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B. Base Tool Changer

MC-16—Manual Tool Changer

1. Product Overview

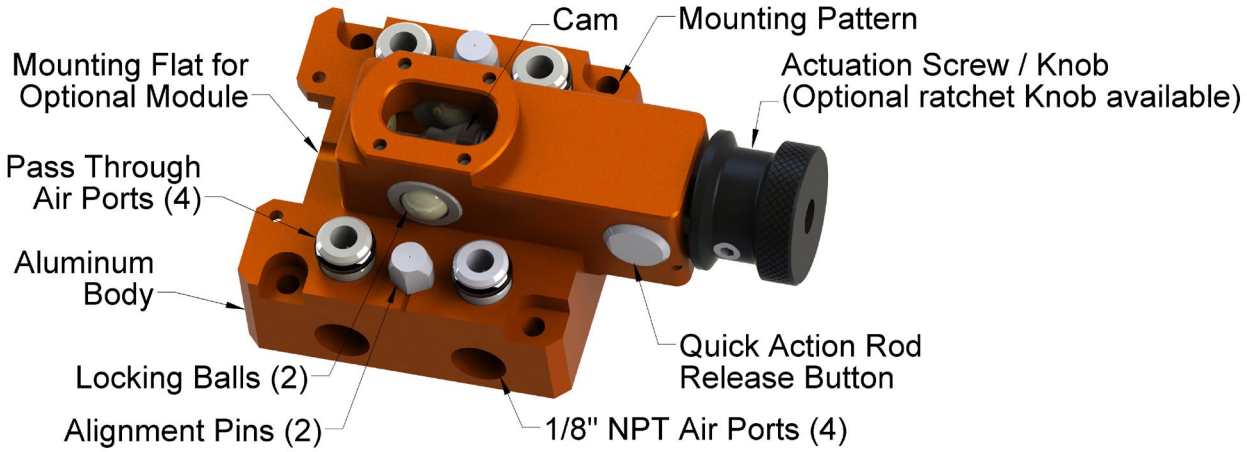
1.1 Master Plate Assembly

The Master base assembly includes an anodized aluminum body, a hardened stainless-steel locking mechanism, and hardened steel alignment pins (see *Figure 1.1*).

The Master plate assembly is equipped with four pass through air ports, 1/8” NPT port are provided in the body for the pneumatic connections. The body or Master plate has one flat side for mounting of optional modules.

The locking mechanism consists of a tapered cam, a set of hardened steel ball bearings, a steel threaded rod, and a spring-loaded quick-action rod release mechanism. The surfaces on the cam are tapered and contact balls as the rod is pushed in or tightened. When the Master and Tool are brought together, the user pushes the button to release the cam toward the lock position. Then the user applies the final tightening torque by twisting the knob. This final tightening is required to ensure the unit has full locking force applied. The ball bearings slide on the tapered surfaces of the Tool-side to apply the lock. Tapered pins located on the Master body mate with holes in the Tool body to ensure repeatable alignment during the coupling process. An extreme pressure grease is applied to the cam and pins to enhance performance and maximize the life of the Master assembly.

Figure 1.1—Master Plate Assembly



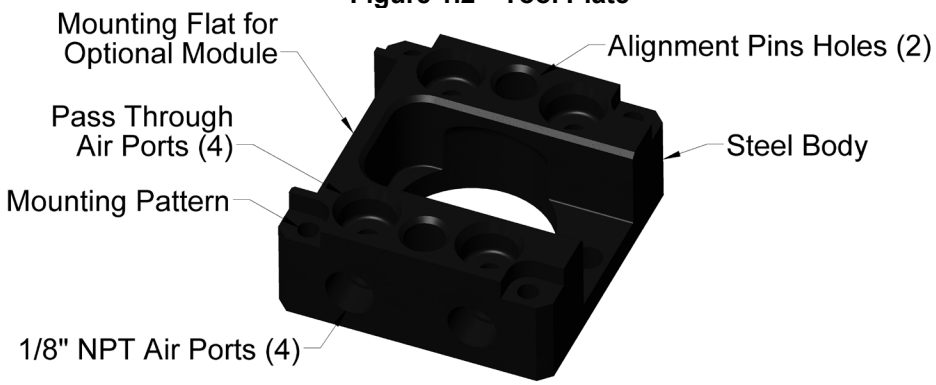
1.1.1 Optional Ratchet Knob

An optional ratchet knob is available to provide additional protection in application where extreme vibrations can cause the actuation to become loose. The ratchet knob locks in the closed position preventing it from coming loose during operation.

1.2 Tool Plate

The hardened steel body of the Tool plate has one flat side for the mounting of optional modules. The Tool plate is equipped with four pass through air ports, 1/8” NPT port are provided in the body for the pneumatic connections.

