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B. Base Tool Changer

QC-1310 Series—Robotic Tool Changer

1. Product Overview

The QC 1310 Robotic Tool Changer enhances the flexibility and reliability of a robotic cell by enabling a robot to change tooling automatically. Various tooling, such as grippers, weld guns, pneumatic and electric motors etc., can be selected and connected to a robot arm.

The QC-1310's main components are a Master and Tool plate. The Master plate attaches to the robot; the Tool plate attaches to selected end-effectors. When installed on the robot arm, the Master plate locks to the Tool plate using (3) pneumatic locking mechanisms. Each locking mechanism uses a patented, multi-tapered cam with ball-locking technology and a patented fail-safe mechanism. With the Master plate coupled to the Tool plate, the passage of utilities from Master to tooling is enabled. Electrical signals, pneumatic signals, power, and fluids can be transferred to the customer tooling through additional modules and ports. Refer to the respective manuals of each module for details on operation.

The Tool Changer is applicable in both automated and manual tool change processes, providing a method for quick tool change in maintenance operations.

For the most current product information and specifications on the QC-1310 Series of Tool Changers, please click the following link: *QC-1310 Series.*

1.1 Master Plate Assembly

The Master base assembly (Master plate) includes an anodized aluminum body, a set of hardened stainless-steel locking mechanisms, and hardened steel alignment pins.

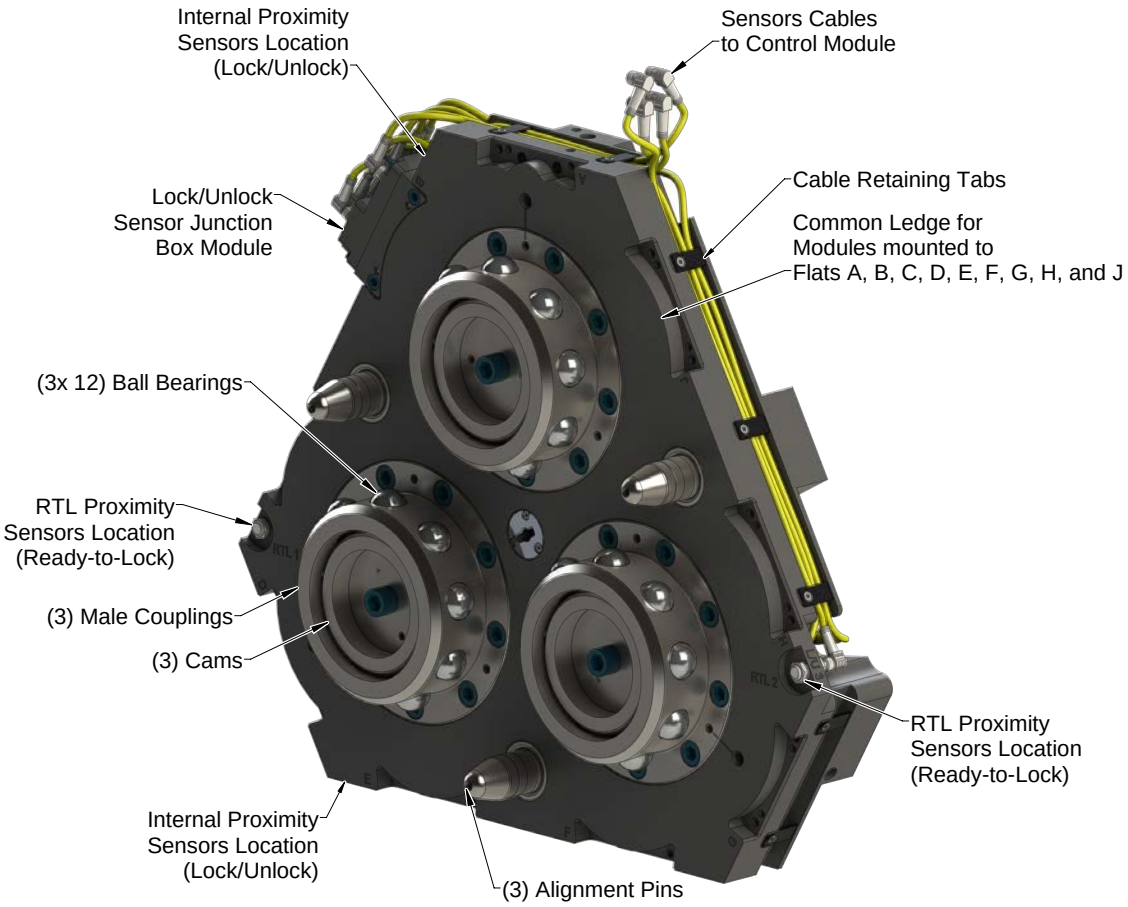
The Master plate has (9) optional mounting flats for installing optional modules. Flat A is designated for integrated valve assembly and Control module or air adapter and signal module. All Tool Changer models come with Lock and Unlock (L/U) sensors and include a master junction box module that mounts to Flat B. Flats C, D, E, F, G, H, and J are fully interchangeable; optional modules suited to the application requirements can be installed on interchangeable flats or moved around to what best suits robot dress package.

The Master plate has (3) locking mechanisms. Each locking mechanism consists of a cam, male coupling, and chrome-steel balls. The tapered alignment pins on the Master plate mate with bushings in the Tool plate to ensure alignment during the coupling process. Extreme pressure grease is applied to the cams, male couplings, ball bearings, and pins to enhance performance and maximize the life of the entire assembly.

The Master plate body contains proximity sensors to verify the L/U position of each locking mechanism: (3) for Lock (L1, L2, and L3) and (3) for Unlock (U1, U2, and U3). The sensor cables are routed to a junction box module where the input of the signals are wired in series, for example: L1 sends a lock signal to L2 which sends a lock signal to L3. Then the junction box module provides an output lock/unlock signal to the control/signal module. For further details on how the cables are routed to the junction box module and control/signal module, refer to *Section 5.2.1—Lock and Unlock Sensor and Sensor Cable Replacement*.

The Master plate also contains (2) proximity sensors mounted to its body to verify Tool plate presence and provide (2) Ready-To-Lock (RTL) signals (R1 and R2) to the control/signal module. The RTL sensor cables route directly to the control/signal module. For a further explanation on the RTL layout, refer to *Section 5.2.2—Ready-to-Lock (RTL) Sensor and Cable Replacement*.

Figure 1.1—Master Plate Assembly



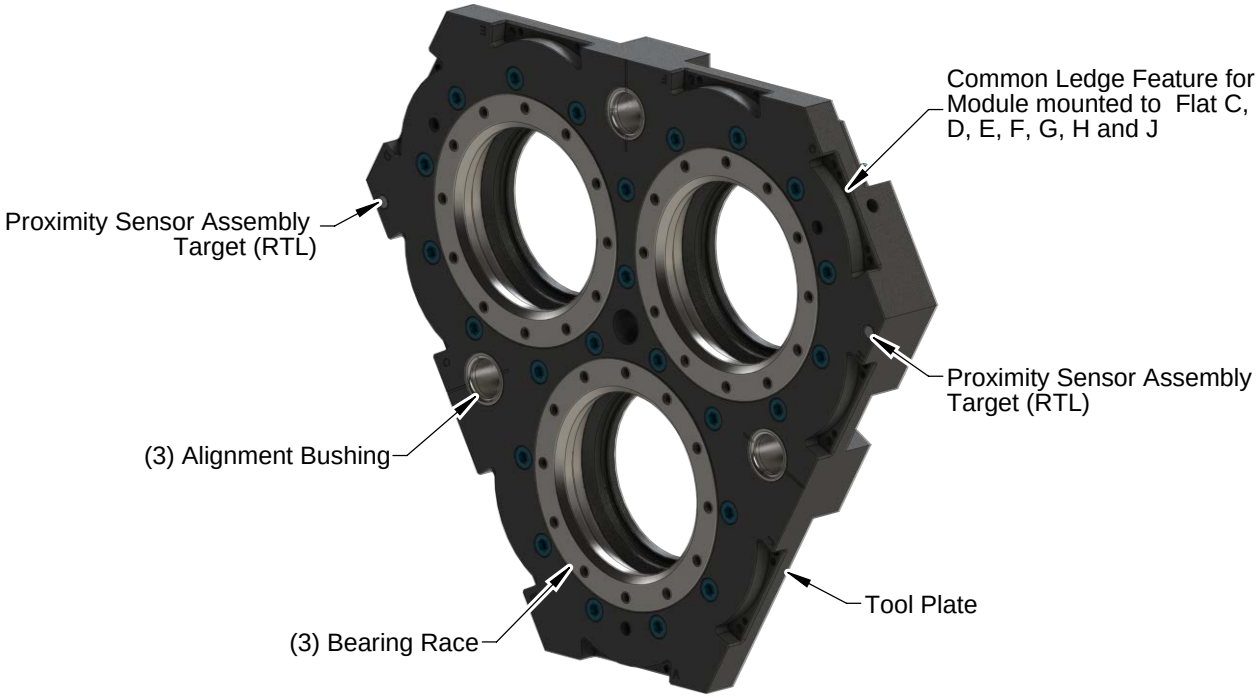
1.2 Tool Plate Assembly

The Tool plate assembly includes an anodized aluminum body and hardened stainless steel bearing races. Flat A of the Tool plate is reserved for the tool-side Control/Signal module and a valve spacer. The Tool plate has (7) flat sides for mounting additional modules (optional).

Proximity sensor targets are mounted to the body of the Tool plate. The targets are used by the Master plate's proximity sensors to verify Tool plate presence when coupled and provide a Ready-To-Lock (RTL) signal.

A mounting pattern is machined into the Tool plate for mounting customer tooling or a tooling interface plate. Refer to *Section 8—Drawings* for details.

Figure 1.2—Tool Plate Assembly



1.3 Optional Modules

On the Tool Changer, (7) flats available are for mounting optional modules. Modules can support various utility pass-through, such as: signal, fluid/air, and power.

Flat A is reserved for a Control/Signal module on both the Master and Tool side (for more information about the control/signal module, refer to the applicable manual). Modules mounted to flats C, D, E, F, G, H, or J are interchangeable to suit the specific robot application.

The optional modules are mounted to the Master or Tool plate using a common ledge mounting feature. Detaching modules from the Master/Tool plate requires removing the (2) M6 socket head cap screws securing each module to the Tool Changer body.

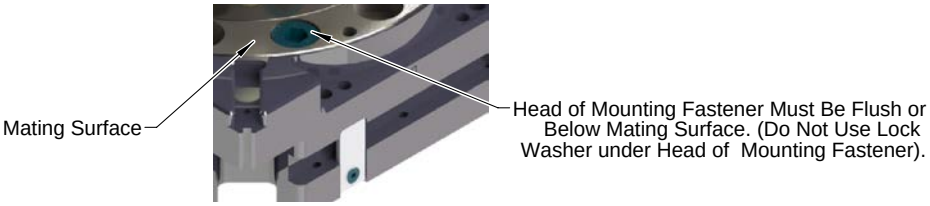
Visit the ATI website (*www.ati-ia.com*) to see what modules are available or contact an ATI Sales

Representative for assistance in choosing modules specific to particular applications.

2. Installation

All fasteners used to mount the Tool Changer to the robot and customer's tooling should be tightened to the torque values indicated in *Table 2.1*. Furthermore, removable (blue) Loctite 242 must be used on these fasteners. Recommended torque values based on engineering standards are contained in the following table**:**

WARNING: Do not use lock washer 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, preventing the locking mechanism from fully engaging. This can lead to personal injury or equipment damage. Make sure the mounting fasteners are flush or below the mating surfaces of the Master and Tool plates.



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

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

Table 2.1—Fastener Size, Class, and Torque Specifications

Mounting Conditions	Fastener Size and Property Class	Recommended Torque
Minimum thread engagement: • ≥ 1X fastener Ø for steel • ≥ 1.5X fastener Ø for aluminum (grade 6061 or higher)	M10-1.5 Class 12.9	55 ft-lbs (75 Nm)
	M12-1.75 Class 12.9	100 ft-lbs (135 Nm)
	M16-2.0 Class 12.9	240 ft-lbs (325 Nm)

Notes:
1. Confirm available engagement with robot manufacturer.
2. Removable (blue) Loctite® 242 must be used on mounting fasteners.

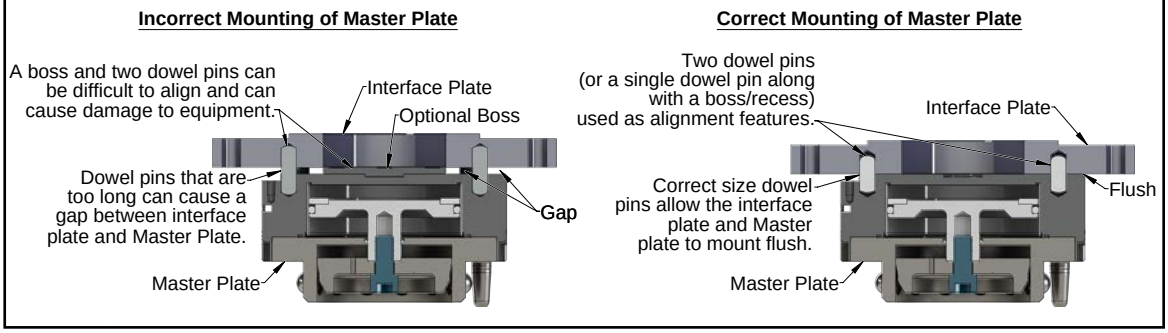
2.1 Master Interface

For technical information on mounting features, refer to *Section 8—Drawings*. The following information is applicable to all types of ATI Tool Changer Master interfaces and custom interfaces to the robot. The QC-1310 Master plate has an interface for two dowel pins (not a boss and dowel pin).

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 two alignment features when securing a Master plate to an interface plate. Using more than two alignment features can cause damage to equipment. Use either two dowel pins or a single dowel pin, along with a boss/recess feature to align the 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 two 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

Parts required: *8 mm hex key*

Supplies required: *Clean rag, Loctite® 242*

1. Wipe down the mounting surfaces with a clean rag.
2. Align the dowel pins to the corresponding holes in the Master plate and secure the Master plate to the robot arm or interface plate with customer supplied (27) M10 socket head cap screws using an 8 mm hex key. 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.

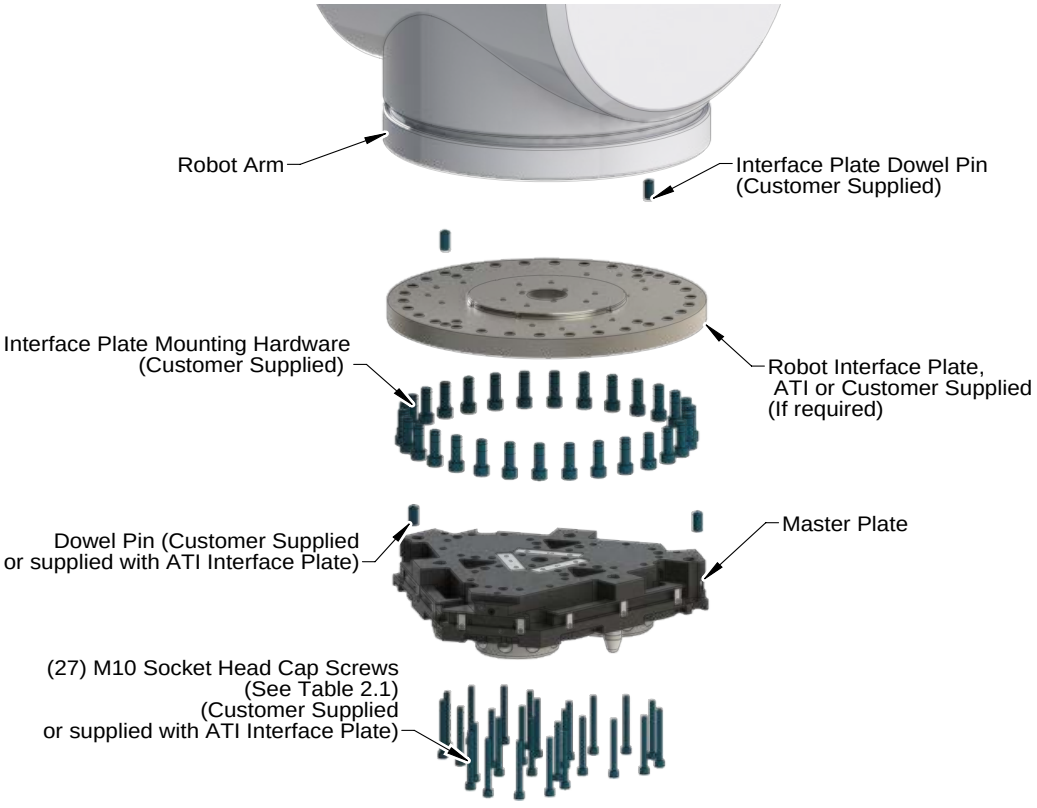
3. Connect utilities to appropriate modules and Master plate connections.
4. When installation is complete, safely resume normal operations.

