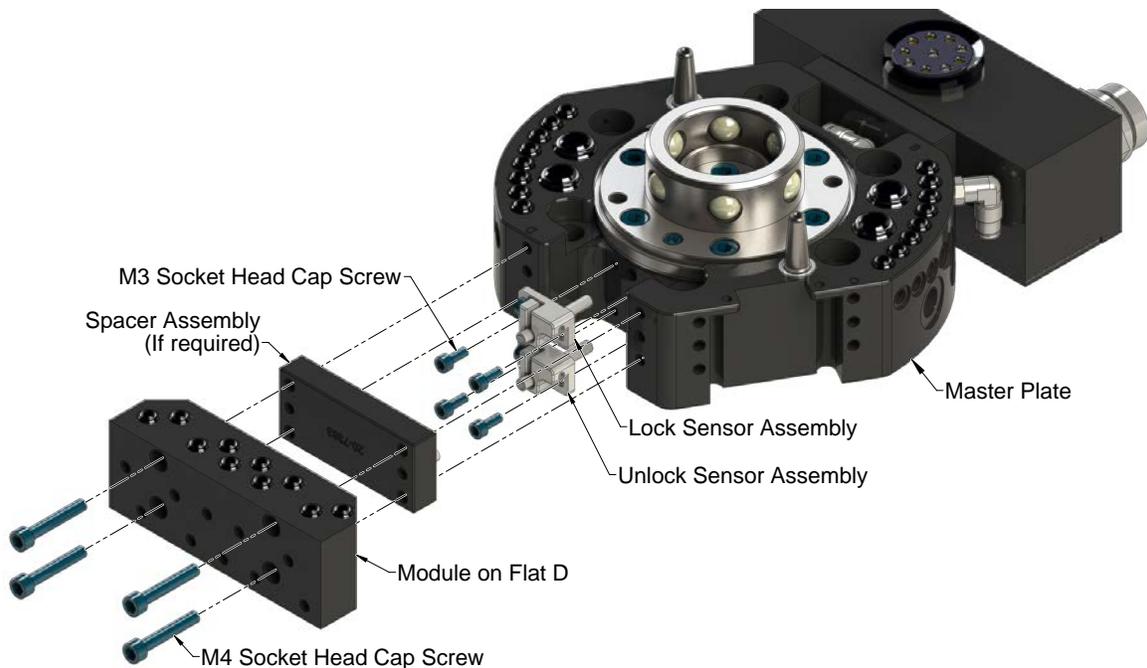
Tools required: 2.5 mm hex key, torque wrench

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. If required, fully disconnect these circuits.
4. Remove any modules and spacer assemblies installed on Flat D.
5. Remove the (2) M3 socket head cap screws that secure the Lock and/or Unlock sensor assembly to the Tool Changer body using a 2.5 mm hex key (refer to [Figure 5.1](#)). Pull the sensor assembly straight out from the Tool Changer body.
6. Discard the removed sensor.



CAUTION: The Lock and Unlock sensor assemblies are precision aligned and permanently assembled at the factory. Do not attempt to disassemble and rebuild.

Figure 5.1— Lock and Unlock Sensor Assembly Replacement



7. Insert the new Lock and/or Unlock sensor into the Tool Changer body as shown in [Figure 5.1](#). Make sure the O-ring is in place and seated properly on the back side of the sensor assembly.
8. Secure the sensor assembly with (2) M3 socket flat head screws using a 2.5 mm hex key. Tighten to 12 in-lbs (1.4 Nm).
9. Install any modules and spacer assemblies that were previously removed from Flat D.
10. To confirm the operation of the Unlock sensor, unlock the Tool Changer and visually check that the LED in the Unlock sensor body is on. To confirm the operation of the Lock sensor, lock the Tool Changer and then visually check that the LED in the Lock sensor body is on.
11. Safely resume normal operation.