Figure 1.2—Tool Plate



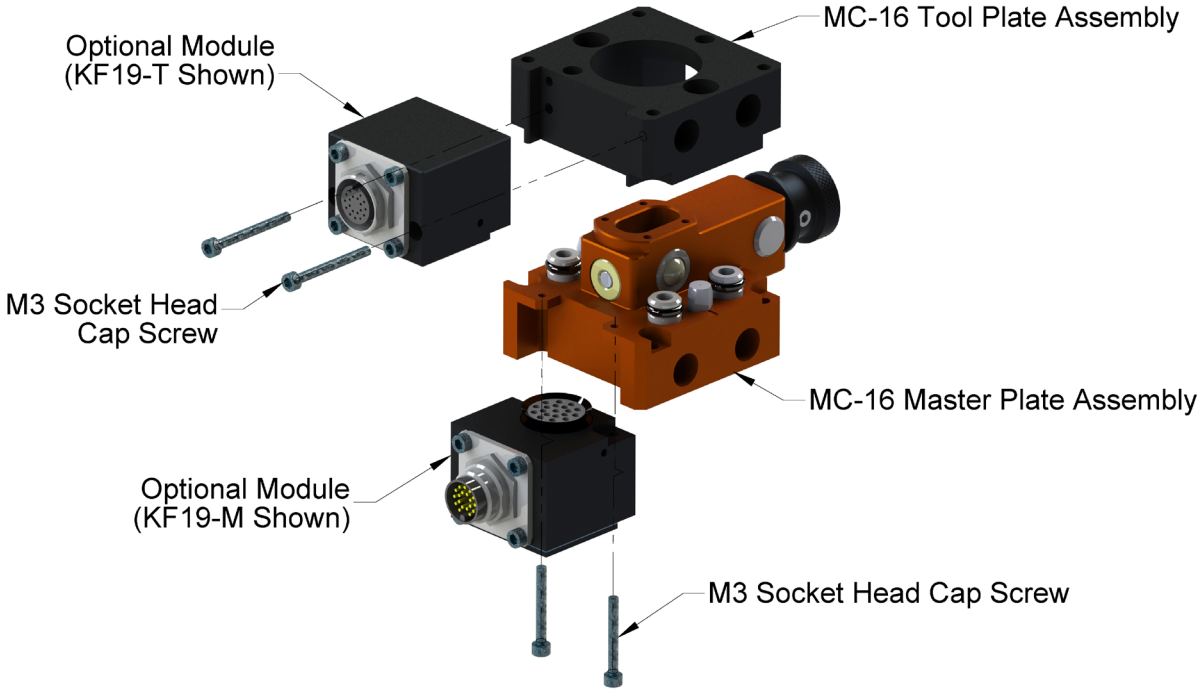
1.3 Optional Modules

There is one flat available for the mounting of the optional modules for support of various utility pass-through, such as electrical signals.

For assistance in choosing the right modules for your particular application, visit our website to see what is available or contact an ATI Sales Representative directly.

The optional modules are mounted to the Master or Tool Plate using a common side mounting feature. Only (2) socket head cap screws need to be unscrewed in order to remove the module from the Master/Tool Plate.

Figure 1.3—Optional Modules



2. Installation

All fasteners used to mount the Tool Changer to the robot and to user Tools should be tightened to a torque value as indicated below. Furthermore, removable Loctite 222® must be used on M4 and M5 fasteners.

> **CAUTION:** Care should be taken to select fasteners for mounting that are not too long, such that a gap is formed at the interface

Mounting conditions	Fastener Size and Property Class	Maximum Recommended Torque
Master Plate to interface plate (6061-T6 aluminum) Minimum thread engagement of 6mm (0.24”) [1.5X fastener Ø]	M4–0.7 Class 12.9	12 in-lbs
Master Plate to Robot (steel; USS ≥ 90KSI) Minimum thread engagement of 6mm (0.24”) [1.5X fastener Ø]	M4–0.7 Class 12.9	25 in-lbs
IP to Master Plate (6061-T6 aluminum) M5 threads into body Minimum thread engagement of 7.5mm (0.30”) [1.5X fastener Ø]	M5–.8 Class 12.9	25 in-lbs
Tool Plate to TIP (6061-T6 aluminum) Minimum thread engagement of 9mm (0.35”) [1.5X fastener Ø]	M4–0.7 Class 12.9	12 in-lbs
Tool Plate to TIP (steel; USS ≥ 90KSI) Minimum thread engagement of 9mm (0.35”) [1.5X fastener Ø]	M4–0.7 Class 12.9	25 in-lbs
TIP to Tool Plate (steel) M5 threads into body Minimum thread engagement of 7.5mm (0.30”) [1.5X fastener Ø]	M5–.8 Class 12.9	25 in-lbs

2.1 Master Interface

The Master assembly is attached to the robot arm. The Master Plate is designed with bolt holes and dowel holes as mounting features. These features are used to accurately position and secure the Master to the robot. An interface plate is utilized to adapt the Master Plate to a specific robot flange that is not compatible with the Master Plate mounting features. Custom interface plates are available upon request. (Refer to *Section 8—Drawings* for technical information on mounting features.)

If the customer chooses to design and build a robot interface plate, the following should be considered:

- The interface plate should be designed to include bolt holes for mounting, and dowel pins for accurate positioning on the robot and Master Plate.
- The thickness of the interface plate must be great enough to provide the necessary thread engagement for the mounting bolts.
- The interface plate must be properly designed to provide rigid mounting to the Master Plate boss area.
- The plate design should take into account clearances required for Tool Changer module attachments and accessories.