2.3 Master Plate Removal

Tools required: *8 mm hex key*

1. Place the Tool safely in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits (for example: electrical, pneumatic, and hydraulic).
4. If necessary, disconnect all utilities (for example: electrical, pneumatic, and hydraulic). Note: support the Master plate while removing the fasteners.
5. Using an 8 mm hex key, remove the (27) M10 socket head cap screws connecting the Master plate to the robot arm or interface plate.
6. Remove the Master plate.

Figure 2.1—Typical Master Plate Installation



2.4 Tool Interface

For technical information on mounting features, refer to *Section 8—Drawings*. The following information is applicable to all types of ATI Tool Changer Tool interfaces and custom interfaces to the customer tooling.

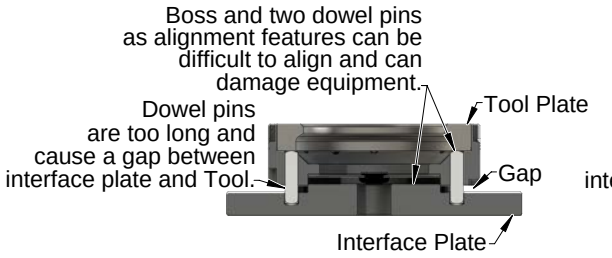
The QC-1310 Tool plate has an interface for two dowel pins (not a boss/recess and dowel pin).

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

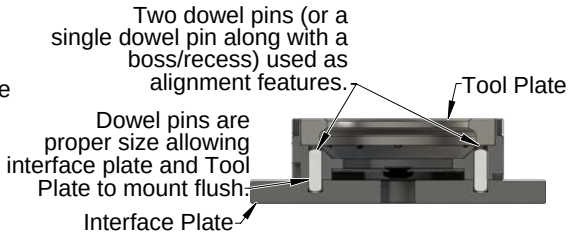
CAUTION: Do not use more than two alignment features when securing a Tool plate to an interface plate. Using more than two alignment features can cause damage to equipment. Use either two dowel pins or a single dowel pin, along with a boss/recess feature to align the Tool plate with the interface plate.

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

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

2.5 Tool Plate Installation

Secure the Tool plate to a tool interface plate or tooling by either inserting fasteners from the Tool plate to the tooling (bolt down) or from the tooling to the Tool plate (bolt up). Loctite and torque recommendations are in *Table 2.1*.

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

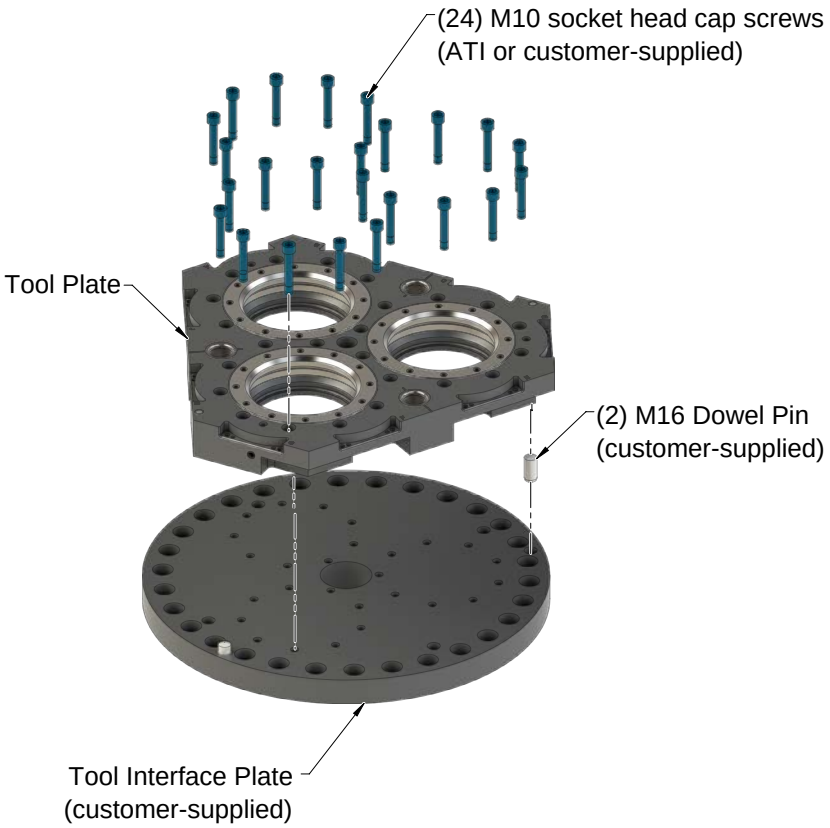
2.5.1 Bolt Down Installation

Tools required: *8 mm hex key*

Supplies required: *Clean rag, Loctite® 242*

1. Clean the mounting surfaces
2. Install the Tool Plate to an interface plate or customer tooling:
   a. Align the interface plate dowel pins to the corresponding holes in the Tool plate.
   b. Apply Loctite 242 to threads of the M10 fasteners.
   c. Use an 8 mm hex key to install the (24) M10 socket head cap screws and secure the Tool plate to the interface plate or customer tooling.
   d. Tighten the screws to 38 ft-lbs (52 Nm).
3. Connect utilities to the appropriate modules and Tool plate connections.
4. When installation is complete, the Tool plate may be put into normal operations.

Figure 2.2—Tool Plate Installation (Bolt Down)



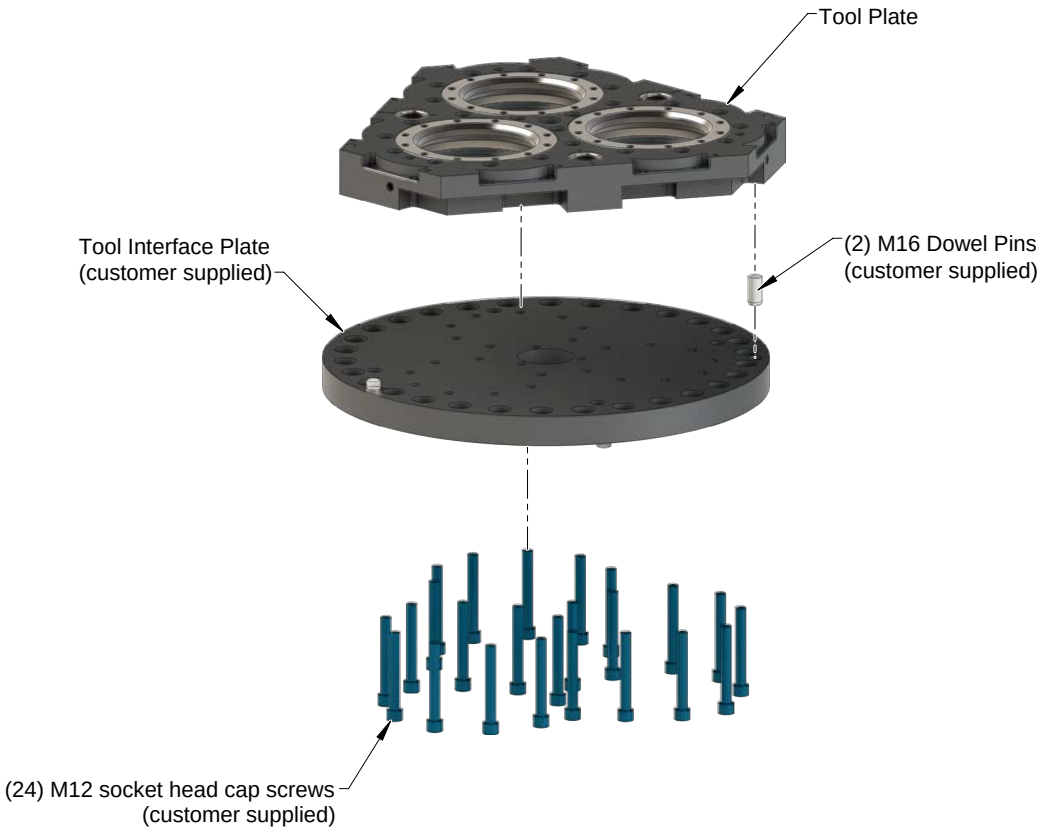
2.5.2 Bolt Up Installation

Tools required: *10 mm hex key*

Supplies required: *Clean rag, Loctite® 242*

1. Clean the mounting surfaces
2. Install the Tool Plate to an interface plate or customer tooling:
   a. Align the interface plate dowel pins to the corresponding holes in the Tool plate.
   b. Apply Loctite 242 to threads of the M12 fasteners.
   c. Use an 10 mm hex key to install the (24) M12 socket head cap screws and secure the Tool plate to the interface plate or customer tooling.
   d. Tighten the screws to 70 ft-lbs (95 Nm).
3. Connect utilities to the appropriate modules and Tool plate connections.
4. When installation is complete, the Tool plate may be put into normal operations.

Figure 2.3—Tool Plate Installation



2.6 Tool Plate Removal

Tools required: *8 mm or 10 mm hex key*

1. Place the Tool safely in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits, for example: electrical, pneumatic, and hydraulic.
4. If necessary, disconnect all utilities, for example: electrical, pneumatic, and hydraulic.
5. Remove the (27) M10 socket head cap screws that secure the Tool plate to the interface plate or tooling or tool interface plate. Use an 8 mm hex key for the M10 screws (bolt down installation) or 10 mm hex key for the M12 screws (bolt up installation).
6. Remove the Tool plate.

2.7 Pneumatic Connections

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 (4.1 to 6.9 bar) is acceptable for operation of the locking mechanism, with a setting of 80 psi (5.5 bat) suggested. The air should be filtered 40 micron or better.

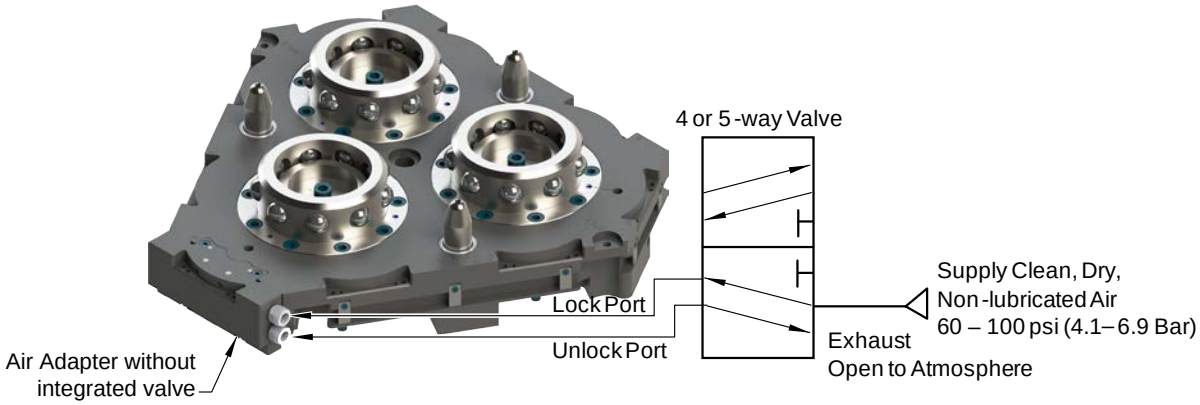
CAUTION: Do not use the Tool Changer in the fail-safe condition. Do not transport the Tool Changer in the fail-safe condition. Possible damage to the locking mechanism could occur.

2.7.1 Valve Requirements and Connections for the Locking Mechanism

If utilizing an air adapter module that does not contain an integrated solenoid valve, the customer is required to supply a 2-position 4-way or 5-way valve to actuate the locking mechanisms in the Master plate. When air is supplied to the Lock or Unlock Port on the Master plate, the opposite port must be vented to the atmosphere (for example: when air i s 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 hinder proper shuttling of the valve and prevent coupling and/or uncoupling from occurring.

CAUTION: The locking mechanism will not function properly when connected to a 3-position valve; a 3-position valve is incapable of venting trapped air pressure from within the Tool Changer. Trapped air pressure could result in injury of personnel or damage to the product and attached tooling. Connect the Lock and Unlock supply air to a 2-position 4-way or 5-way valve.

Figure 2.4—Lock and Unlock Pneumatic Connections



2.8 Electrical Connections

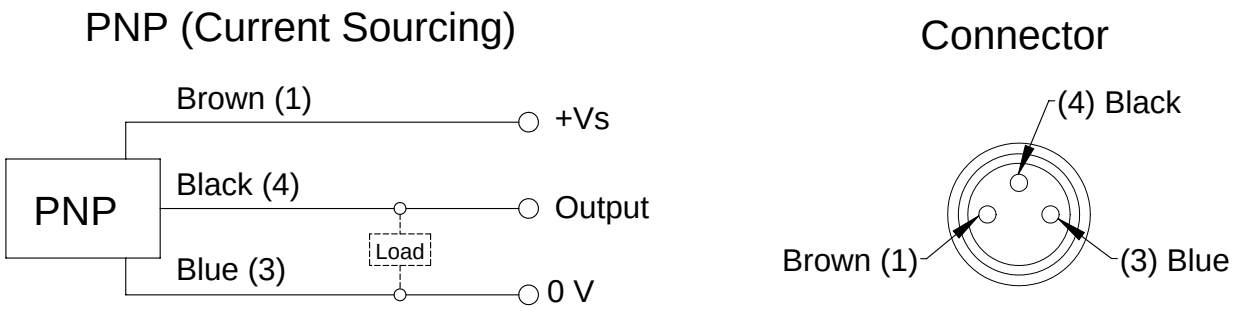
A Tool Changer is available with integrated Lock/Unlock sensors. If sensors are not used, plugs will be provided to seal the locking mechanism. If a Control/Signal module is to be utilized on Flat A when ordered, the sensors will be connected to the module prior to shipping.

2.8.1 PNP Type Lock, Unlock and RTL Sensors

These sensors are used on 9121-1310M-0-0-0-0-0-0-0-0-0-SM3.

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

Figure 2.5—PNP Type Lock, Unlock and RTL Sensors



3. Operation

The Master locking mechanism is pneumatically driven to couple and uncouple with the bearing race on the Tool plate. The Master plate utilizes air ports from an air or air/valve adapter module to provide lock and unlock pressure to the locking mechanism.

CAUTION: Safe, reliable operation of the Tool Changer is dependent on a continuous supply of compressed air at a pressure of 60 to 100 psi. Robot motion should be halted if the air supply pressure drops below 60 psi for any reason.

The robot should be programmed to minimize misalignment during coupling and uncoupling. Additionally, the tool stand should be durable and not allow deflection under Tool weight; should that occur, alignment of the Tool Changer plates will be taken outside of accepted offsets. For recommended maximum allowable offsets prior to coupling, see the following *Figure 3.1* and *Table 3.1*. In some cases, offsets greater than what is shown in *Table 3.1* can be accommodated by the Master and Tool plates; however, this will increase wear.

Lock-up should occur with the Master plate in the No-Touch™ locking zone (see *Table 3.1*) but without the Master plate physically in contact with the Tool plate. As locking occurs, the Master plate should draw the Tool plate into the locked position.

Figure 3.1—Offset Definitions

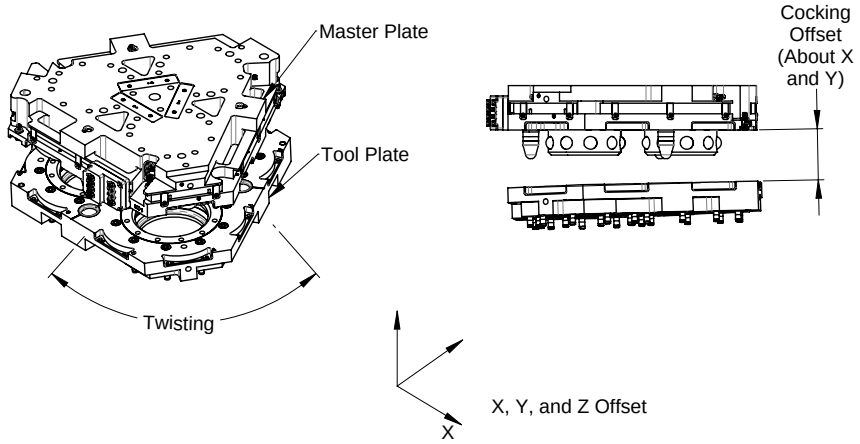


Table 3.1—Maximum Recommended Offsets Prior to Coupling

Model	No-Touch Zone Z Offset (Max)[1]	X and Y Offset (Max) [2]	Cocking Offset (Max)	Twisting Offset (Max)
QC-1310	0.065” (1.65 mm)	±0.08” (2 mm)	±0.7°	±1°

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 two 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 RTLV, 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 (for TSL)

NOTICE: Improperly designed tool stands cause components to become stuck and causes excessive wear of components. Thus, carefully consider tool stand design for optimal operation of the Tool Changer. For assistance, contact an ATI representative.

When Tool plates are not in use, store the Tool plate with attached customer tooling in a tool stand. ATI provides compatible tool stands designed for durability, longevity, and maximum adaptability to fit most customers' applications. The ATI Tool Stand Large (TSL) system is compatible with ATI Tool Changer sizes QC-150 and larger. The TSL systems can be configured in a variety of arrangements and are available with additional modular accessories such as covers and tool sensing. For products available, contact an ATI representative or refer to the following ATI webpage: *http://www.ati-ia.com/products/toolchanger/toolstand/large/LargeStand.aspx*.