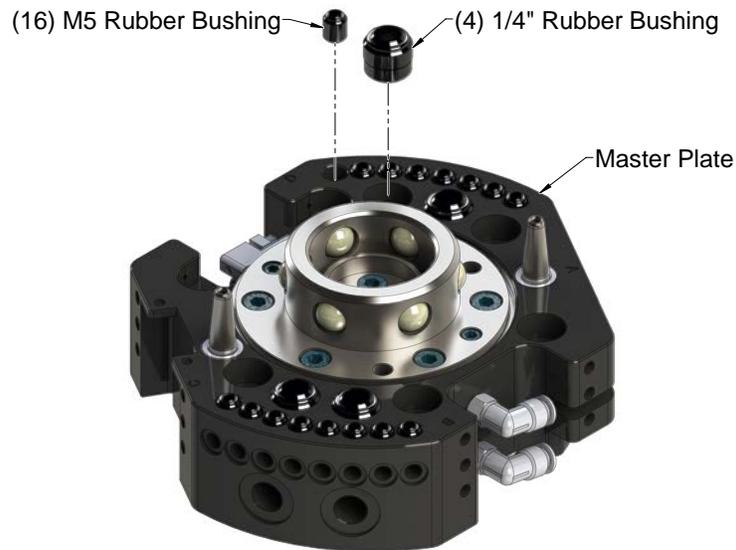
5.2.2 Rubber Bushing Replacement

Parts required: Refer to [Section 6—Serviceable Parts](#)

Tools required: needle nose pliers

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. If required, fully disconnect these circuits.
4. Using needle nose pliers, grasp the rubber bushing and pull it out of the Master body. Refer to [Figure 5.2](#).
5. Lightly lubricate the new rubber bushing and push into the Master body (refer to [Figure 5.2](#)).
6. Safely resume normal operation.

Figure 5.2— Rubber Bushing Replacement



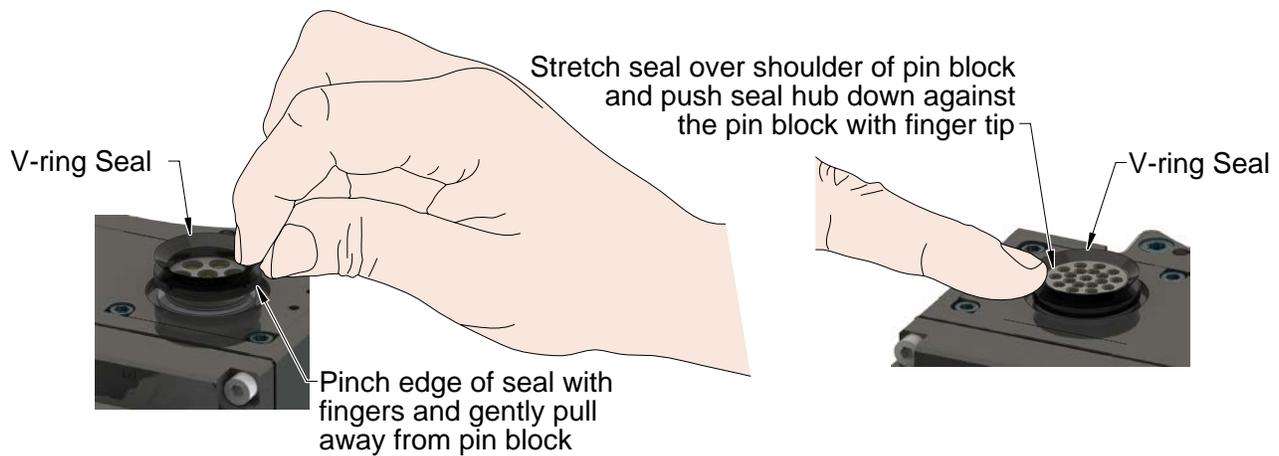
5.2.3 Seal Inspection and Replacement

Parts required: Refer to [Section 6—Serviceable Parts](#)

The seal protects the electrical connection between the Master and Tool module. If the seal becomes worn or damaged, replace the seal.

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, and pull the seal away from the pin block on the Master module.
5. To install a new seal, stretch the new seal over the shoulder of the pin block.
6. Push the seal hub down against the pin block.
7. Safely resume normal operation.