2.2 Tool Interface

The Tool Plate is attached to customer-supplied tooling. The Tool Plate is designed with bolt and dowel holes as mounting features. These features are used to accurately position and secure the end-effector. Most often an End-effector Interface Plate (EIP) is utilized to adapt the Tool Plate to an end-effector that is not compatible with the Tool Plate mounting features.

Custom EIPs can be supplied by ATI to meet customer requirements (Refer to *Section 8—Drawings* for technical information on mounting features.).

When the customer chooses to design and build an End-effector Interface Plate, the following should be considered:

- The interface plate should be designed to include bolt holes for mounting, and dowel pins for accurate positioning.
- The thickness of the interface plate must be great enough to provide the necessary thread engagement for the mounting bolts.
- The plate design should take into account clearances required for Tool Changer module attachments and accessories.

2.3 Optional Module Installation

The optional modules are typically installed by ATI prior to shipment. The following the steps outlining the field installation and removal of optional modules.

2.3.1 Installing Optional Modules

1. Clean the mounting surfaces.
2. Align the module to the mounting flat as shown in *Figure 1.3*.
3. If fasteners do not have pre-applied adhesive, apply Loctite 222® to the supplied M3 Socket head cap screws. Install the (2) M3 socket head screws securing the module to the Master or Tool plate and tighten to 7–10 in-lbs.

2.3.2 Removing Optional Modules

1. Depending upon the service or repair being done, customer connections up to the module may or may not need to be disconnected.
2. Remove the M3 socket head cap screws and lift the module from the Master or Tool plate. Refer to *Figure 1.3*

2.4 Tool Stand Design

In most cases, the Tools are stored in a Tool Stand when not being used by the robot. During coupling and lock-up, the Tool Stand must allow for movement (float) in a plane parallel with the mating surfaces of the Master Plate and Tool Plates (X and Y). This will help reduce wear on alignment pin features and help to extend the life of the product.

Ideally, the Tool should be hanging vertically in the Tool Stand so that gravity helps to uncouple the Tool Plate from the Master Plate during unlocking. It is possible to design Tool Stands that hold tools in the horizontal position, but care must be taken that the necessary compliance is provided during coupling and uncoupling. In general, “horizontal-position” tool stands will cause more wear on the locking mechanism and locating features of the Tool and Tool Stand.

Tool Stands may also need to incorporate means for covering Tools and electrical modules to protect them in dirty environments, such as grinding or welding. Alternatively, locating Tool Stands in areas shielded from weld spatter, fluids, adhesives, or other debris would eliminate the need for Tool covers.

2.4.1 Tool Locating Features

The Tool should be positively and repeatably located in the Tool Stand. A variety of methods may be used to accomplish this. A common method is to use tapered

dowel pins in holes. As the Tool Plate approaches during locking, the taper lets the Tool float into its locked position even with small deviations in position.

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

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

3. Operation

The Master locking mechanism is manually-driven to couple and uncouple with the Tool Plate. The Master Plate utilizes mechanical leverage from the actuation screw to provide lock and unlock force to the locking mechanism.