ATI can provide a Teaching Aid to assist users with teaching the robot how to couple the Master with the Tool in a tool stand. For more information, refer to the *QC-1310 Teaching Aid manual* or the *ATI website*.

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

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

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

NOTICE: The cleanliness of the work environment strongly influences the operation of the Tool Changer. The more contaminants present in 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 tool stands away from debris generators.

2) Covers incorporated into the tool stands.

3) 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 for long-term functionality, provided regular maintenance is performed. A visual inspection and preventive maintenance schedule, depending on the application, is supplied in the following table: Detailed assembly drawings are provided in *Section 8—Drawings*. 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

- ☐ Inspect fasteners for proper torque, interferences, and wear. Tighten and correct as required. Refer to *Table 2.1—Fastener Size, Class, and Torque Specifications.*

Ball Bearings/Alignment Pins/Bushings/Bearing Race

- ☐ Inspect for wear and proper lubrication. MobilGrease XHP222 Special a NLGI #2 lithium complex grease with molybdenum disulfide additive is suggested for locking mechanism and alignment pin lubrication. Over time, lubricants can become contaminated with debris; therefore, it is recommended to thoroughly clean the existing grease and replace with new as needed. See *Section 4.2—Cleaning and Lubrication of the Locking Mechanism and Alignment Pins.*Inspect for excessive alignment pin/bushing wear—possibly an indication of misaligned robot position during pickup/drop-off. Check tool stand for wear and alignment problems. To replace worn alignment pins, refer to *Section 5.2.3—Alignment Pin Replacement.*
- ☐ Inspect for wear on the ball bearings/bearing race—possibly an indication of excessive loading.

Sensors and Cables

- ☐ Inspect sensor cable connectors for tightness. If loose, tighten connections.
- ☐ Inspect sensor cables for any damage, cuts, and abrasion. Replace as necessary. Refer to *Section 5.2.1—Lock and Unlock Sensor and Sensor Cable Replacement*.

Hoses

- ☐ Inspect hose connection for tightness and leaks. If leaking or loose, secure hose connection.
- ☐ Inspect hoses for interferences, abrasions, cuts, and leaks. Replace as necessary.

Electrical Contacts/Pin Block (Modules)

- ☐ Inspect for damage, debris, and stuck/burnt pins. Clean pin blocks as necessary, Refer to *Section 4.3—Pin Block Inspection and Cleaning.*

Seals (Modules)

- ☐ Inspect for wear, abrasion, and cuts. Refer to *Section 5.2.4—Seal Inspection and Replacement*

4.2 Cleaning and Lubrication of the Locking Mechanism and Alignment Pins

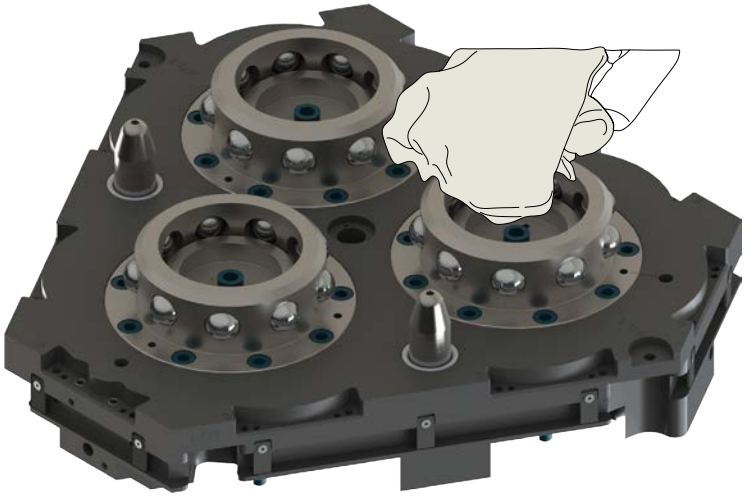
Supplies required: *Clean rag, MobilGrease® XHP222 Special Grease*

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

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

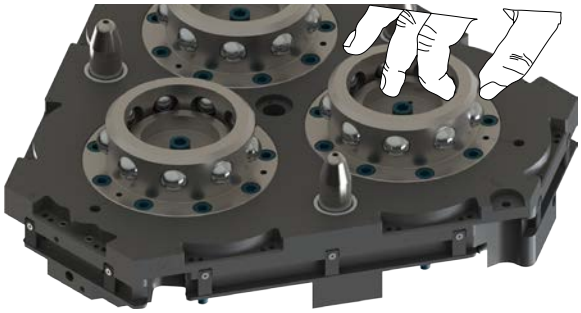
5. Use a clean rag to thoroughly remove any lubricant and debris from the inner surface of the male coupling and cam.

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.

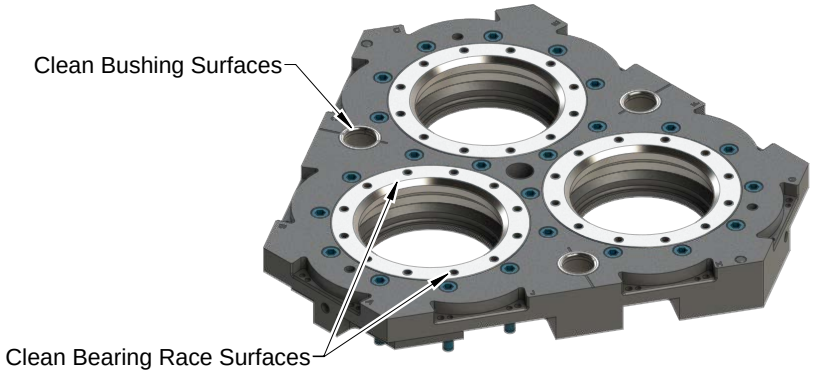
Figure 4.4—Apply Lubricant to Locking Mechanism

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 (for example: electrical, pneumatic, and hydraulic circuits).
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 and/or cleaners or solvents to clean the contact pins. Using abrasive media and/or cleaners or solvents will cause damage to the contact surface or cause pins to stick. Clean contact surfaces with a vacuum or non-abrasive media such as a nylon brush (ATI part number 3690-0000064-60).

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

5. Troubleshooting and Service Procedures

The following section provides troubleshooting and service information to help diagnose conditions and repair the Tool Changer or Control/Signal module.

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

5.1 Troubleshooting Procedures

The troubleshooting table is provided to assist in diagnosing issues that may cause the Tool Changer not to function properly.

Table 5.1—Troubleshooting

Symptom	Cause	Resolution
Tool Changer will not lock and/or unlock (or Lock sensor does not indicate Tool Changer is Locked)	Air pressure supply to the Lock/Unlock ports is unavailable or insufficient.	Verify proper air pressure and pneumatic valve are supplied. Refer to *Section 2.7—Pneumatic Connections.*
	Air pressure is trapped in de-energized Lock or Unlock ports.	Air pressure must be vented to the atmosphere properly. Refer to *Section 2.7—Pneumatic Connections* or to the troubleshooting section of the air/valve adapter manual for more information.
	Pneumatic connections are loose or damaged. The valve power supply circuit is damaged or interrupted.	Refer to the air/valve adapter manual for more information.
	Debris is caught between the Master and Tool plates.	Remove debris from between Master and Tool plates. Verify mounting fasteners are secure and do not protrude above the mating surfaces.
	The ball bearings and/or cam are not moving freely in the male coupling.	Clean and lubricate as needed to restore smooth operation (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 (for TSL).* Re-teach the robot to bring the Master plate and Tool plate closer together prior to attempting to lock.
	The Control/Signal module or air/valve adapter is not operating correctly.	Check the troubleshooting section of the manual for the specific module.
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 and Sensor Cable 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 and Sensor Cable Replacement.*
Ready-To-Lock (RTL) does not read “on” when Master and Tool plates are mated.	Ready-To-Lock (RTL) sensors are not activated, indicating Tool is not positioned properly.	Re-teach the robot to bring the Master plate and Tool plate closer together prior to attempting to lock. Refer to *Section 3—Operation*. Check that both RTL sensors and cables are not damaged and sensor connection to the Control/Signal module or air adapter are tight. Replace damaged RTL sensors as necessary. Refer to *Section 5.2.2—Ready-to-Lock (RTL) Sensor and Cable Replacement.* The degree to which the RTL sensors are involved in the Tool Changer coupling sequence depends upon the control module used and how the customer robot program is written.

Table 5.1—Troubleshooting		
Symptom	**Cause**	**Resolution**
Units Equipped with Electrical/Servo/Control/Signal Modules		
Loss of Communication	Debris is in and/or around contact pins. Contact Pin worn or damaged.	Inspect V-ring seal for damage, replace damaged seal. Refer to *Section 5.2.4—Seal Inspection and Replacement.* Inspect spring pins and pin block for stuck pins, contamination, and debris (*Section 4.3—Pin Block Inspection and Cleaning*).
	Cable connections are loose or cables damaged.	Check that cable connection are secure and cables are not damaged.

5.2 Service Procedures

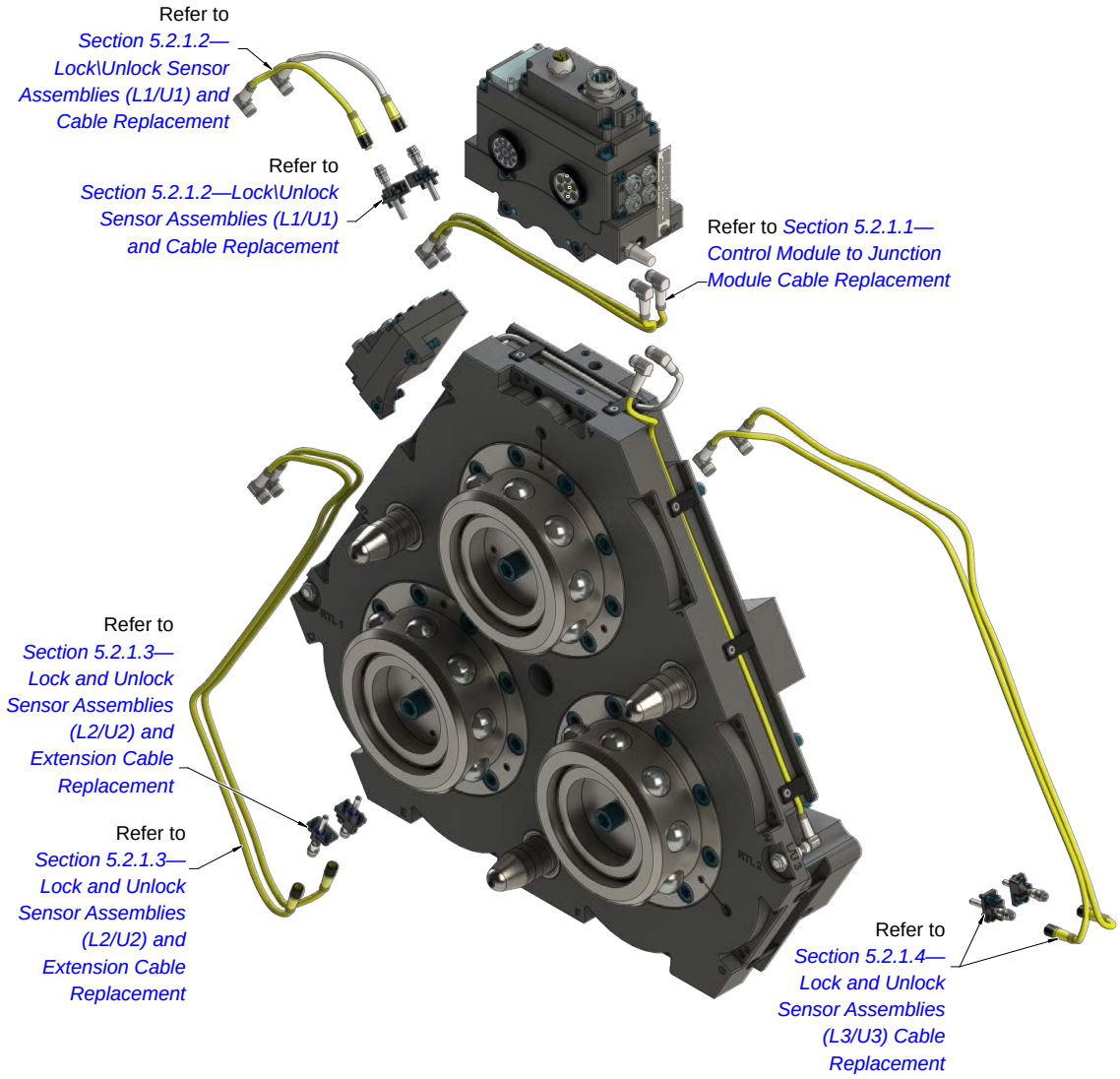
Component replacement procedures are provided in the following section:

5.2.1 Lock and Unlock Sensor and Sensor Cable Replacement

The proximity sensors are designed for reliability and therefore, should not require frequent replacement. If problems arise, examine all other possible solutions before replacing the sensor. Check continuity, air supply, lubrication, pneumatic components, etc. For links to sensor and sensor cable replacement, refer to *Figure 5.1* and *Figure 5.13*.

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 Sensors and Sensor Cable Replacement



5.2.1.1 Control Module to Junction Module Cable Replacement

Refer to Figure 5.2

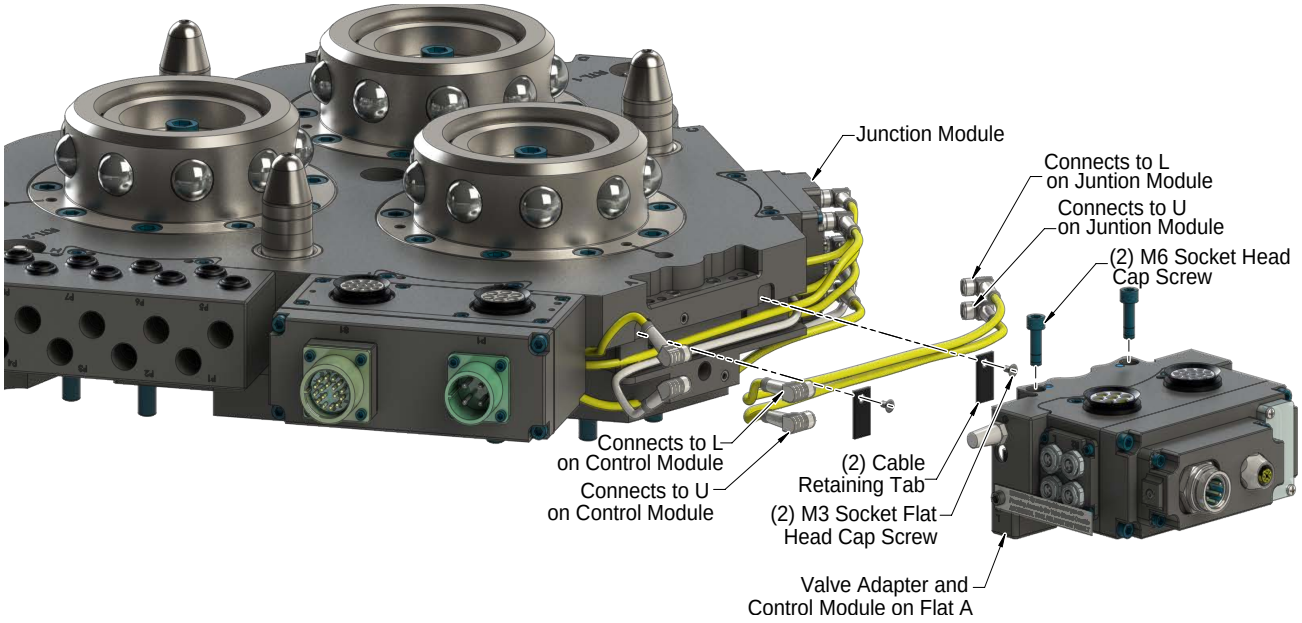
Parts required: *Section 6—Serviceable Parts*

Tools required: *2 mm, 2.5 mm, and 5 mm hex key*

Supplies required: *Clean rag, Loctite® 242*

1. Place the Tool safely in a secure location.
2. Uncouple the Master and Tool plates.
3. Inspect the sensor cable for damage, check the cable continuity, and check the cable connection.
   - If loose, reconnect the cable. Proceed to step *16* to confirm sensor operation.
   - If cable is damaged, proceed to the next step.
4. Turn off and de-energize all energized circuits, for example: electrical, pneumatic, and hydraulic circuits.
5. Using compressed air and a clean rag, remove debris and grease from the outer surfaces of the Tool Changer body.
6. Disconnect the cable connector(s) from the Control/Signal module on Flat A.
7. Remove the valve adapter and Control/Signal module installed on Flat A by removing the (2) M6 socket head cap screws securing the module to the Tool Changer body using a 5 mm hex key. Lift the module off the Tool Changer body.
8. Using a 2 mm hex key, remove the (2) M3 socket flat head cap screws and (2) cable retaining tabs on Flat A of the Tool Changer body.
9. With the new cables ready, disconnect the cable connector(s) of the old cable from the junction box module on Flat B and connect the new cables to the junction box.
10. Remove the old cable(s) from the cable channel of the Tool Changer body. Discard the damaged cable(s).