Figure 5.3—V-ring Seal Replacement



5.2.4 Alignment Pin Replacement

Parts required: Refer to [Section 6—Serviceable Parts](#)

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

Supplies required: Clean rag, MobilGrease XHP222, Loctite 242

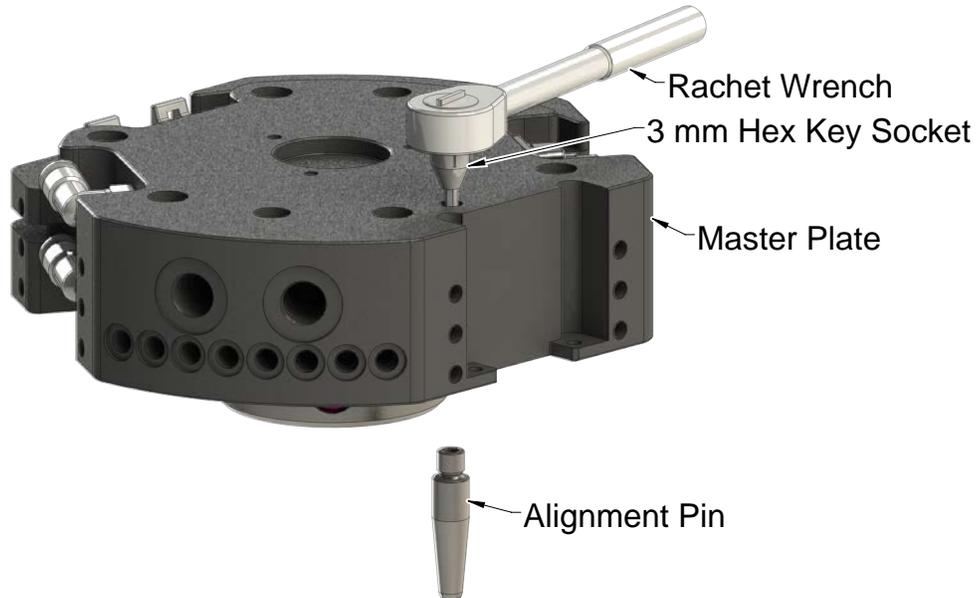
1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits; for example, electrical, air, water, etc. If required, fully disconnect these circuits.
4. Clean off debris and excess grease from the Alignment pin.
5. Unscrew the alignment pin assembly from the Master plate using a 2.5 mm hex key (see [Figure 5.4](#)). If alignment pin cannot be removed using the hex key in the tip, go to step 6. If alignment pin was removed, go to step 7.

Figure 5.4—2.5 mm hex key



6. Another approach would be to use the access hole in the back side of the Master plate. If not already removed, remove the Master plate refer to [Section 2.3—Master Plate Removal](#). Use a 3 mm hex key to remove the alignment pin from the back side of the Master plate by turning the alignment pin clockwise to drive the pin out the front of the plate. (Refer to [Figure 5.5](#)).

Figure 5.5—Alternative Method



7. Verify that the assembly (pin and set screw) are intact.
8. Apply Loctite 242 and install the Alignment Pin Assembly into the Bushing on the Tool Changer. Tighten to 60 in-lbs (6.8 Nm).
9. Apply MobilGrease XHP222 Special grease to the Alignment Pin. See [Section 4.2—Cleaning and Lubrication of the Locking Mechanism and Alignment Pins](#).
10. If repairs are complete, energize all circuits; for example, electrical, air, water, etc.