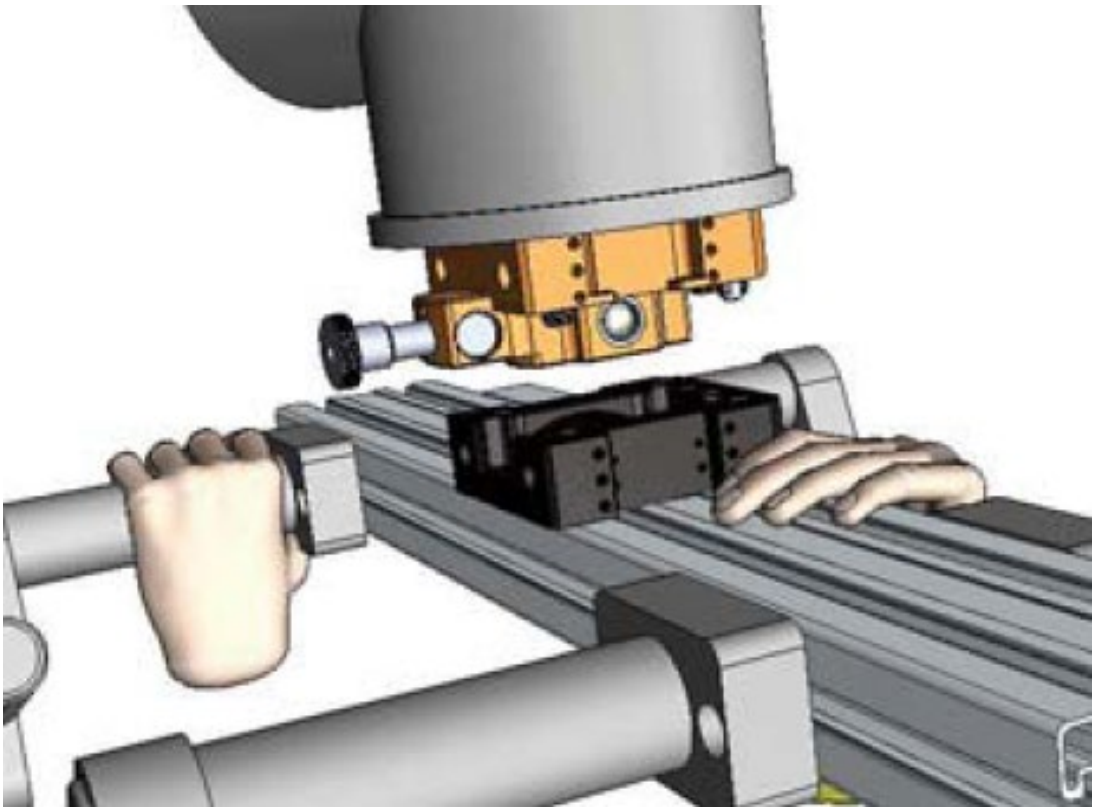
3.1 Coupling Sequence

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

NOTICE: All Tool Changers are initially lubricated using *MobilGrease® XHP222 Special* grease. The end user must apply additional lubricant to the locking mechanism components and alignment pins prior to start of service (See *Section 4.2—Locking Mechanism, Alignment Pins Cleaning and Lubrication*). Tubes of lubricant for this purpose are shipped with every Tool Changer. Note: *MobilGrease® XHP222 Special* is a NLGI #2 lithium complex grease with molybdenum disulfide.

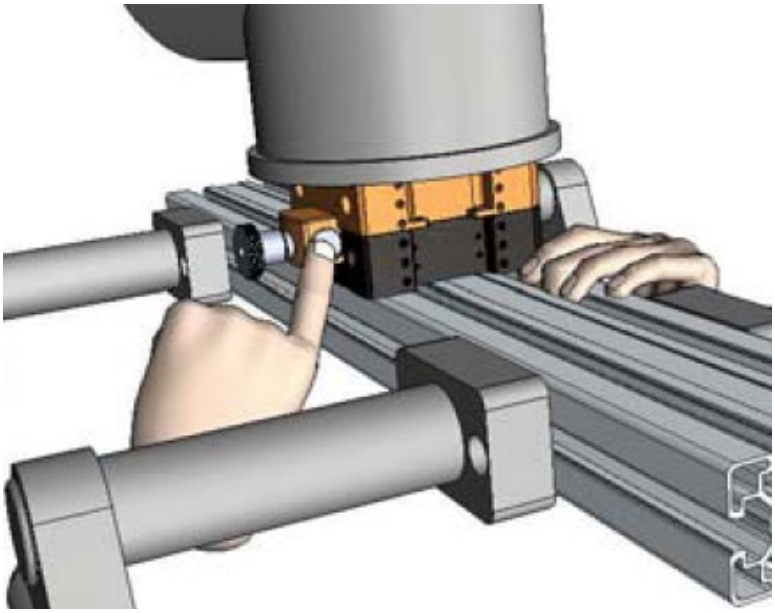
Position the Master above the Tool and move the Master into locking position. The mating surfaces of the Master and Tool should be parallel upon approach. Make sure that the tapered alignment pins from the Master enter the alignment holes on the Tool. The alignment pins should be relatively concentric with the alignment holes such that they do not rub against the edge. Note: In *Figure 3.1* through *Figure 3.3* the MC036 is shown for reference.

Figure 3.1—Bring Tool to Master



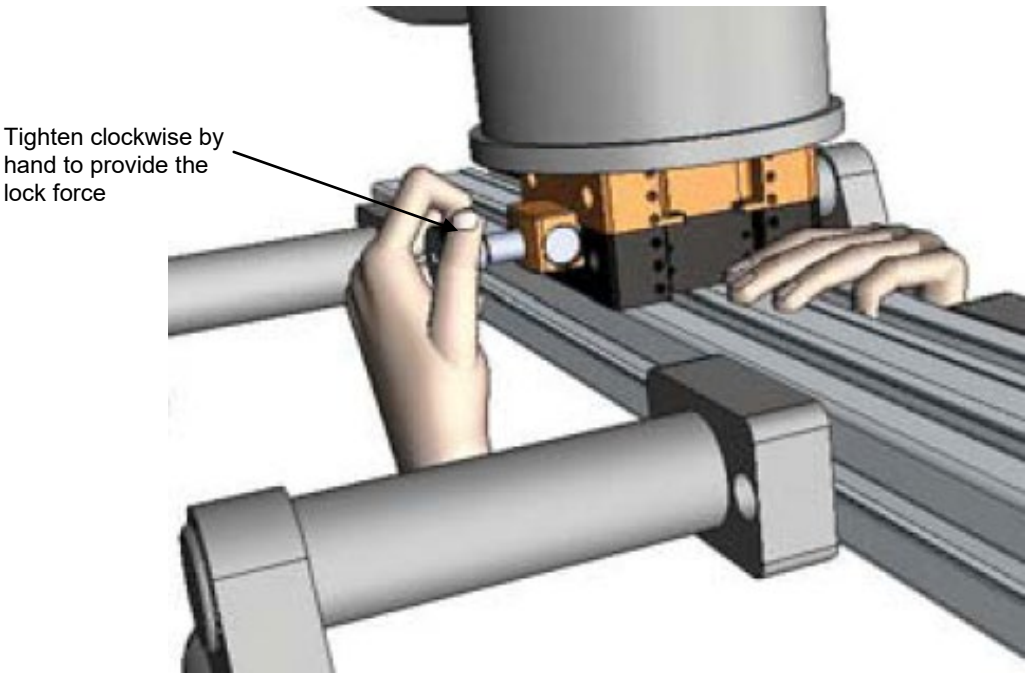
Push the quick action rod release button on the Master body. Be sure the Tool is engaged with the Master. There should be no gap between the Master and Tool at this time.