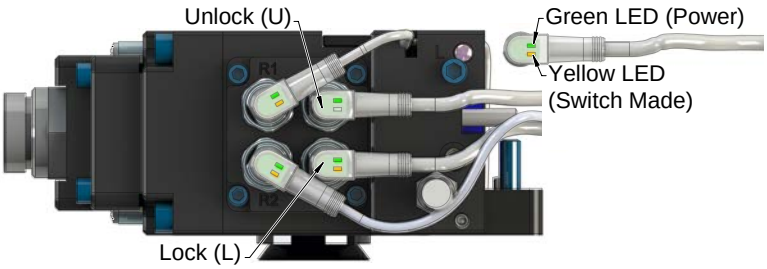
Figure 5.2—Control/Signal Module to Junction Module Cable Replacement



11. Route the new cable(s) into the cable channel on top of Flat A of the Tool Changer body.
12. Secure the cable(s) to the channel on the Flat A ledge using the (2) M3 socket flat head cap screws and (2) cable retaining tabs. Tighten the screws to contact using a 2 mm hex key.

13. Reinstall the valve adapter and Control/Signal module on Flat A.
    a. If the module fasteners do not have pre-applied adhesive, apply Loctite 242 to the fasteners.
    b. Use a 5 mm hex key to tighten the Control/Signal module's (2) M6 socket head cap screws to 70 in-lbs (7.9 Nm) to secure the module to the Tool Changer body.
14. Connect the cable connector(s) to the Control/Signal module.
15. When repairs are complete, return circuits to normal operation.
16. Confirm the operation of the Unlock sensor by unlocking the Tool Changer. The Unlock sensor cable LED should be on.
17. Confirm the operation of the Lock sensor by locking the Master to the Tool. The Lock sensor cable LED should be on.

Figure 5.3—Unlock and Lock Sensor Cable LEDs



5.2.1.2 Lock\Unlock Sensor Assemblies (L1/U1) and Cable Replacement

Parts required: *Section 6—Serviceable Parts*

Tools required: *2.5 mm hex key*

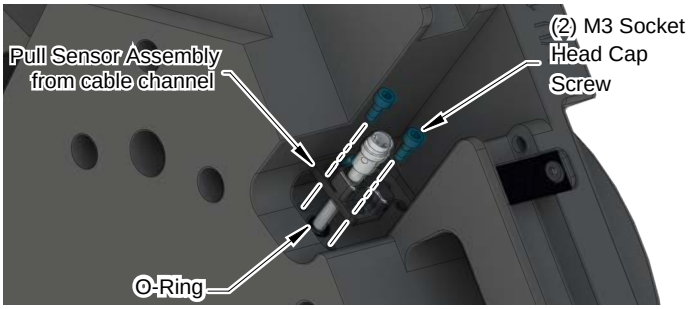
Supplies required: *Clean rag, Loctite® 242*

1. Place the Tool in a secure location.
   - Inspect the sensor cable for damage, check the cable continuity, check the cable connection.
   - If loose, reconnect the cable. To confirm sensor operation, proceed to step *15*. If the cable is damaged, proceed to the next step.
2. Turn off and de-energize all energized circuits (for example: electrical, pneumatic, and hydraulic circuits).
3. Using compressed air and a clean rag, remove debris and grease from the outer surfaces of the Tool Changer body.
4. Disconnect the L1/U1 cables from the Lock/Unlock sensor assembly that is between Flat A and Flat B.
5. If replacing the sensor assemblies, proceed to the next step. If replacing only the L1/U1 cable(s), proceed to step *12*.
6. Use a 2.5 mm hex key to remove the (2) M3 socket head cap screws that secure the sensor assembly to the tool changer body.

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

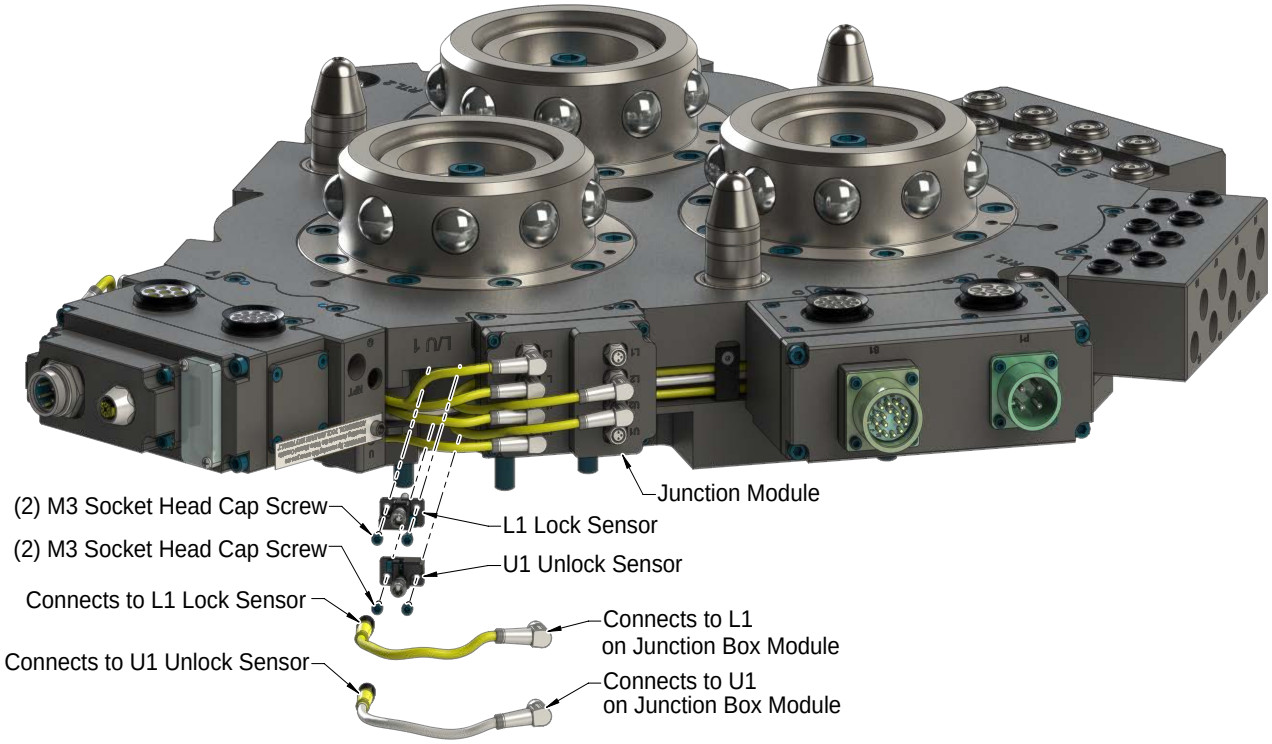
7. Pull the sensor assembly straight out from the cable channel of the Tool Changer body to remove the Lock and/or Unlock sensor assembly.
8. Ensure the O-ring around the old sensor cylinder barrel is removed with the old sensor and does not remain attached to the Tool Changer body.

Figure 5.4—Lock/Unlock Sensor Removal and Installation



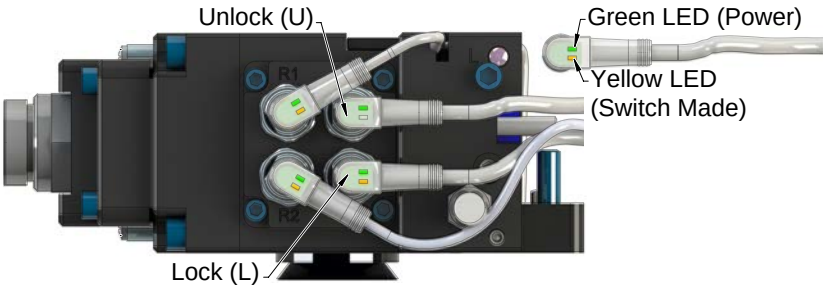
9. Install sensor assembly onto the Tool Changer body as shown in *Figure 5.4*.
10. Use a 2.5 mm hex key to secure the sensor assembly to the tool changer body with the (2) M3 socket head cap screws. Tighten the screws to 12 in-lbs (1.4 Nm).
11. If replacing the sensor assembly only, attach the old L1 and U1 cables to the sensor assembly. Proceed to step *14*.
12. If replacing the cables, attach the appropriate ends of the new L1 and U1 cables to the sensor assembly.
13. Disconnect the old cable from the junction box module and discard the old cables. Connect the loose ends of the new L1/U1 cables to the appropriate connections on the junction box module.

Figure 5.5—Lock and Unlock Sensor Assemblies (L1/U1) Cable Replacement



14. When repairs are complete, return circuits to normal operation.
15. Confirm the operation of the Unlock sensor by unlocking the Tool Changer. The Unlock sensor cable LED should be on.
16. Confirm the operation of the Lock sensor by locking the Master to the Tool . The Lock sensor cable LED should be on.

Figure 5.6—Unlock and Lock Sensor Cable LEDs



5.2.1.3 Lock and Unlock Sensor Assemblies (L2/U2) and Extension Cable Replacement

Refer to *Figure 5.8*

Parts required: *Section 6—Serviceable Parts*

Tools required: *2 mm, 2.5 mm, and 5 mm hex key*

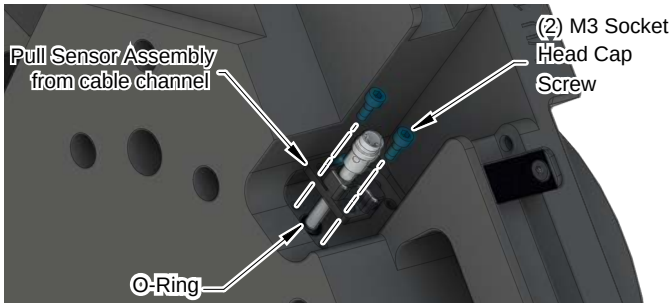
Supplies required: *Clean rag, Loctite® 242*

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Inspect the sensor cable for damage, check the cable continuity, check the cable connection.
   - If loose, reconnect the cable. Proceed to step *20* to confirm sensor operation.
   - If cable is damaged, proceed to the next step.
4. Turn off and de-energize all energized circuits (for example: electrical, pneumatic, and hydraulic circuits).
5. Using compressed air and a clean rag, remove debris and grease from the outer surfaces of the Tool Changer body.
6. Disconnect the L2/U2 cables from the Lock/Unlock sensor assembly that is between Flat D and Flat E.
7. If replacing only the sensor assembly, proceed to the next step. If replacing the sensor cables, proceed to step *14*.
8. Using a 2.5 mm hex key, remove the (2) M3 socket head cap screws that secure the Lock/Unlock sensor assembly to the Tool Changer body.

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

9. Pull the sensor assembly out from the cable channel of the Tool Changer body.
10. Ensure the O-ring around the old sensor cylinder barrel is removed with the old sensor and does not remain attached to the Tool Changer body.

Figure 5.7—Lock/Unlock Sensor Removal and Installation



11. Install new sensor assembly onto the Tool Changer body as shown in *Figure 5.8*.
12. Use a 2.5 mm hex key to secure the sensor assembly to the tool changer body using the (2) M3 socket head cap screws. Tighten the screws to 12 in-lbs (1.4 Nm).
13. If replacing only the sensor assembly, reconnect the L2/U2 cables to the sensor and proceed to step *19* to confirm operation. If replacing the cables, proceed to the next step.
14. Remove modules, tabs, and junction box to prepare for cable removal and installation:
    a. Remove any modules installed on Flat C and/or Flat D by removing the (2) M6 socket head cap screws securing each module to the Tool Changer body using a 5 mm hex key. Lift the modules off the Tool Changer body.

b. Using a 2 mm hex key, remove the (3) M3 socket flat head cap screws and (3) cable retaining tabs on the ledges of Flat B and Flat C of the Tool Changer body.

c. Using a 2 mm hex key, remove the (2) M3 socket flat head cap screws and (2) cable retaining tabs on the ledge of Flat D of the Tool Changer body.

d. Using a 5 mm hex key, remove the (2) M6 socket head cap screws securing the junction box module to Flat B of the Tool Changer body.

e. Remove the junction box module, with the cables still attached, from Flat B.

15. Remove the old L2/U2 cables installed within the channel along the ledge of Flat B, Flat C, and Flat D. Discard the old cables.

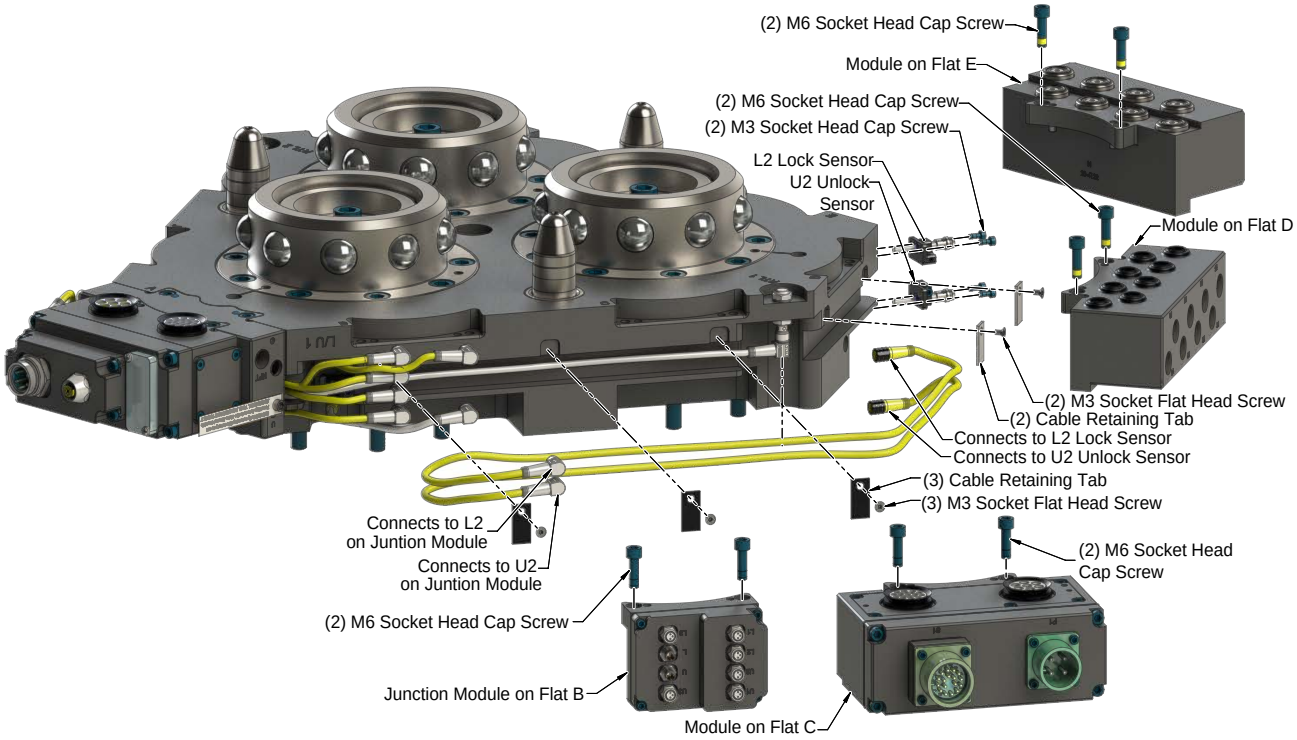
16. Install the new cables:

a. Connect the new L2/U2 cables to the sensor assembly and route the cables through the cable channel along the ledges of Flat B, Flat C, and Flat D.

b. Secure the cables within the channel along Flat D using the (2) M3 socket flat head cap screws and (2) cable retaining tabs. Tighten the screws to contact using a 2 mm hex key.

c. Secure the cables within the channel along Flat B and Flat C on the Tool Changer body edge using (3) M3 socket flat head cap screws and (3) cable retaining tabs. Tighten the screws to contact using a 2 mm hex key.

Figure 5.8—Lock and Unlock Sensor Assemblies (L2/U2) Cable Replacement



17. Reinstall all previously installed modules on Flat C and D.

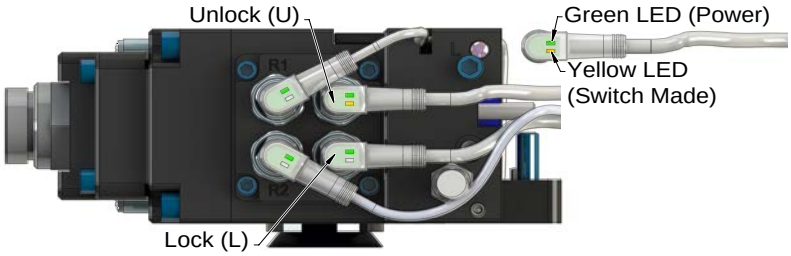
a. If the module(s) fasteners do not have pre-applied adhesive, apply Loctite 242 to the M6 socket head cap screws fasteners.

b. Use a 5 mm hex key to secure each module to the Tool Changer body with (2) M6 socket head cap screws. Tighten the screws to 70 in-lbs (7.9 Nm).