6. Serviceable Parts

6.1 QC-50 Master Plates

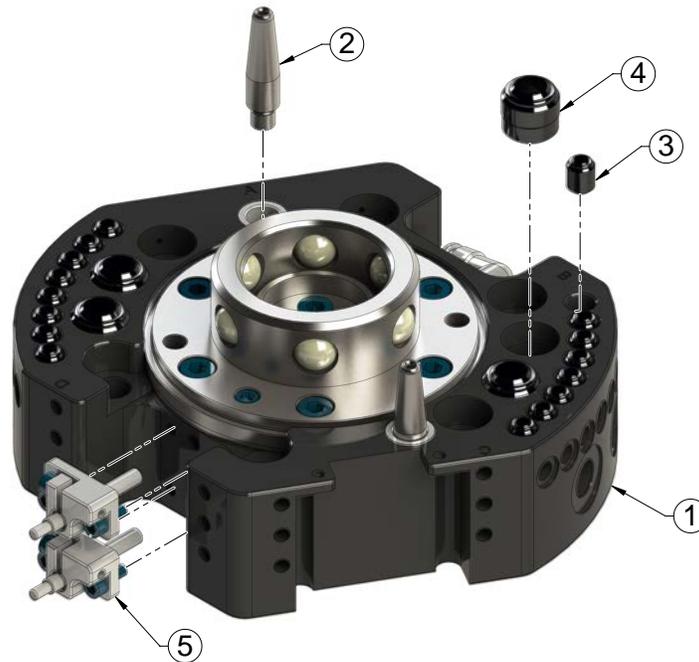


Table 5.2—Master Plate

Item No.	Qty	Part Number	Description
1	1	9120-050AM-0-0-0-0-E	QC-50 Master Assembly, BSPP, M5 Ports
2	2	3700-20-1373	Mono Alignment Pin, QC-100, A2
3	16	4010-0000009-02	M5 Rubber Bushing, Nitrile, Light-5
4	4	4010-0000021-01	1/4" NPT Nitrile rubber bushing
9120-050AM-0-0-0-0-SB-(E)			
5	2	9005-20-1483	Carrier Assembly, PNP, 5M Cable
9120-050AM-0-0-0-0-SB1-(E)			
5	2	9005-20-2457	Sensor Carrier, PNP. 4 mm Smooth Barrel, 0.2M hardwired Straight M8 Connector

6.2 QC-50 Tool Plate



Table 5.3—Tool Plate

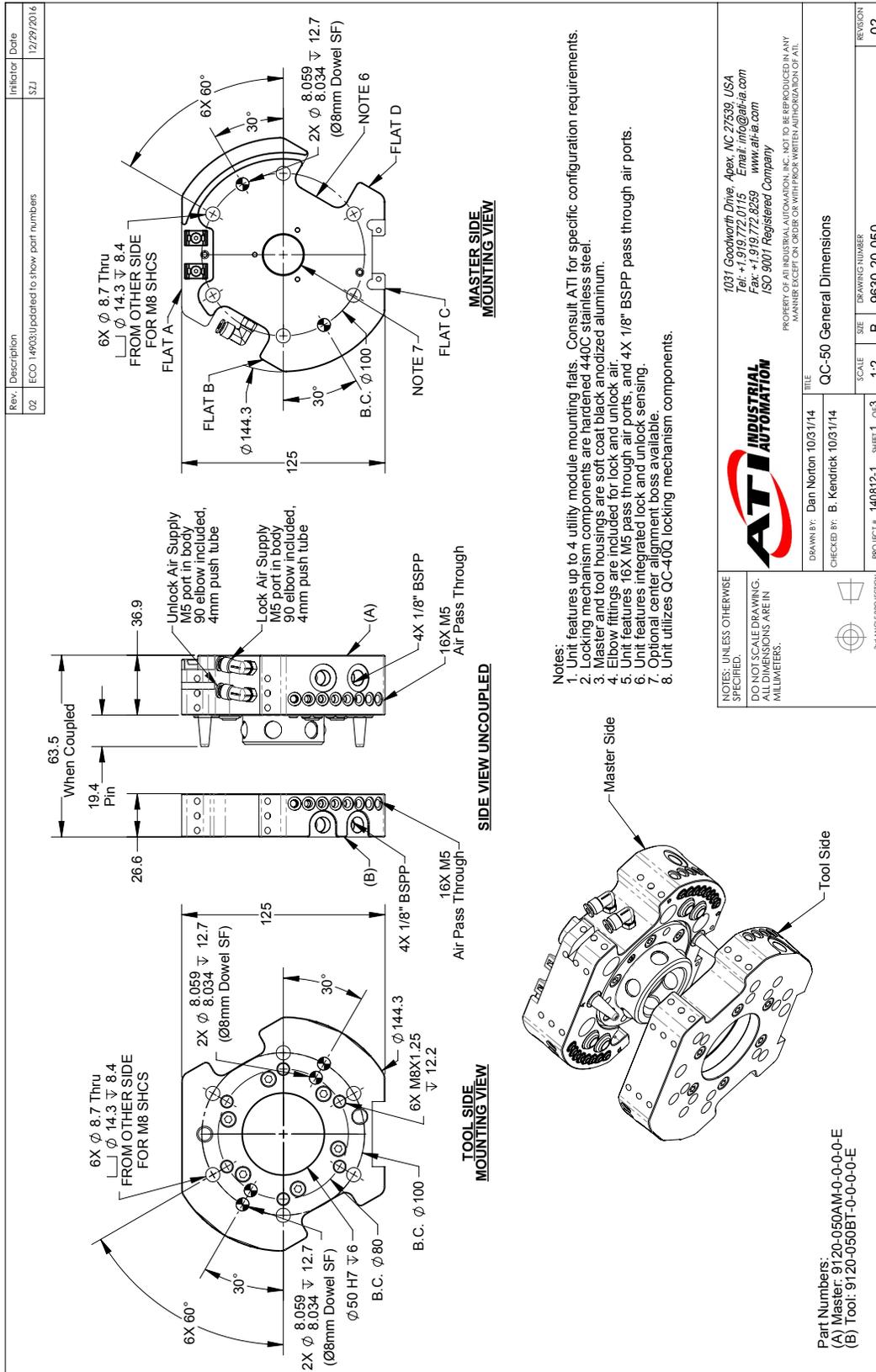
Item No.	Qty	Part Number	Description
1	1	9120-050BT-0-0-0-0-E	QC-50 Tool Assembly, BSPP and M5