Figure 3.2—Push Button for Quick Locking



Then apply the tightening torque to the knob to provide the final clamping force. In lab testing, 25 in-lbs of tightening torque was determined to provide the optimal clamping force, but anywhere between 10 in-lbs and 25 in-lbs is adequate. This tightening force range equates to the average human tightening a knob by hand. Do not use a tool and over-tighten or excessive wear on components will occur and the product lifespan will be shortened.

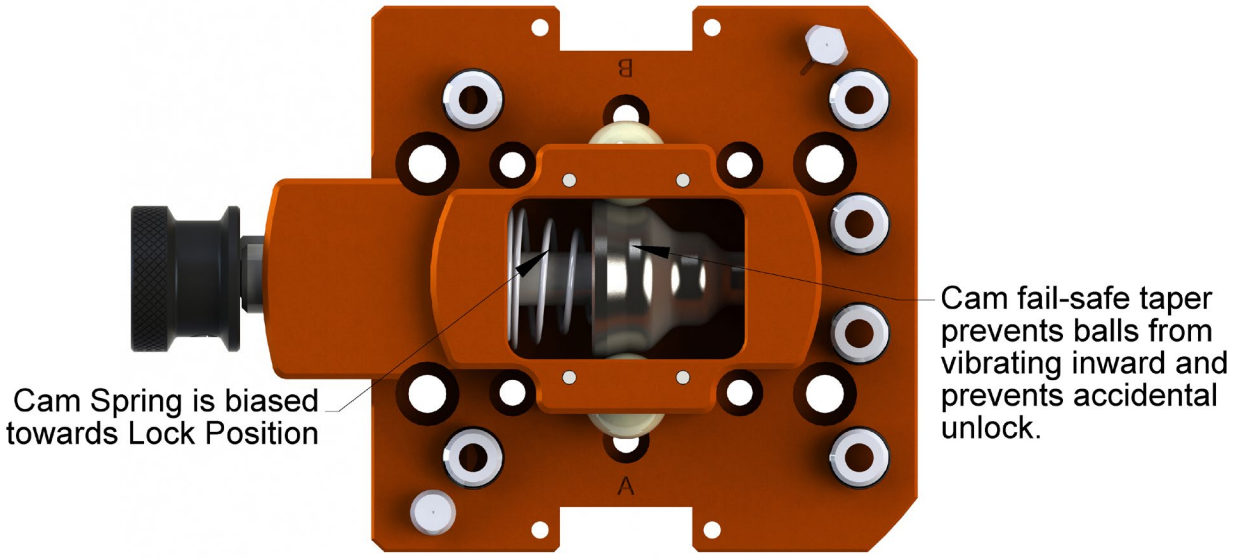
Figure 3.3—Tighten Knob for Full Lock



3.2 Fail-Safe Operation

The manual Tool Changer features two fail-safe features. The first feature is the cam spring feature. When the Master is locked, the cam is spring-loaded to bias it to keep it locked. This spring prevents the cam from vibrating to the unlock position as well as allows for a quick action lock movement when the button is pushed (see Figure 3.4).

Figure 3.4—Fail Safe Operation (MC-36 shown)



The second fail-safe feature is the fail-safe tapered surface on the cam. As the cam is screwed in towards lock position, the balls roll along the first taper. The first taper simply provides the travel necessary to move towards lock. Then the balls roll past the intermediate tapered surface and onto the final tapered surface called the lock angle. This lock angle, combined with the tightening torque from the cam shaft, results in a high mechanical advantage and reliable locking force. In the event that the cam shaft is accidentally loosened, the cam may want to back out toward unlock position. If this happens, the balls will contact the intermediate “fail-safe” taper on the cam profile, and become trapped, as the forces on the Tool pull against the Master, the effect of this fail-safe taper strengthens. Both the cam spring and the fail-safe cam tapered surface act together to provide a high assurance and high level of safety.

3.3 Uncoupling

The Tool Changer should be positioned in the Tool Stand in the **same location** as that when coupling took place.

Unscrew the cam all the way out of the lock position. Take precautions to ensure the Tool will not fall on your fingers. The unit will not fully disengage the Tool until the cam is all the way unscrewed. It is safe to remove the Master from the Tool only when the cam is in the **fully** unlocked position.

NOTICE: : If the unit is equipped with an optional ratchet knob pull out on the knob and unscrew until the ratchet knob is past the ratcheting device on the Tool Changer body .

4. Maintenance

NOTICE: The cleanliness of the work environment strongly influences the trouble-free operation of the changer. The dirtier the environment, the greater the need is for protection against debris. Protection of the entire EOAT, the Master, the Tool, and all of the modules may be necessary. Protective measures include the following: 1) placement of Tools Stands away from debris generators, 2) covers incorporated into the Tool Stands [see Section 2.3] and 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 to provide a long life with regular maintenance.