18. Connect the L2/U2 cables to corresponding connectors on the junction box.

19. When repairs are complete, return circuits to normal operation.
20. Confirm the operation of the Unlock sensor by unlocking the Tool Changer. The Unlock sensor cable LED should turn on.
21. Confirm the operation of the Lock sensor by locking the Master to the Tool. The Lock sensor cable LED should turn on.

Figure 5.9—Unlock and Lock Sensor Cable LEDs



5.2.1.4 Lock and Unlock Sensor Assemblies (L3/U3) Cable Replacement

Parts required: *Section 6—Serviceable Parts*

Tools required: *2 mm, 2.5 mm, and 5 mm hex key*

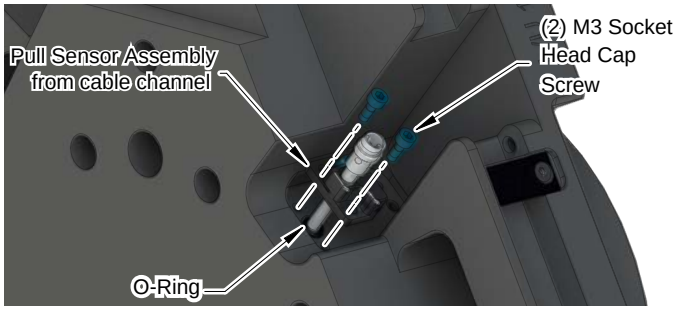
Supplies required: *Clean rag, Loctite® 242*

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Inspect the sensor cable for damage, check the cable continuity, check the cable connection. If loose, reconnect the cable. To confirm sensor operation, proceed to step *21*. If the cable is damaged, proceed to the next step.
4. Turn off and de-energize all energized circuits (for example: electrical, pneumatic, and hydraulic circuits).
5. Using compressed air and a clean rag, remove debris and grease from the outer surfaces of the Tool Changer body.
6. Disconnect the L3/U3 cables from the Lock/Unlock sensor assembly that is between Flat G and Flat H.
7. If replacing only the sensor assemblies, proceed to the next step. If replacing the sensor assemblies and/or cables, proceed to step *14*.
8. Using a 2.5 mm hex key, remove the (2) M3 socket head cap screws that secure the Lock/Unlock sensor assembly to the Tool Changer body.

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

9. Pull the sensor assembly straight out from the cable channel of the Tool Changer body.
10. Ensure the O-ring around the old sensor cylinder barrel is removed with the old sensor and does not remain attached to the Tool Changer body.

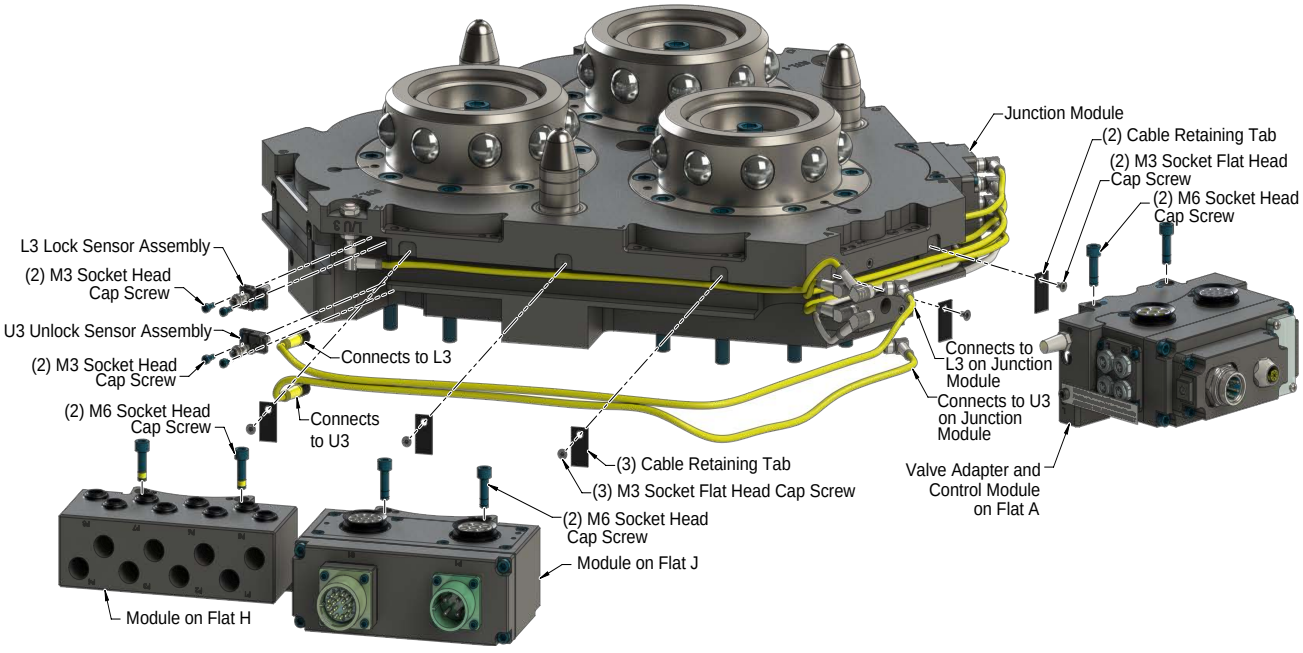
Figure 5.10—Lock/Unlock Sensor Removal and Installation



11. Install the new sensor assembly onto the Tool Changer body as shown in *Figure 5.10*.
12. Use a 2.5 mm hex key to secure the sensor assembly to the Tool Changer body using the (2) M3 socket head cap screws. Tighten the screws to 12 in-lbs (1.4 Nm).
13. If replacing only the sensor assemblies, reconnect the cables to the sensor assembly and proceed to step *20* to confirm operation. If replacing the cables, proceed to the next step.
14. Using a 5 mm hex key, remove the (2) M6 socket head cap screws securing the Control/Signal module to Flat A and remove the Control/Signal module from the Tool Changer body.

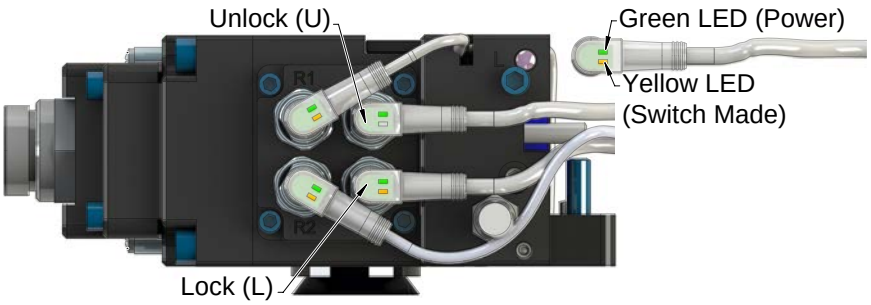
15. Remove modules and tabs to prepare for cable removal and installation:
    a. Remove any modules installed on Flat H and/or Flat J by removing the (2) M6 socket head cap screws securing each module to the Tool Changer body using a 5 mm hex key. Lift the modules off the Tool Changer body.
    b. Using a 2 mm hex key, remove the (3) M3 socket flat head cap screws and (3) cable retaining tabs on Flat H and Flat J of the Tool Changer body.
    c. Using a 2 mm hex key, remove the (2) M3 socket flat head cap screws and (2) cable retaining tabs on Flat A of the Tool Changer body.
16. Remove the L3/U3 cable installed within the channel of Flat H, Flat J, and Flat A. Discard the old cable.
17. Install the new cables:
    a. Connect a new L3/U3 cable to the Lock/Unlock sensor assembly and route the cable through the cable channel along the ledges of Flat H, Flat J and Flat A.
    b. Secure the cables within the cable channel along the edge of Flat H and Flat J using (3) M3 socket flat head cap screws and (3) cable retaining tabs. Tighten the screws to contact using a 2 mm hex key.
    c. Secure the cables within the cable channel along the edge of Flat A using the (2) M3 socket flat head cap screws and (2) cable retaining tabs. Tighten the screws to contact using a 2 mm hex key.
18. Connect the new L3/U3 cables to the appropriate connection on the junction box module.
19. Reinstall all previously installed modules.
    a. If the module(s) fasteners do not have pre-applied adhesive, apply Loctite 242 to the M6 socket head cap screws fasteners.
    b. Use (2) M6 socket head cap screws to secure each module to the Tool Changer body. Tighten the screws to 70 in-lbs (7.9 Nm) using a 5 mm hex key.

Figure 5.11—Lock and Unlock Sensor Assemblies (L3/U3) Cable Replacement



20. When repairs are complete, return circuits to normal operation.
21. Confirm the operation of the Unlock sensor by unlocking the Tool Changer. The Unlock sensor cable LED should turn on.
22. Confirm the operation of the Lock sensor by locking the Master to the Tool. The Lock sensor cable LED should turn on.

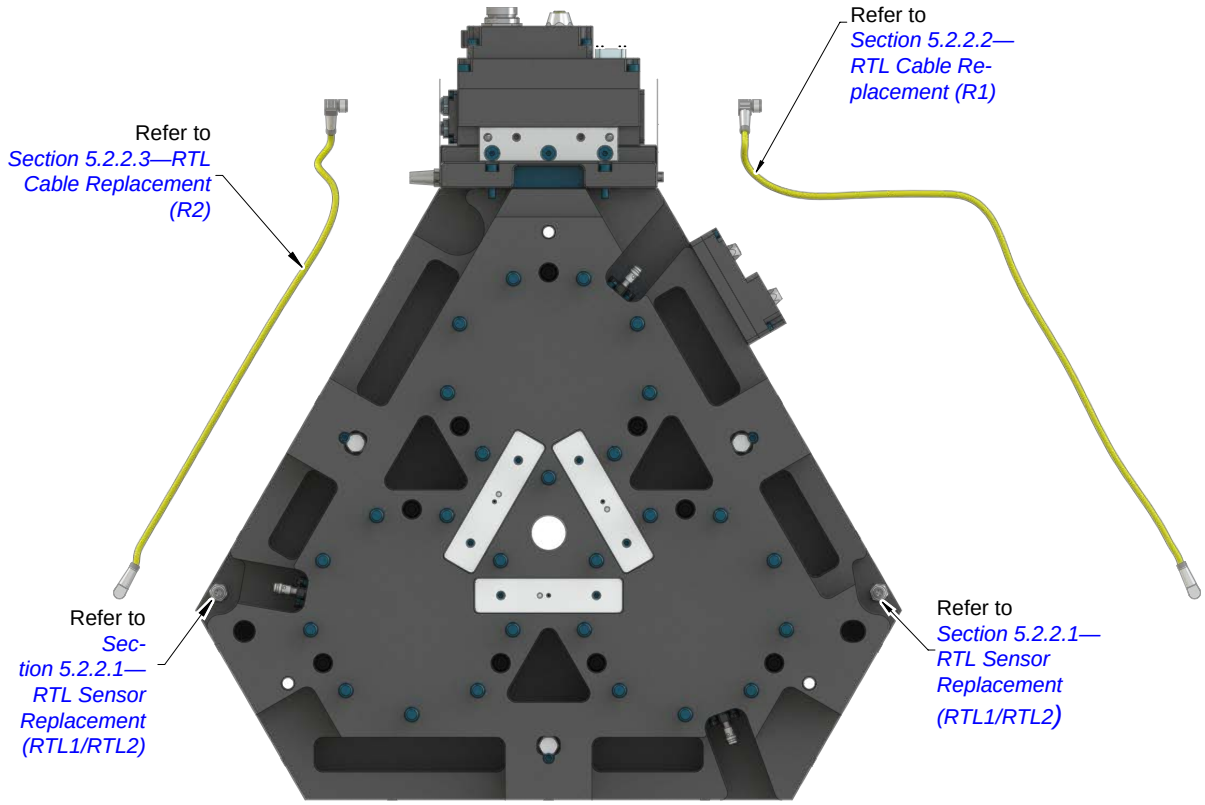
Figure 5.12—Unlock and Lock Sensor Cable LEDs



5.2.2 Ready-to-Lock (RTL) Sensor and Cable Replacement

The proximity sensors are designed for reliability and, therefore, should not require frequent replacement. If problems arise, examine all other possible solutions before replacing the sensor—check continuity, air supply, lubrication, pneumatic components, etc. For RTL sensor and sensor cable replacement, refer to the following sections:

Figure 5.13—RTL Cable Replacement



5.2.2.1 RTL Sensor Replacement (RTL1/RTL2)

Refer to *Figure 5.14*.

Parts required: *Section 6—Serviceable Parts*

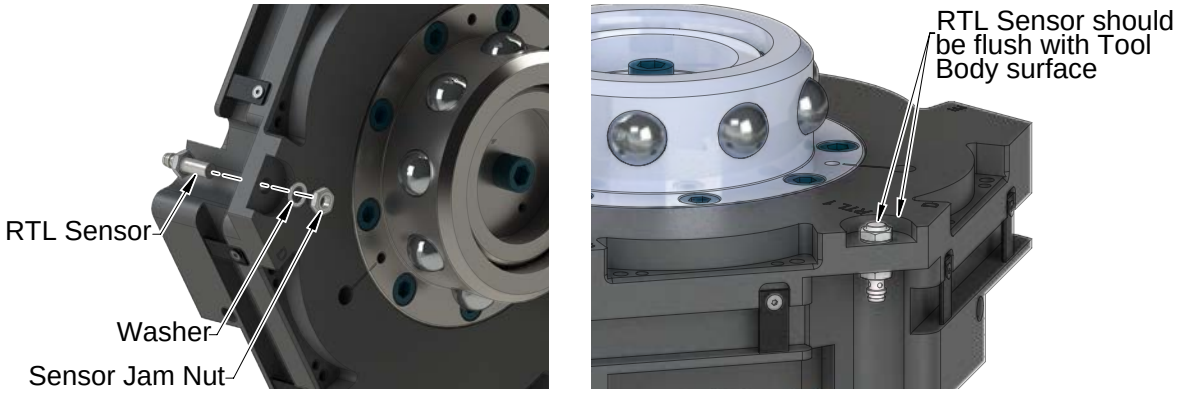
Tools required: *1/2" socket or wrench*

Supplies required: *Clean rag*

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Inspect the sensor cable for damage, check the cable continuity, check the cable connection.
   - If loose, reconnect the cable. Test sensor functionality. Proceed to step *14* to confirm sensor operation.
   - If damaged, replace the cable (refer to *Section 5.2.2.2—RTL Cable Replacement (R1)* and *Section 5.2.2.3—RTL Cable Replacement (R2)*). To replace the RTL sensor, proceed to the next step.
4. Turn off and de-energize all energized circuits, for example: electrical, pneumatic, and hydraulic circuits.
5. Using compressed air and a clean rag, remove debris and grease from the outer surfaces of the Tool Changer body.

6. Disconnect the RTL sensor cables from the RTL sensors. The RTL1 sensor is located between Flat C and Flat D; the RTL2 sensor is located between Flat G and Flat H
7. Loosen the jam nut that secures the sensor to the Tool Changer body.
8. Loosen the RTL sensor from the Tool Changer body using a 1/2'' socket or wrench. Discard the jam nut and washer located around the sensor.
9. Remove the RTL sensor from the Tool Changer body; discard the removed sensor.
10. Apply Loctite 222 to the RTL sensor bore in the Tool Changer body and screw the new RTL sensor into the Tool Changer body until the face of the sensor is flush with the surrounding face of the Master body.

Figure 5.14—Removal and Installation of RTL Sensor Assembly



11. Connect the RTL sensor cable to the new sensor.
12. Using a 1/2" socket or wrench, tighten the jam nut that secures the sensor to the Tool Changer body. Torque to 20 in-lbs (2.3 Nm).
13. When repairs are complete, return circuits to normal operation.
14. Confirm the operation of the RTL sensor by bringing a metallic object into close proximity to the face of the sensor. The LED in the body of the sensor should light up.

NOTICE: Some Control/Signal modules supply power to the RTL sensors in series. The RTL (R2) sensor will have to be switched before power is supplied to the RTL (R1) sensor. If this is the case bring a metallic object into close proximity of both the RTL (R1 and R2) sensor.