7. Specifications

Table 5.4—Troubleshooting		
Specification	Values	Description
Recommended Max Payload	110 lbs. (50kg)	The mass attached to the Tool Changer.
Operating Temperature Range	-20–150°F (-30–66°C)	Optimal operating temperature
Operating Pressure Range	60–100 psi (4.1–6.9 bar)	Locking mechanism supply pressure operating range. Supply to be clean, dry, and filtered to 40 micron or better.
Coupling Force @ 80 psi	1,300 lbs. (590kg)	Axial holding force
Recommended Max Moment X-Y (Mxy)	2,000 in-lbs (226 Nm)	Maximum recommended working load for optimum performance of the Tool Changer
Recommended Max Torque about Z (Mz)	2,000 in-lbs (226 Nm)	Maximum recommended working torque for optimum performance of the Tool Changer
Positional Repeatability	0.0006” (0.015 mm)	Repeatability tested at rated load at one million cycles.
Weight (coupled, no access.)	5.09 lb (2.3 kg)	Master 3.37 lb (1.53 kg) / Tool 1.72 lb (0.78 kg)
Max. Recommended distance between Master and Tool plate	0.1” (2.5 mm)	No-Touch™ locking technology allows the Master and Tool plates to lock with separation when coupling.
Pass through Port, (Qty) Size (Cv, Min)	(16) M5, and (4) 1/8 BSPP	Maximum pressure of 100 psi (6.9 bar), Nitrile seals
Mounting/Customer Interface	Master plate	100 mm BC, (6) M8 Through Holes, (2) 8 mm Dowels(SF)
	Tool plate	100 mm BC, (6) M8 Through Holes, (2) 8 mm Dowels(SF)