A visual inspection and preventative maintenance schedule is provided in the table below depending upon the application. Details are provided in *Section 8—Drawings*.

NOTICE: All Tool Changers are initially lubricated using *MobilGrease® XHP222 Special* grease. The end user must apply additional lubricant to the locking mechanism components and alignment pins prior to start of service (See Section 4.2). Tubes of lubricant for this purpose are shipped with every Tool Changer. Note: *MobilGrease® XHP222 Special* is a NLGI #2 lithium complex grease with molybdenum disulfide.

Table 5.1—Preventative Maintenance Checklist

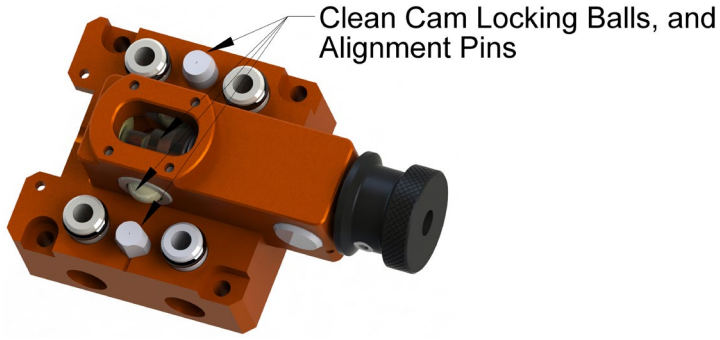
Application(s)	Tool Change Frequency	Inspection Schedule
General Usage, Material Handling, Docking Station	More than 1 per minute	Weekly
	Less than 1 per minute	Monthly
Wet or Humid Environments	All	Weekly
Welding/Servo/Deburring, Foundry Operations (Dirty Environments)	All	Weekly
Locking Mechanism Cam and Alignment Pins		
□ Inspect for lubrication and wear. A NLGI #2, lithium-based grease with molybdenum disulfide additive is suggested for locking mechanism and alignment pin lubrication. Over time, lubricants can become contaminated with process debris. Therefore, it is recommended to thoroughly clean the existing grease and replace with new as needed. Refer to *Section 4.2—Locking Mechanism, Alignment Pins Cleaning and Lubrication.*		
□ Excessive alignment pin/bushing wear may be an indication of poor robot position during pickup/drop-off. Adjust robot position as needed. Check Tool Stand for wear and alignment problems. Refer to *Section 4.3—Alignment Pin Replacement*.		
Mounting Fasteners and Interface Connections		
□ Inspect for proper torque and interference or wear, abrasions, cuts of hoses, and electrical cables. Tighten and correct as required.		
O-rings and Rubber Bushings		
□ Exposed o-rings and rubber bushings may be subject to damage during normal operation. Inspect for wear, abrasion, and cuts. Replace damaged o-rings and rubber bushings as needed.		
Electrical Module		
□ Clear debris from area of the contact using compressed air. Do not directly clean contacts as abrasion may occur and the performance of the contact may be compromised. Inspect Electrical Contacts for wear or damage. Refer to *Section 4.4—Electrical Module Pin Block Contact Inspection and cleaning.*		
□ Inspect V-Ring Seal for wear, abrasion, and cuts. Refer to *Section 4.5—Electrical Module Seal Inspection and Replacement.*		

4.2 Locking Mechanism, Alignment Pins Cleaning and Lubrication

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

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

Figure 4.1—Clean and Lubricate Locking Mechanism and Alignment Pins



3. Apply a liberal coating of lubricant to the cam, locking balls, and the alignment pins.

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

1. Use a clean rag to thoroughly remove any lubricant and debris from the engagement surfaces and the alignment holes.
2. No re-lubrication is necessary on the Tool Plate components.

4.3 Alignment Pin Replacement

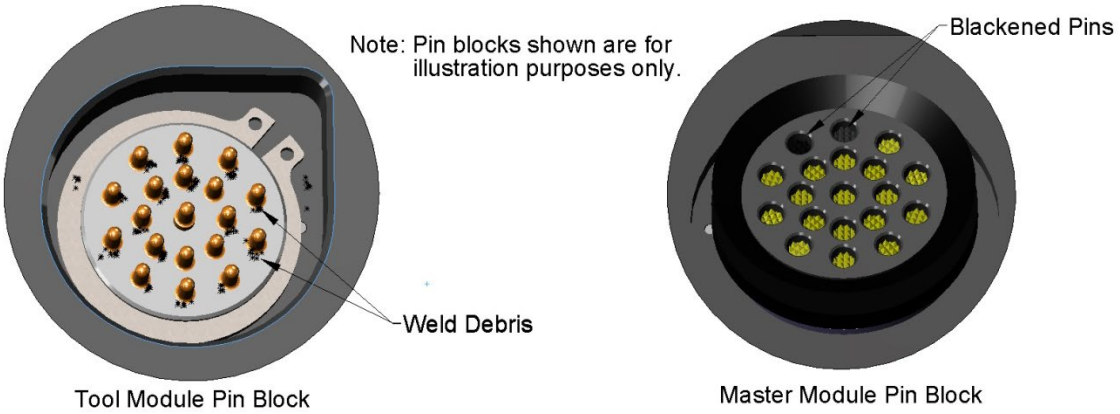
1. Alignment pins can be removed via pliers or by pushing the pins out from the back of the Master housing.
2. Install the new alignment pin into the body via an arbor press. Verify the pin is fully seated into the body. The pin heads should seat fully against the Master body.
3. Also be sure the diamond head is oriented as shown.