Figure 5.15—RTL (R1 and R2) Sensor Cable LEDs

5.2.2.2 RTL Cable Replacement (R1)

Refer to *Figure 5.16*

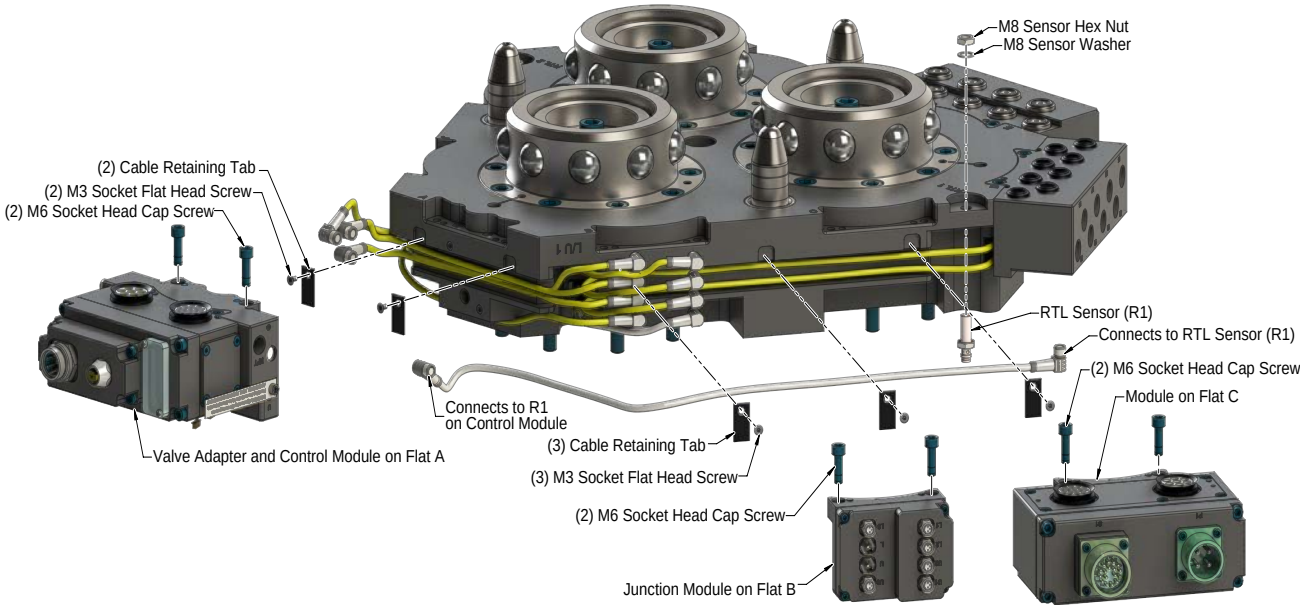
Parts required: *Section 6—Serviceable Parts*

Parts required: *2 mm and 5 mm hex key*

Supplies required: *Clean rag, 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, pneumatic, and hydraulic circuits).
4. Using compressed air and a clean rag, remove debris and grease from the outer surfaces of the Tool Changer body.
5. Disconnect the cable from the RTL1 Sensor located between Flat C and Flat D on the Tool Changer body.
6. Remove modules, junction box, and tabs to access the cable channels:
   a. Using a 5 mm hex key, remove the (2) M6 socket head cap screws that secure the valve adapter and Control/Signal module to Flat A and remove from the Tool Changer body.
   b. Using a 5 mm hex key, remove the (2) M6 socket head cap screws that secure the junction box to Flat B and remove from the Tool Changer body.
   c. Remove any module installed on Flat C by removing the (2) M6 socket head cap screws securing the module to the Tool Changer body using a 5 mm hex key. Lift the module off the Tool Changer body.
   d. Using a 2 mm hex key, remove the (3) M3 socket flat head cap screws and (3) cable retaining tabs along the edge of Flat B and Flat C of the Tool Changer body.
   e. Using a 2 mm hex key, remove the (2) M3 socket flat head cap screws and (2) cable retaining tabs along the edge of Flat A of the Tool Changer body.
7. Remove the RTL cable (R1) cable installed within the channel along Flat C, Flat B, and Flat A of the Tool Changer body. Discard the old cable.
8. Install the new cable:
   a. Connect the new cable to the RTL1 sensor.
   b. Route the new cable through the cable channel along the ledges of Flat C, Flat B and Flat A of the Tool Changer body.
   c. Secure the cables to the ledges of Flat C and Flat B using (3) M3 socket flat head cap screws and (3) cable retaining tabs. Tighten the screws to contact using a 2 mm hex key.
   d. Secure the cables to the ledge of Flat A using the (2) M3 socket flat head cap screws and (2) cable retaining tabs. Tighten the screws to contact using a 2 mm hex key.
9. Reinstall all previously installed modules. If the M6 socket head cap screws module(s) fasteners do not have pre-applied adhesive, apply Loctite 242 to the fasteners.
   a. Use (2) M6 socket head cap screws to secure each module to the Tool Changer body. Tighten the screws to 70 in-lbs (7.9 Nm) using a 5 mm hex key.
10. Connect the new RTL1 cable connector to the Control/Signal module (R1) on Flat A.

Figure 5.16—RTL1 Cable Replacement



11. When repairs are complete, return circuits to normal operation
12. Confirm the operation of the RTL sensor by bringing a metallic object into close proximity to the face of the sensor; refer to *Figure 5.17*. The LED in the sensor cable should light up.

NOTICE: Some Control/Signal modules supply power to the RTL sensors in series. The RTL2 sensor will have to be switched on before power is supplied to the RTL1 sensor. Should this be the case, bring a metallic object into close proximity of both the RTL (R1 and R2) sensors to test sensor functionality.

Figure 5.17—RTL Sensor Test

Figure 5.18—RTL (R1 and R2) Sensor Cable LEDs

5.2.2.3 RTL Cable Replacement (R2)

Refer to *Figure 5.19*

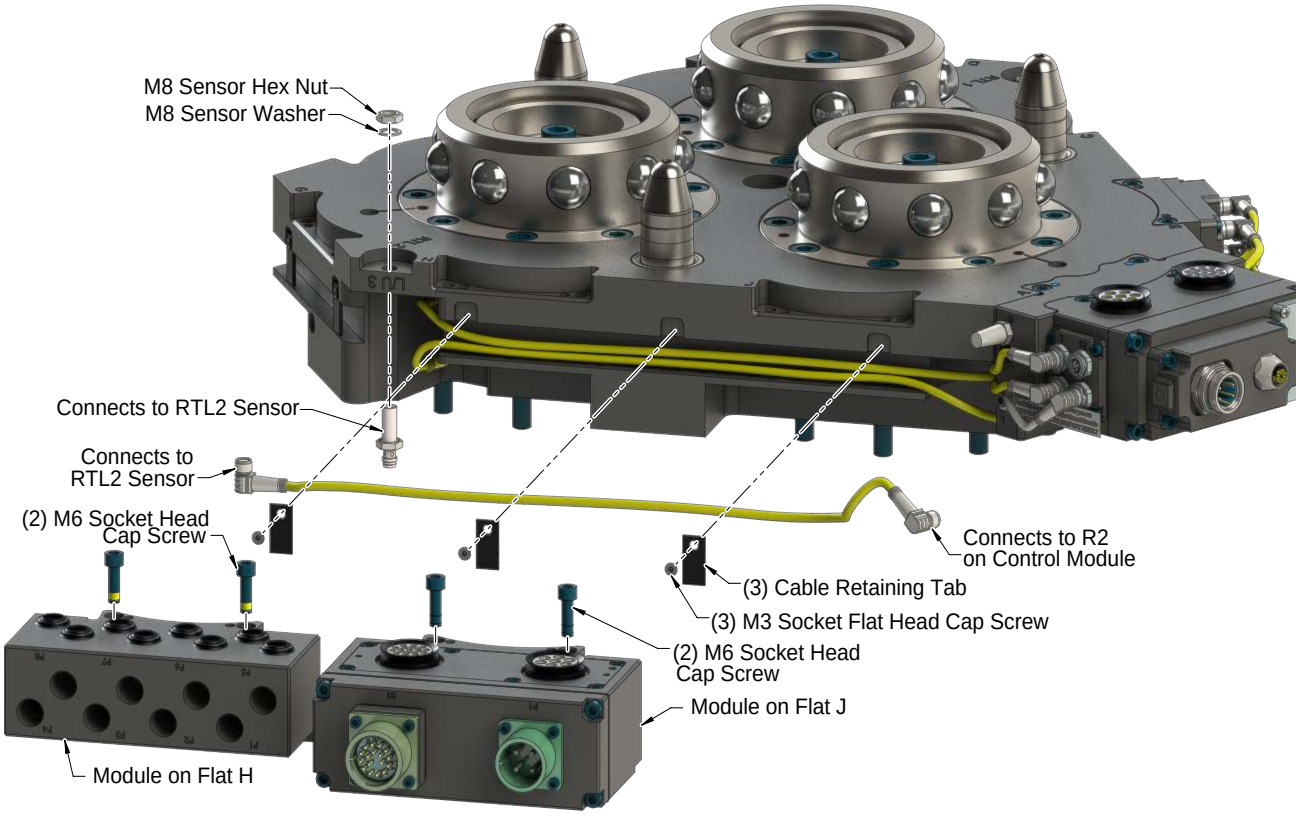
Parts required: *Section 6—Serviceable Parts*

Tools required: *2 mm and 5 mm hex key*

Supplies required: *Clean rag, 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, pneumatic, and hydraulic circuits.
4. Using compressed air and a clean rag, remove debris and grease from the outer surfaces of the Tool Changer body.
5. Disconnect the cable from the RTL2 Sensor.
6. Remove any module installed on Flat J and/or H by removing the (2) M6 socket head cap screws securing each module to the Tool Changer body using a 5 mm hex key. Lift the module(s) off the Tool Changer body.
7. Using a 2 mm hex key, remove the (3) M3 socket flat head cap screws and (3) cable retaining tabs along the edge of Flat H and Flat J of the Tool Changer body.
8. Remove the RTL2 cable installed within the channel along the ledges of Flat H, and Flat J of the Tool Changer body. Disconnect the cable from the Control/Signal module and discard the old cable.
9. Connect the new cable to the RTL2 Sensor.
10. Route the new cable into the cable channel along the ledges of Flat H and Flat J of the Tool Changer body.
11. Secure the cables to the ledge of Flat H and Flat J using (3) M3 socket flat head cap screws and (3) cable retaining tabs. Tighten the screws to contact using a 2 mm hex key.
12. Reinstall all previously installed modules. If the module(s) fasteners do not have pre-applied adhesive, apply Loctite 242 to the M6 socket head cap screws fasteners.
13. Install (2) M6 socket head cap screws to secure each module to the Tool Changer body using a 5 mm hex key. Tighten to 70 in-lbs (7.9 Nm).
14. Connect the new RTL2 cable connector to the Control/Signal module (R2) on Flat A.

Figure 5.19—RTL2 Cable Replacement



15. When repairs are complete, return circuits to normal operation
16. Confirm the operation of the RTL sensor by bringing a metallic object into close proximity to the face of the sensor. The LED in the sensor cable should light up.

Figure 5.20—RTL Sensor Test

Figure 5.21—RTL (R1 and R2) Sensor Cable LEDs

5.2.3 Alignment Pin Replacement

Refer to *Figure 5.22*.

Parts required: *Refer to Section 6—Serviceable Parts*

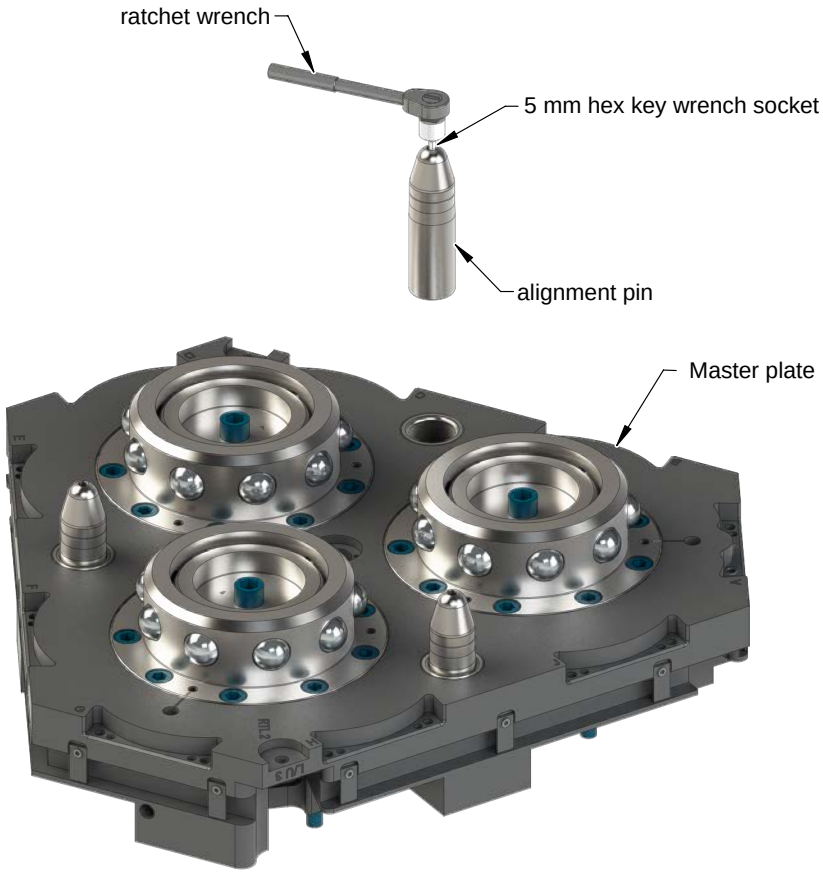
Tools required: *5 mm hex key socket, torque wrench*

Supplies required: *Clean rag, MobilGrease® XHP222, Loctite® 242*

1. Place the Tool in a secure location.
2. Turn off and de-energize all energized circuits, for example: electrical, pneumatic, and hydraulic circuits.
3. Using compressed air and a clean rag, remove debris and grease from the outer surfaces of the Tool Changer body.
4. Unscrew the alignment pin assembly from the Master plate using a 5 mm hex key socket. If the alignment pin cannot be removed, contact ATI-Industrial Automation (*Applications.Engineers@novanta.com*).

NOTICE: If the pin cannot be removed using the hex key in the tip, it may be necessary to remove it by other means, such as locking pliers.

Figure 5.22—Alignment Pin Removal



5. Apply Loctite 242 to the female threads of the alignment pin.
6. Install the alignment pin into the bushing on the Tool Changer. Tighten to 60 in-lbs (6.8 Nm).
7. Apply MobilGrease XHP222 Special grease to the alignment pin (see *Section 4.2—Cleaning and Lubrication of the Locking Mechanism and Alignment Pins*).
8. When repairs are complete, safely return normal operation.

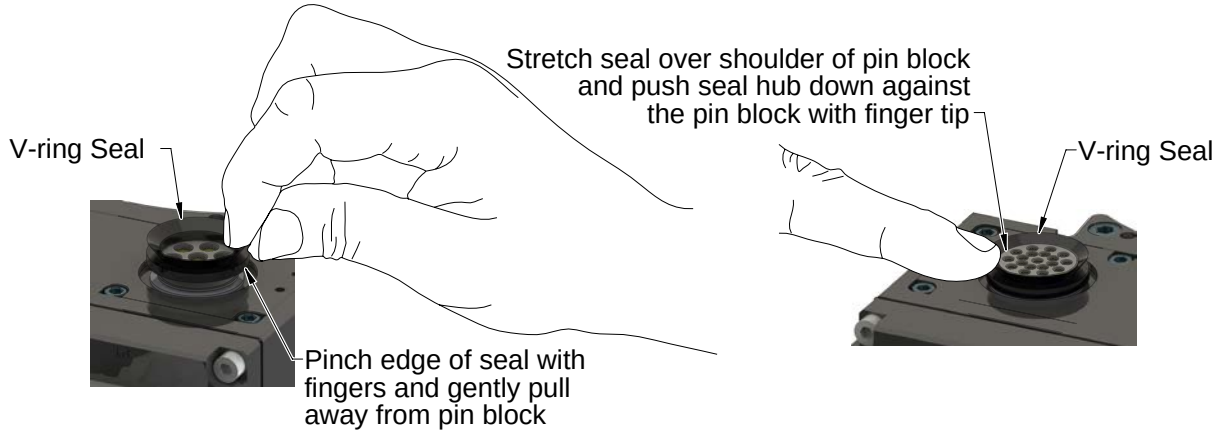
5.2.4 Seal Inspection and Replacement

Parts required: *Refer to Section 6—Serviceable Parts*

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

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

Figure 5.23—V-ring Seal Replacement



6. Serviceable Parts

6.1 Common Master Serviceable Parts

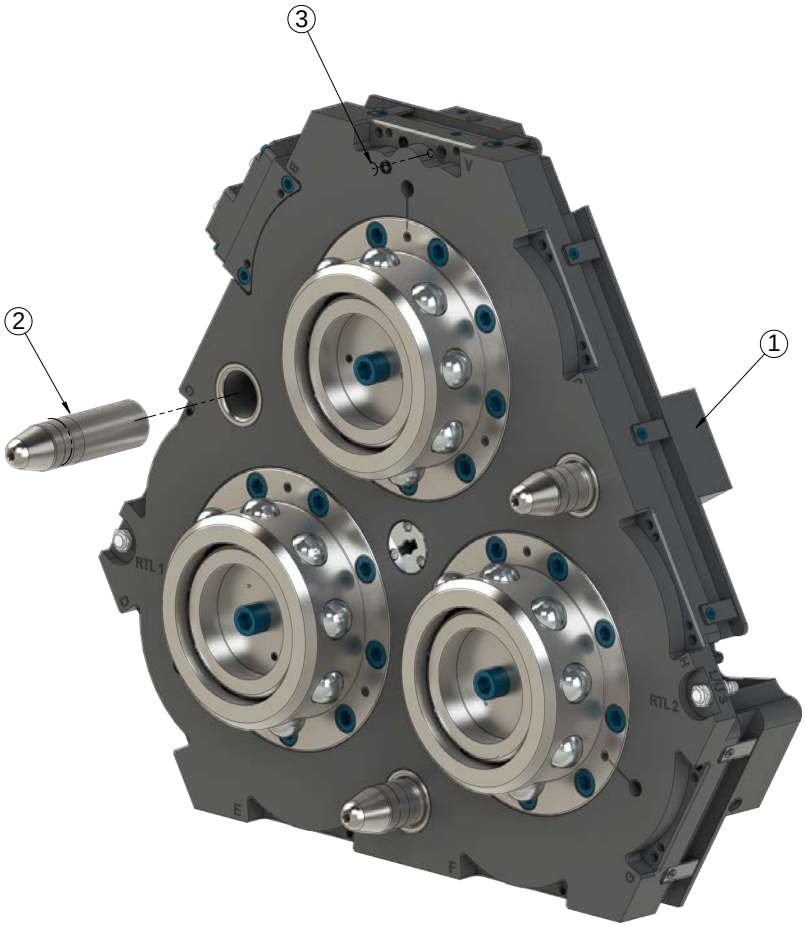


Table 5.2—Common Master Parts			
Item No.	**Qty**	**Part Number**	**Description**
1	**1**	9121-1310M-0-JB-0-0-0-0-0-0-S0	QC-1310 Master with Screw Connect RTL Sensors, LED Cables, Junction Box. Requires Air/Control/ Signal Module.
		9121-1310M-0-JB-0-0-0-0-0-0-SM3	QC-1310 Master with Screw Connect PNP Lock/ Unlock and RTL Sensors, LED Cables, Junction Box. Requires Air/Control/Signal Module.
2	3	3700-20-6025	Alignment Pin, Two Piece, 1-1/8” Dia., Stepped
3	2	3410-0001052-01	O-ring for Flat A

6.2 Models 9121-1310M-0-JB-0-0-0-0-0-0-0-SM/-SM3

For common serviceable parts, refer to *Section 6.1—Common Master Serviceable Parts*.