8. Drawings

8.1 QC-50 Tool Changer with Standard Tool Plate

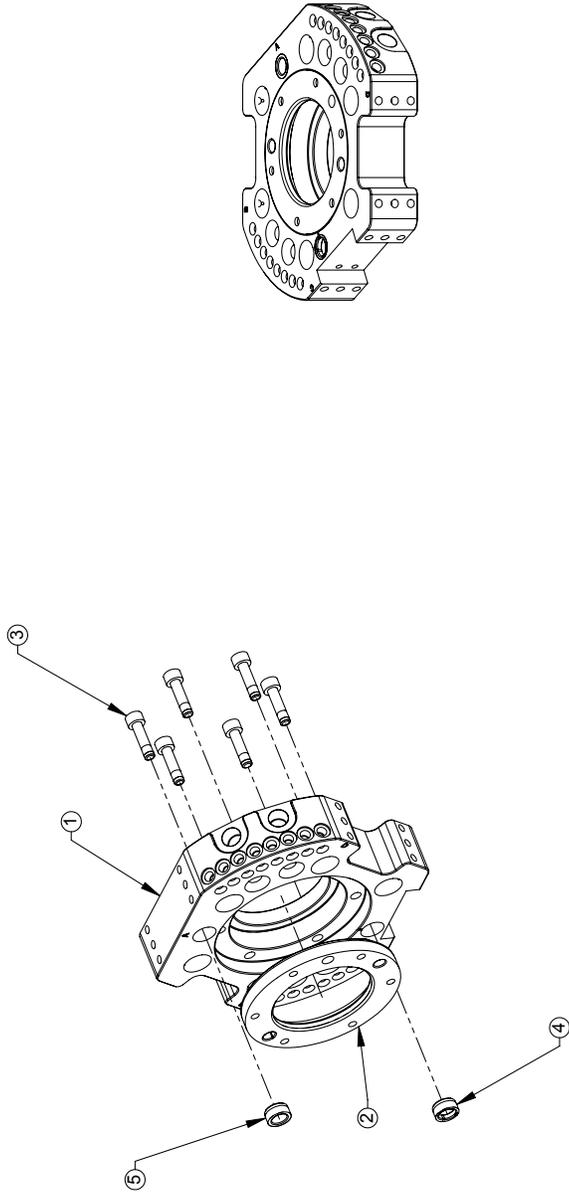


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DRAWN BY: Dan Norton 10/31/14 CHECKED BY: B. Kendrick 10/31/14 PROJECT #: 140812-1 SHEET 1 of 3	TITLE: QC-50 General Dimensions DRAWING NUMBER: 9630-20-050 SCALE: 1:2 SIZE: B
REVISION: 02	

	Rev.	Description See Sheet I	Initiator	Date
	-		-	-

QC-50 Master Assembly

<p>NOTES: UNLESS OTHERWISE SPECIFIED: DO NOT SCALE DRAWING. ALL DIMENSIONS ARE IN MILLIMETERS.</p>	<p>3RD ANGLE PROJECTION</p>	<p>INDUSTRIAL AUTOMATION</p> <p>1031 Goodworth Drive, Apex, NC 27539, USA Tel: +1 919 772 0115 Email: info@ati-ia.com Fax: +1 919 772 8259 www.ati-ia.com ISO 9001 Registered Company</p> <p>PROPERTY OF INDUSTRIAL AUTOMATION, INC. NOT TO BE REPRODUCED IN ANY MANNER EXCEPT ON ORDER OR WITH PROPER WRITTEN AUTHORIZATION OF ATI.</p>	<p>TITLE QC-50 General Dimensions</p> <p>DRAWN BY: Dan Norton 10/31/14 CHECKED BY: B. Kendrick 10/31/14</p> <p>SCALE 1:5 SHEET 2 OF 3</p>	<p>DRAWING NUMBER 9630-20-050</p> <p>REVISION 02</p>
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Rev.	Description	Initiator	Date									
-	See Sheet 1	-	-									
<p>NOTES: UNLESS OTHERWISE SPECIFIED, DO NOT SCALE DRAWING. ALL DIMENSIONS ARE IN MILLIMETERS.</p> <div style="display: flex; justify-content: space-around;">   </div> <p style="font-size: x-small;">3RD ANGLE PROJECTION</p>		<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%;">DRAWN BY: Dan Norton 10/31/14</td> <td style="width: 50%;">TITLE: QC-50 General Dimensions</td> </tr> <tr> <td>CHECKED BY: B. Kendrick 10/31/14</td> <td>SCALE: 1:5</td> </tr> <tr> <td>PROJECT #: 140812-1</td> <td>SHEET 3 OF 3</td> </tr> <tr> <td style="text-align: center;">DRAWING NUMBER</td> <td style="text-align: center;">REVISION</td> </tr> <tr> <td style="text-align: center;">B 9630-20-050</td> <td style="text-align: center;">02</td> </tr> </table>	DRAWN BY: Dan Norton 10/31/14	TITLE: QC-50 General Dimensions	CHECKED BY: B. Kendrick 10/31/14	SCALE: 1:5	PROJECT #: 140812-1	SHEET 3 OF 3	DRAWING NUMBER	REVISION	B 9630-20-050	02
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