Figure 4.2—Alignment Pin Replacement

4.4 Electrical Module Pin Block Contact Inspection and cleaning

1. Inspect the Master and Tool pin blocks for any debris or darkened pins.

Figure 4.3—Inspect Master and Tool Pin Blocks

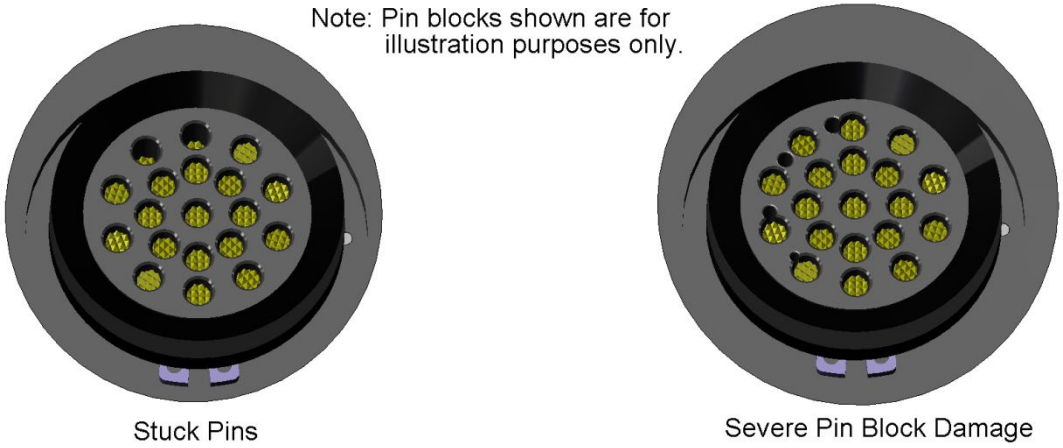


2. If debris or darkened pins exist, remove debris using a vacuum, and clean using a nylon brush (ATI part number 3690-0000064-60).

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

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

Figure 4.4—Stuck Pin and Pin Block Damage



4. If stuck pins or severe pin block damage exists, contact ATI for possible pin replacement procedures or module replacement.

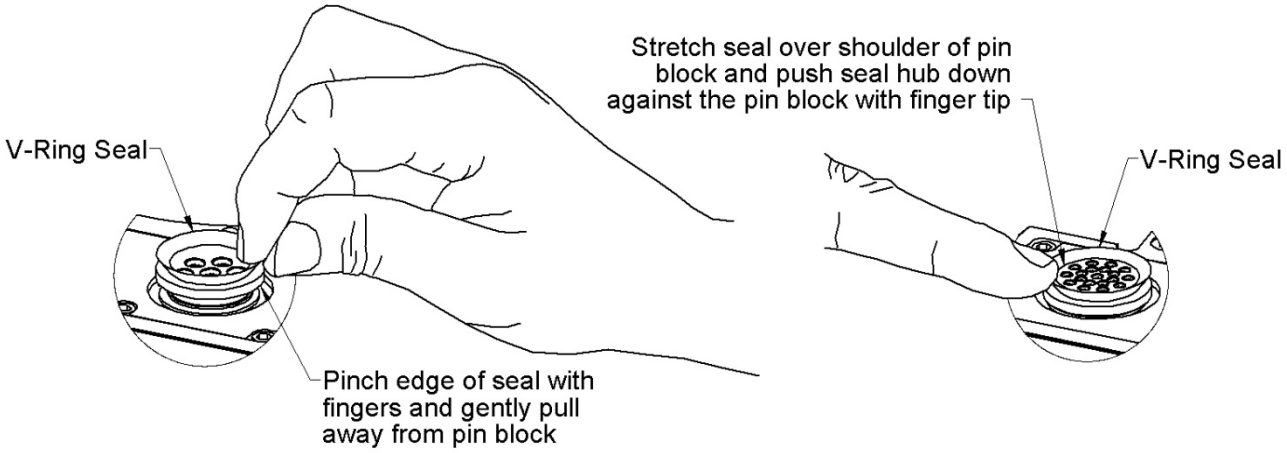
4.5 Electrical Module Seal Inspection and Replacement

The seal protect the electrical connection between the Master and Tool module. If the seal becomes worn or damaged it needs to be replaced.

1. To remove the existing seal, pinch edge of seal with fingers and gently pull the seal away from the pin block on the Master.
2. Pull the seal off the pin block.

3. To install a new seal, stretch the new seal over the shoulder of the pin block.
4. Push the seal's hub down against the pin block using finger tip.

Figure 4.5—V-Ring seal Replacement



5. Troubleshooting

Check these conditions for all symptoms prior to troubleshooting:

- Proper pneumatic and electrical connections have been made to the Manual Coupler.
- Mounting screws are properly installed.
- Locking Cam Screw is fully tightened (to approximately 25 in-lbs).