6.2.1 Cables, Sensor Assemblies, and Junction Box

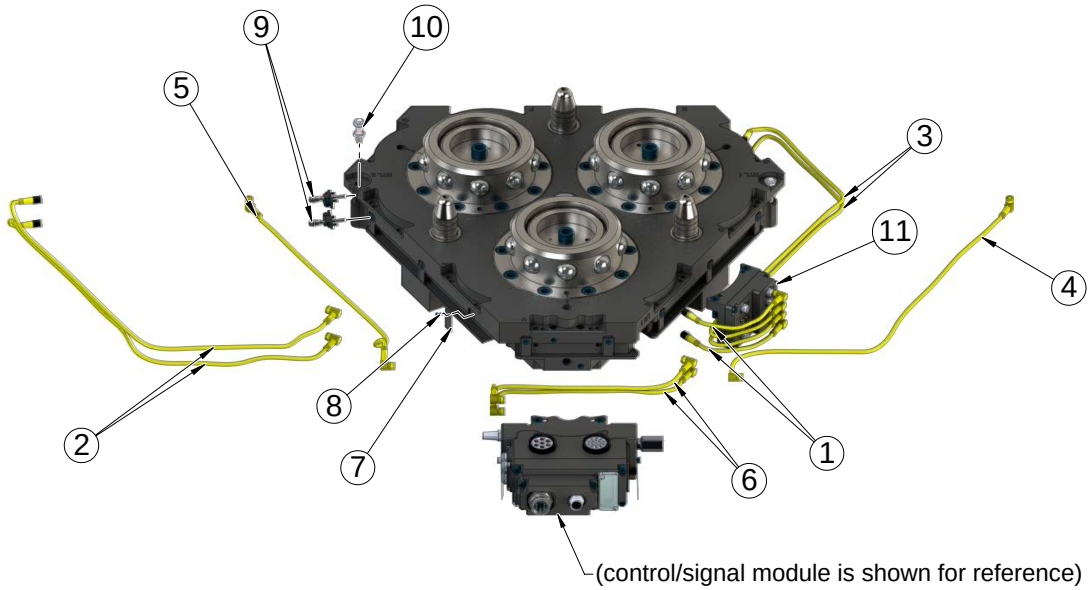


Table 5.3—Cables, Sensors, and Junction Box					
Item No.	Qty	Part Number	Description	Model	
				SM0	SM3
Lock and Unlock Sensor Cables on Master Plate (L/U 1, L/U 2, L/U 3)					
1	2	9120-C-3PF-3PM90-0021-PNP	PNP Lock/Unlock 1 Cable, 0.21 m, L1 & U1 to junction box		✓
2	2	9120-C-3PF-3PM90-0072-PNP	PNP Lock/Unlock 2 Cable, 0.72 m, L2 & U2 to junction box		✓
3	2	9120-C-3PF-3PM90-0068-PNP	PNP Lock/Unlock 3 Cable, 0.68 m, L3 & U3 to junction box		✓
RTL Sensor Cables (R1 and R2)					
4	2	9120-C-3PF90-3PM90-0064-PNP	PNP RTL 1 Cable, 0.64 m, RTL1 to control/signal module	✓	✓
5	2	9120-C-3PF90-3PM90-0046-PNP	PNP RTL 2 Cable, 0.46 m, RTL2 to control/signal module	✓	✓
Lock and Unlock Sensor Cables for the Control/Signal Module					
6	2	9120-C-3PF90-3PM90-0036-PNP	PNP Primary Lock/Unlock Cable, 0.36 m, L & U to control/signal module		✓
Cable Tabs					
7	15	3700-20-4092	Cable Retaining Tab	✓	✓
8	15	3500-1258006-11	M3 x 6 Socket Flat Head Screw	✓	✓
Lock/Unlock Sensor Assemblies					
9	3	9005-20-1917	PNP Lock/Unlock Sensor Assembly		✓
RTL Sensor Assemblies					
10	2	9005-20-2301	PNP RTL Sensor Assembly (screw)	✓	✓
Junction Box					
11	1	9000-20-1499	PNP Lock/Unlock Daisy-Chain Junction Box		✓

Note:
1. -S0 version uses a sensor cover plate, ATI P/N 9005-20-1983.

6.3 Tool Plate Serviceable Parts

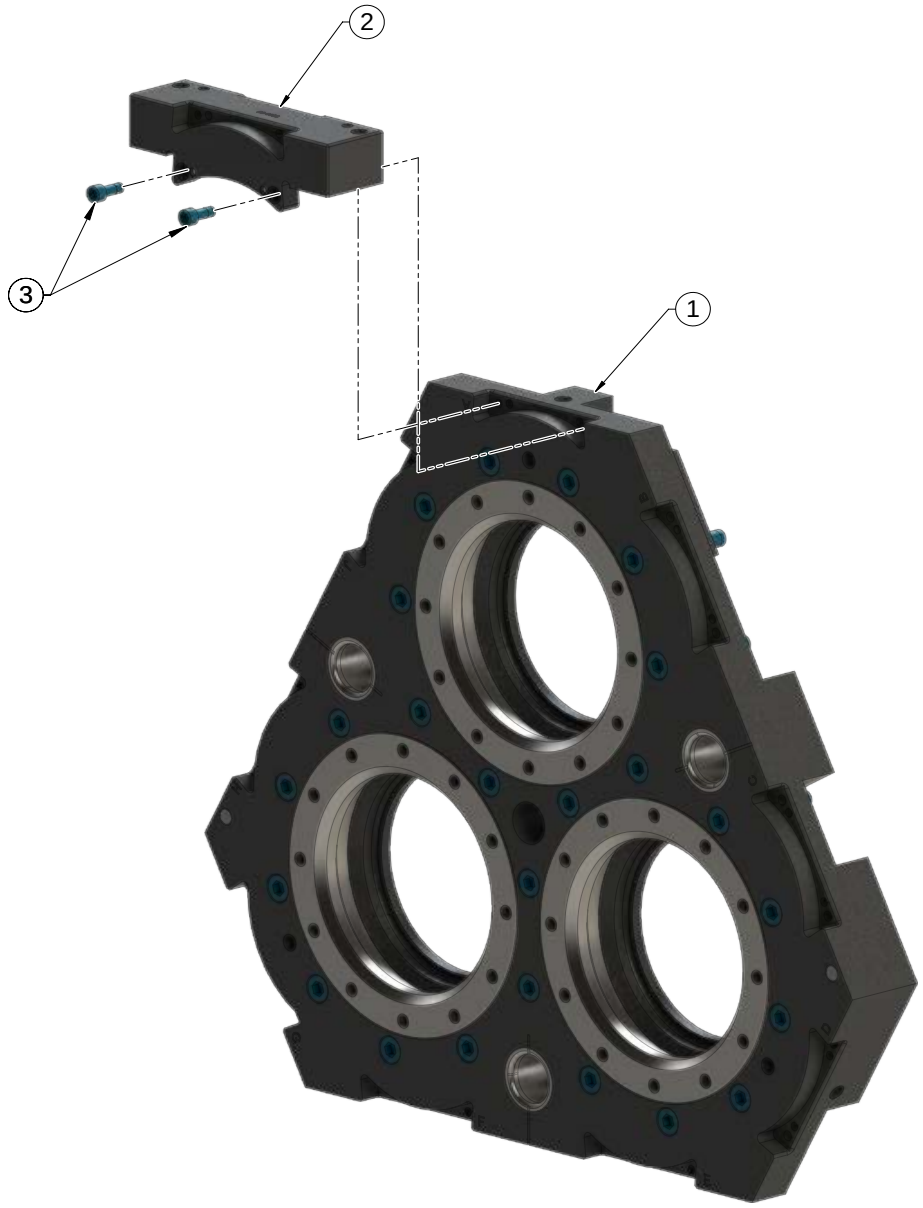


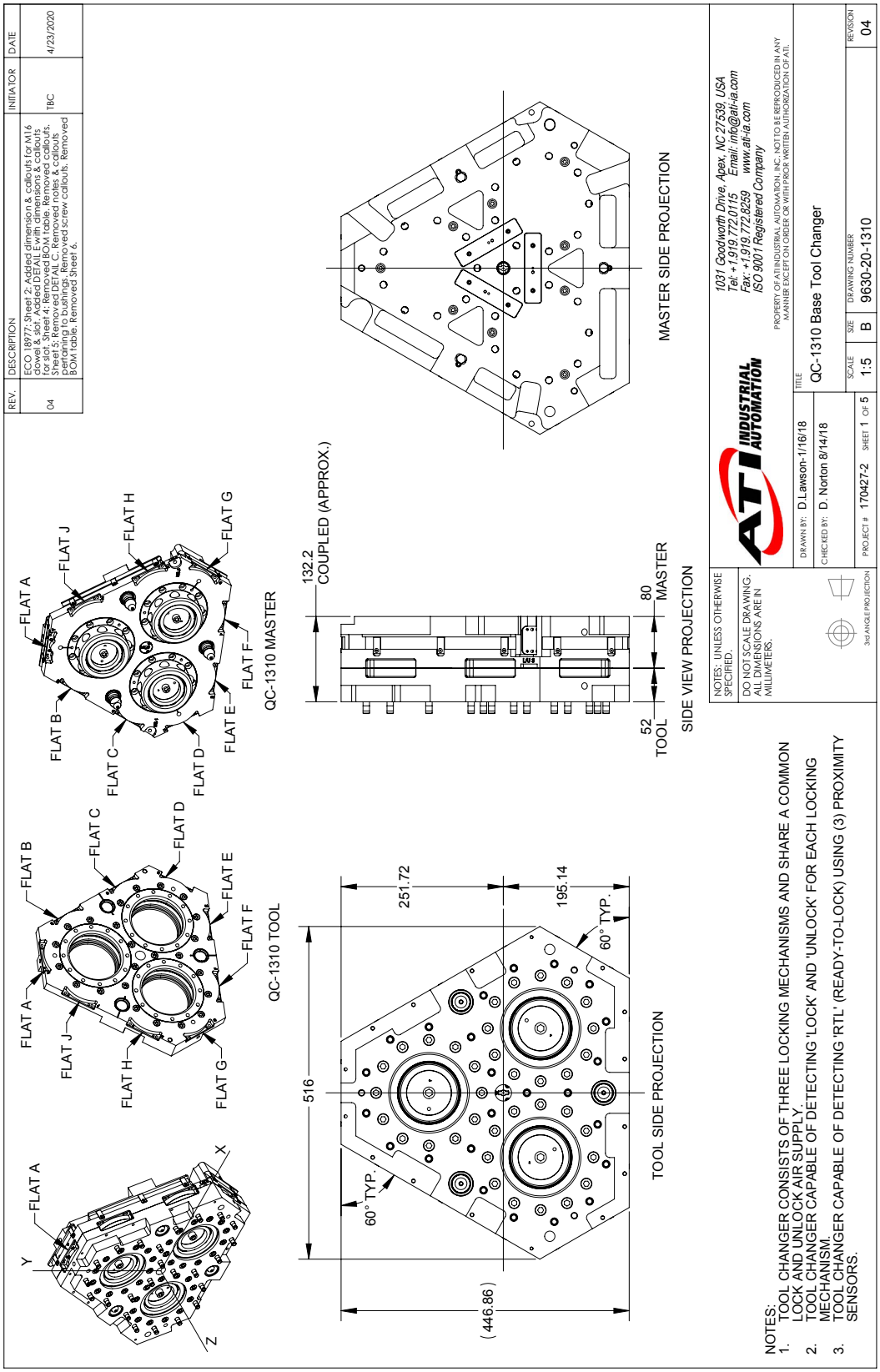
Table 5.4—Tool Plate			
Item No.	**Qty**	**Part Number**	**Description**
1	1	9121-1310T-0-0-0-0-0-0-0-0-0	QC-1310 Base Tool Assembly, No Options
2	1	9005-20-1605	QC-1310 Tool Junction Module Adapter Assembly
3	2	3500-1066020-15A	M6 x 20 mm socket head cap screws Blue Microspheres

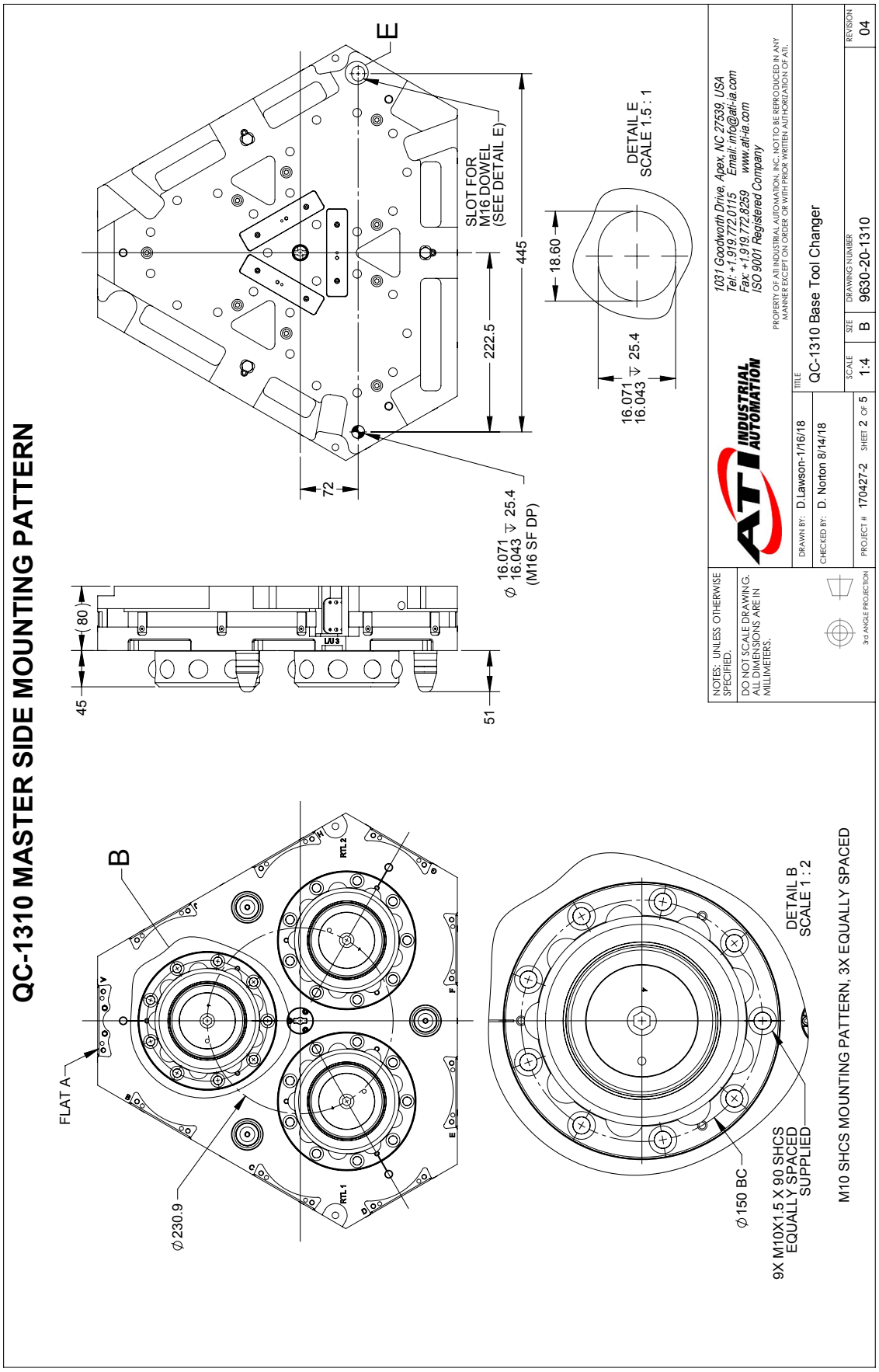
7. Specifications

Table 5.5—Master and Tool Plates		
Recommended Max Payload	6600 lbs. (2990 kg)	The mass attached to the Tool Changer.
Operating Temperature Range	-20°–150°F (-30°–66°C)	Optimal operating temperature.
Operating Pressure Range	4.1–6.9 bar (60–100 psi)	Locking mechanism supply pressure operating range. Supply to be clean, dry, and filtered to 40 micron or better.
Coupling Force @ 80 psi	26,000 lbs. (110,000 N)	Axial holding force
Recommended Max Moment X-Y (Mxy) **Recommended Max Torque about Z (Mz)**	97,500 in-lb (11,000 Nm) 111,000 in-lb (12,600 Nm)	Maximum recommended working load for optimum performance of the Tool Changer Maximum recommended working torque for optimum performance of the Tool Changer
Positional Repeatability	0.0006” (0.0152 mm)	Repeatability tested at rated load at one million cycles.
Weight (coupled, no access.)	142 lbs. (64 kg)	Master 95 lbs (43 kg) / Tool 47 lbs (21 kg)
Max. Recommended distance between Master and Tool plate	0.065” (1.65 mm)	No-Touch locking technology allows the Master and Tool plates to lock with separation when coupling.
Sensor Information, signal name	L/U (Lock/Unlock) RTL (Ready-To-Lock)	Internal proximity sensors (6) with cable and connector to indicate locking mechanism position. Proximity sensors (2) with cable and connector for direct wiring to Control/Signal module to indicate Master and Tool mating surfaces within close proximity of each other.
Mounting/Customer Interface	Master plate Tool plate	See *Section 8—Drawings*

8. Drawings

8.1 QC-1310 Tool Changer




QC-1310 MASTER SIDE MOUNTING PATTERN
E
SLOT FOR
M16 DOWEL
(SEE DETAIL E)
445
222.5
72
16.071
16.043 ∓ 25.4
(M16 SF DP)
DETAIL E
SCALE 1.5 : 1
18.60
16.071
16.043 ∓ 25.4
(80)
45
51
B
FLAT A
Φ230.9
Φ150 BC
9X M10X1.5 X 90 SHCS
EQUALLY SPACED
SUPPLIED
DETAIL B
SCALE 1 : 2
M10 SHCS MOUNTING PATTERN, 3X EQUALLY SPACED
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
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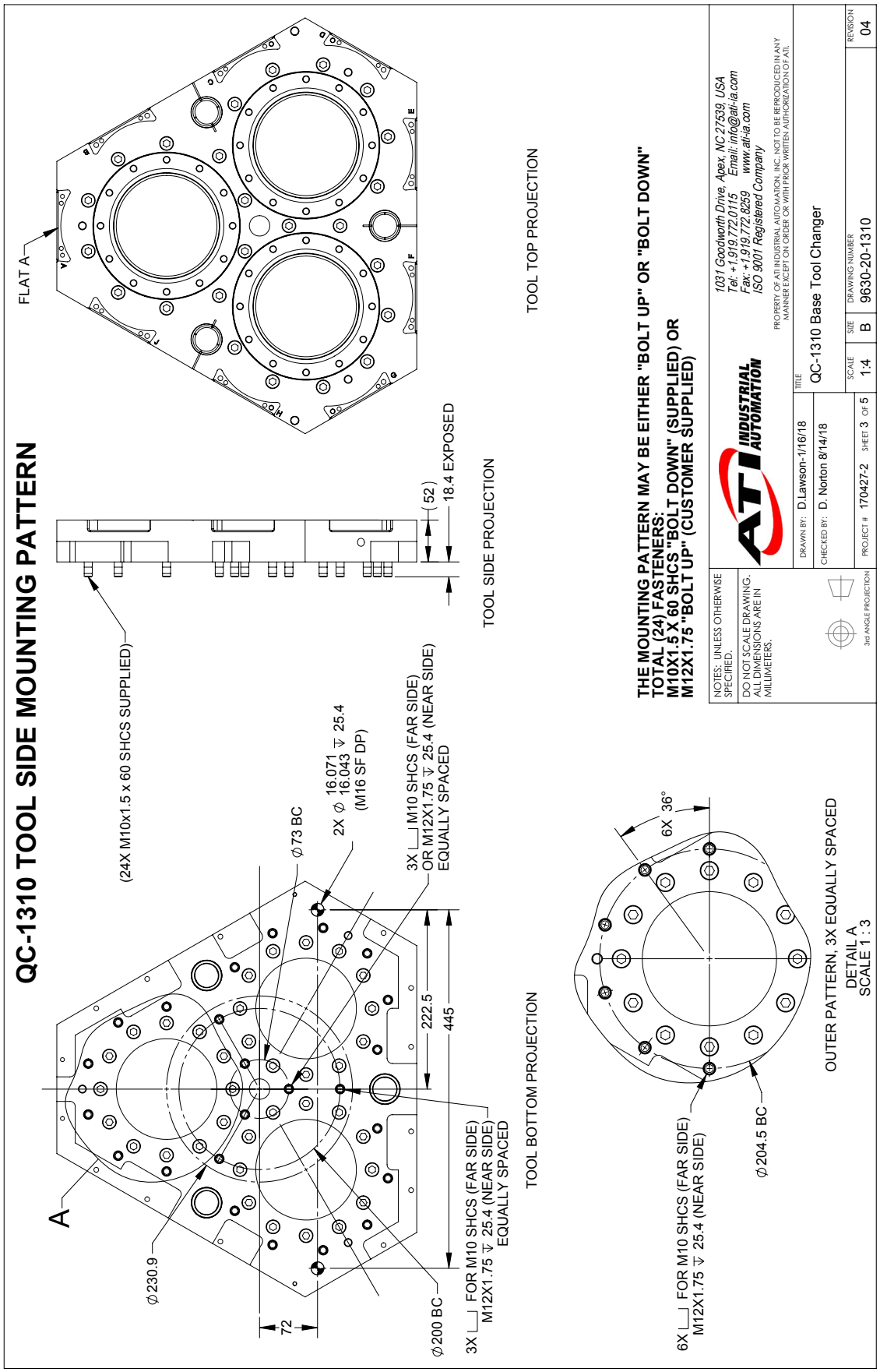
INDUSTRIAL AUTOMATION
NOTES: UNLESS OTHERWISE SPECIFIED.
DO NOT SCALE DRAWING. ALL DIMENSIONS ARE IN MILLIMETERS.
DRAWN BY: D.Lawson-1/16/18
CHECKED BY: D. Norton 8/14/18
TITLE
QC-1310 Base Tool Changer
SCALE 1:4
SIZE B
DRAWING NUMBER 9630-20-1310
REVISION 04
PROJECT # 170427-2 SHEET 2 OF 5
3rd ANGLE PROJECTION


QC-1310 TOOL SIDE MOUNTING PATTERN
FLAT A
TOOL TOP PROJECTION
(24X M10x1.5 x 60 SHCS SUPPLIED)
52
18.4 EXPOSED
TOOL SIDE PROJECTION
THE MOUNTING PATTERN MAY BE EITHER "BOLT UP" OR "BOLT DOWN"
TOTAL (24) FASTENERS:
M10X1.5 X 60 SHCS "BOLT DOWN" (SUPPLIED) OR
M12X1.75 "BOLT UP" (CUSTOMER SUPPLIED)
Ø73 BC
2X Ø 16.071 ∓ 25.4
16.043
(M16 SF DP)
3X └┘ M10 SHCS (FAR SIDE)
OR M12X1.75 ∓ 25.4 (NEAR SIDE)
EQUALLY SPACED
222.5
445
A
Ø230.9
72
Ø200 BC
3X └┘ FOR M10 SHCS (FAR SIDE)
M12X1.75 ∓ 25.4 (NEAR SIDE)
EQUALLY SPACED
TOOL BOTTOM PROJECTION
6X 36°
6X └┘ FOR M10 SHCS (FAR SIDE)
M12X1.75 ∓ 25.4 (NEAR SIDE)
Ø204.5 BC
OUTER PATTERN, 3X EQUALLY SPACED
DETAIL A
SCALE 1 : 3
NOTES: UNLESS OTHERWISE SPECIFIED.
DO NOT SCALE DRAWING. ALL DIMENSIONS ARE IN MILLIMETERS.
3rd ANGLE PROJECTION
DRAWN BY: D.Lawson-1/16/18
CHECKED BY: D. Norton 8/14/18
PROJECT # 170427-2 SHEET 3 OF 5
TITLE
QC-1310 Base Tool Changer
SCALE 1:4
SIZE B
DRAWING NUMBER 9630-20-1310
REVISION 04
ATI INDUSTRIAL AUTOMATION
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
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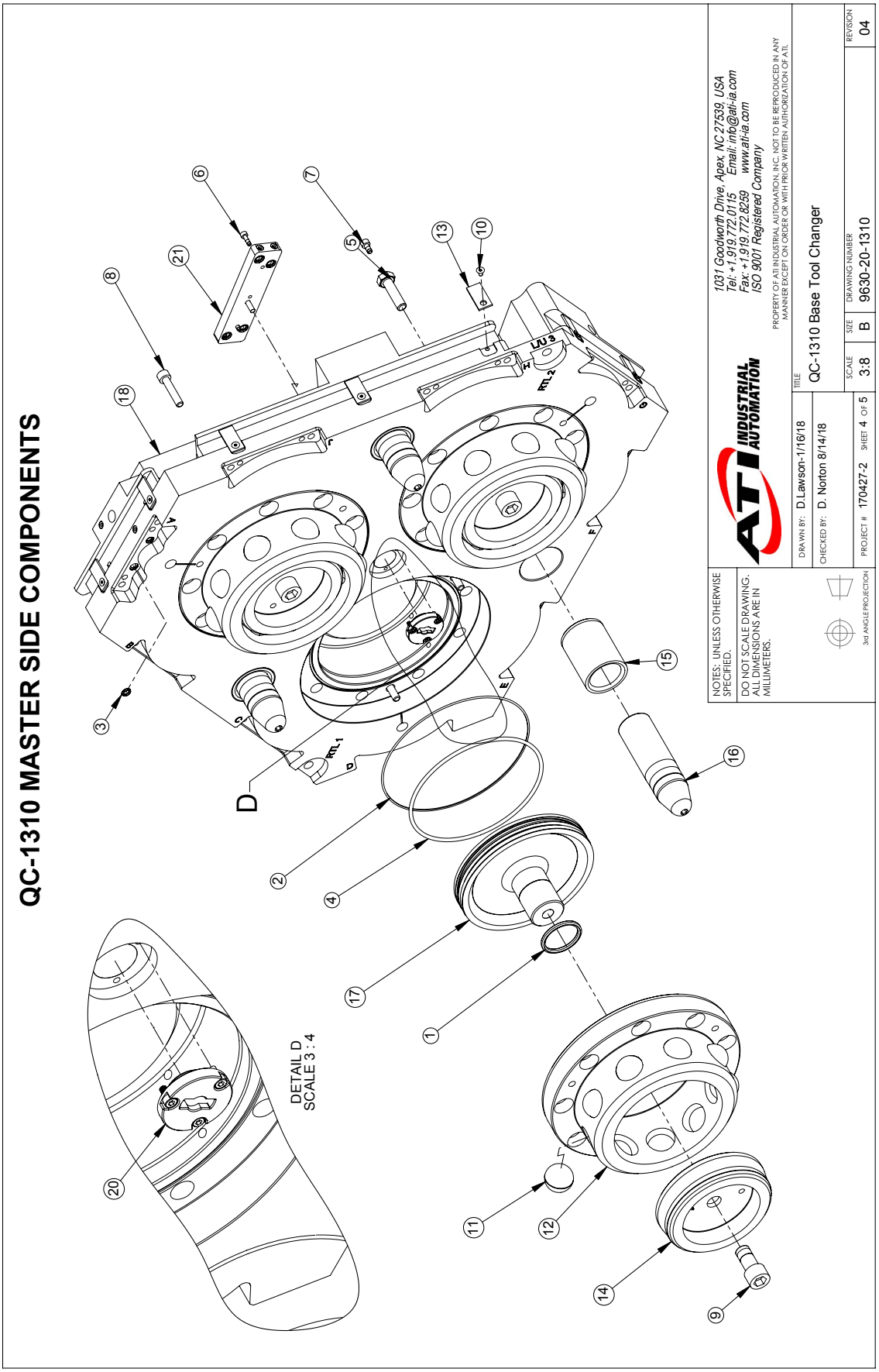
QC-1310 MASTER SIDE COMPONENTS
DETAIL D
SCALE 3 : 4
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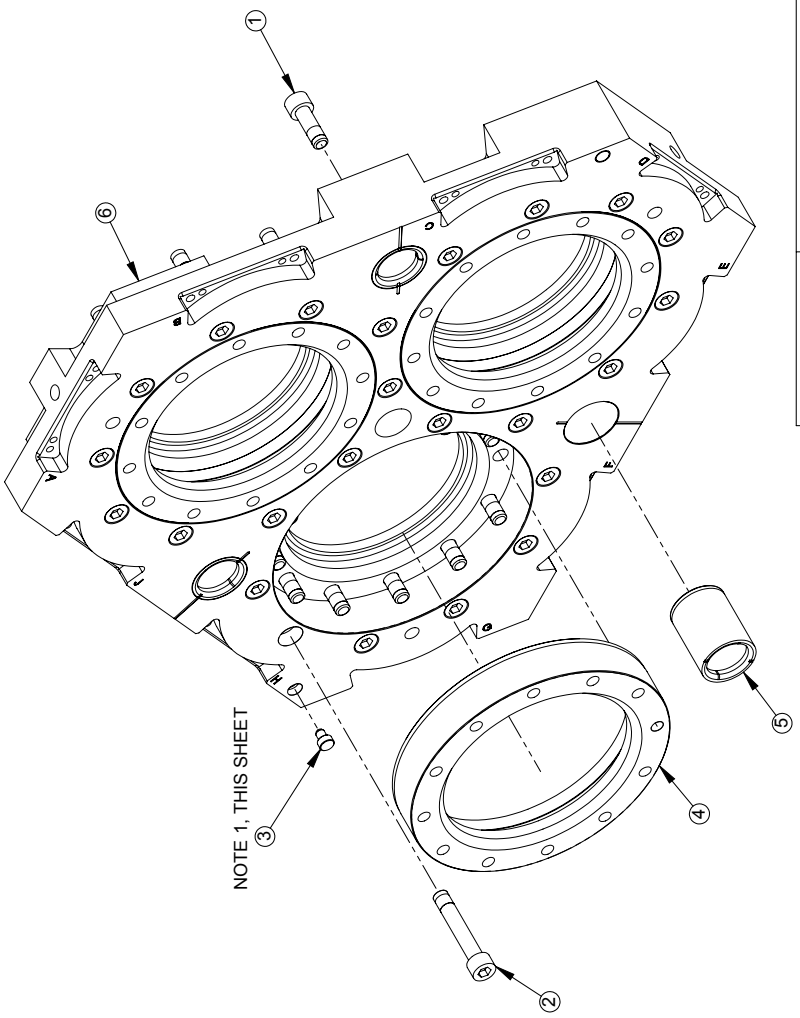
NOTES: UNLESS OTHERWISE SPECIFIED.
DO NOT SCALE DRAWING. ALL DIMENSIONS ARE IN MILLIMETERS.
DRAWN BY: D.Lawson-1/16/18
CHECKED BY: D. Norton 8/14/18
PROJECT # 170427-2
SHEET 4 OF 5
TITLE
QC-1310 Base Tool Changer
SCALE 3:8
SIZE B
DRAWING NUMBER 9630-20-1310
REVISION 04
3rd ANGLE PROJECTION

QC-1310 TOOL SIDE COMPONENTS



NOTES: (SHEET 5)

1. PRESS BUTTONS FLUSH WITH BODY (+0 / 0.010").

NOTES: UNLESS OTHERWISE SPECIFIED.

DO NOT SCALE DRAWING. ALL DIMENSIONS ARE IN MILLIMETERS.

3rd ANGLE PROJECTION

DRAWN BY: D.Lawson-1/16/18

CHECKED BY: D. Norton 8/14/18

PROJECT # 170427-2 SHEET 5 OF 5

TITLE: QC-1310 Base Tool Changer

SCALE: 3:8

SIZE: B

DRAWING NUMBER: 9630-20-1310

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INDUSTRIAL AUTOMATION

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