Symptom	Cause	Resolution
Unit will not lock or unlock	The locking mechanism cam is jammed.	Clean and lubricate as needed to restore smooth operation (see *Section 4—Maintenance*).
	The cam screw is not moving.	Check for debris in the handle area of the locking mechanism, and clean if necessary.
	The Master and Tool are not touching prior to lock.	Check that the Tool is properly seated in the Tool Stand. Verify that there is no debris between the Master and Tool prior to locking.

6. Recommended Spare Parts

Assembly	Part Number	Description
Master Plate	9122-016M-000	Complete MC-16 Master Assembly, with Air Ports
	3690-5800803-10	Round Alignment Pin, Steel
	3690-5800804-10	Diamond Alignment Pin, Steel
	3410-0001291-01	O-rings – Air ports
	For Other Components see *Section 8—Drawings*	
Tool Plate	9122-016T-000	Complete MC-16 Tool Plate, No Options
	For Other Components *Section 8—Drawings*	
Optional Ratchet Knob	9005-20-1814	Complete MC Ratchet Knob Assembly
	For Other Components *Section 8—Drawings*	

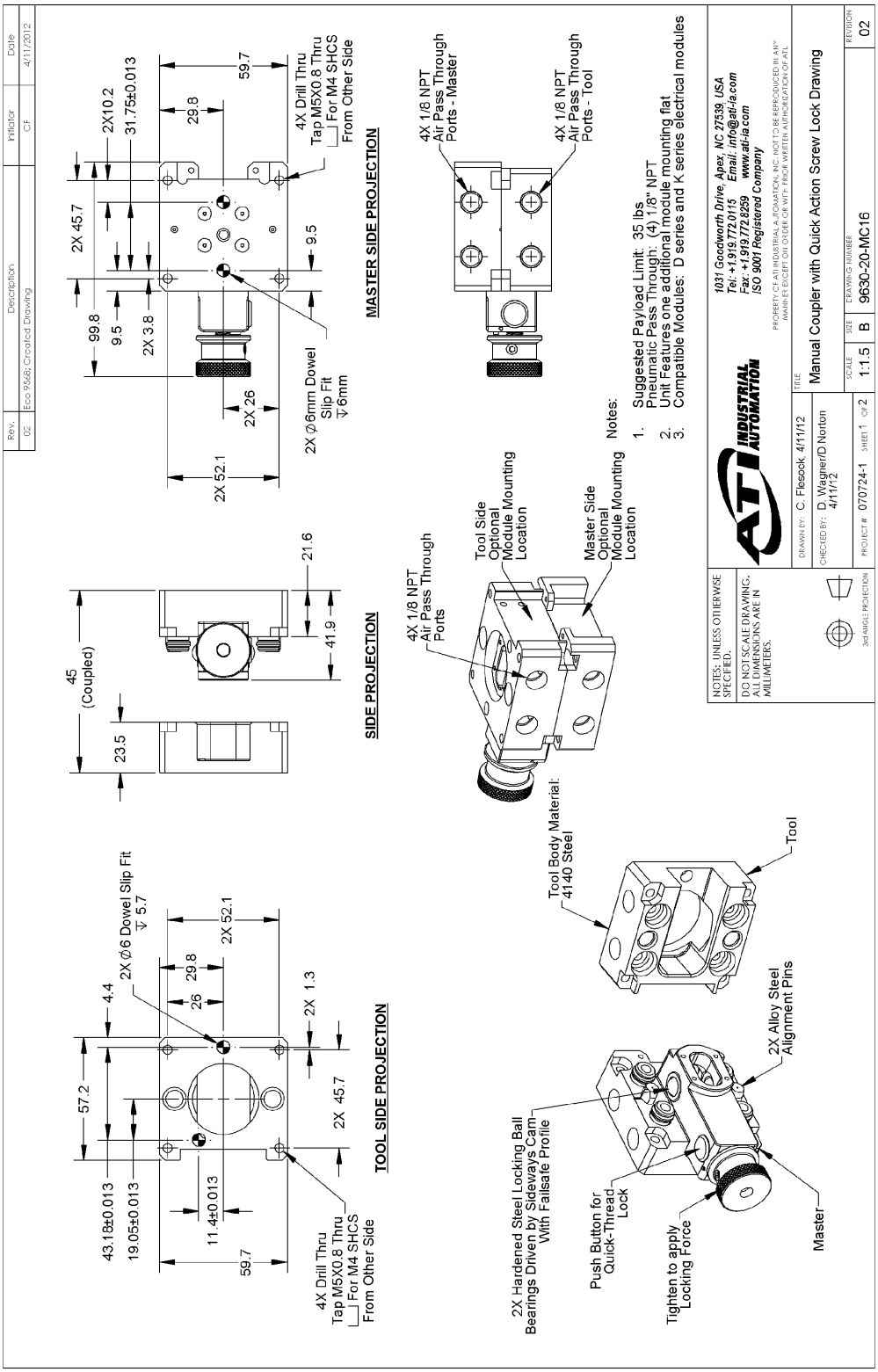
7. Specifications

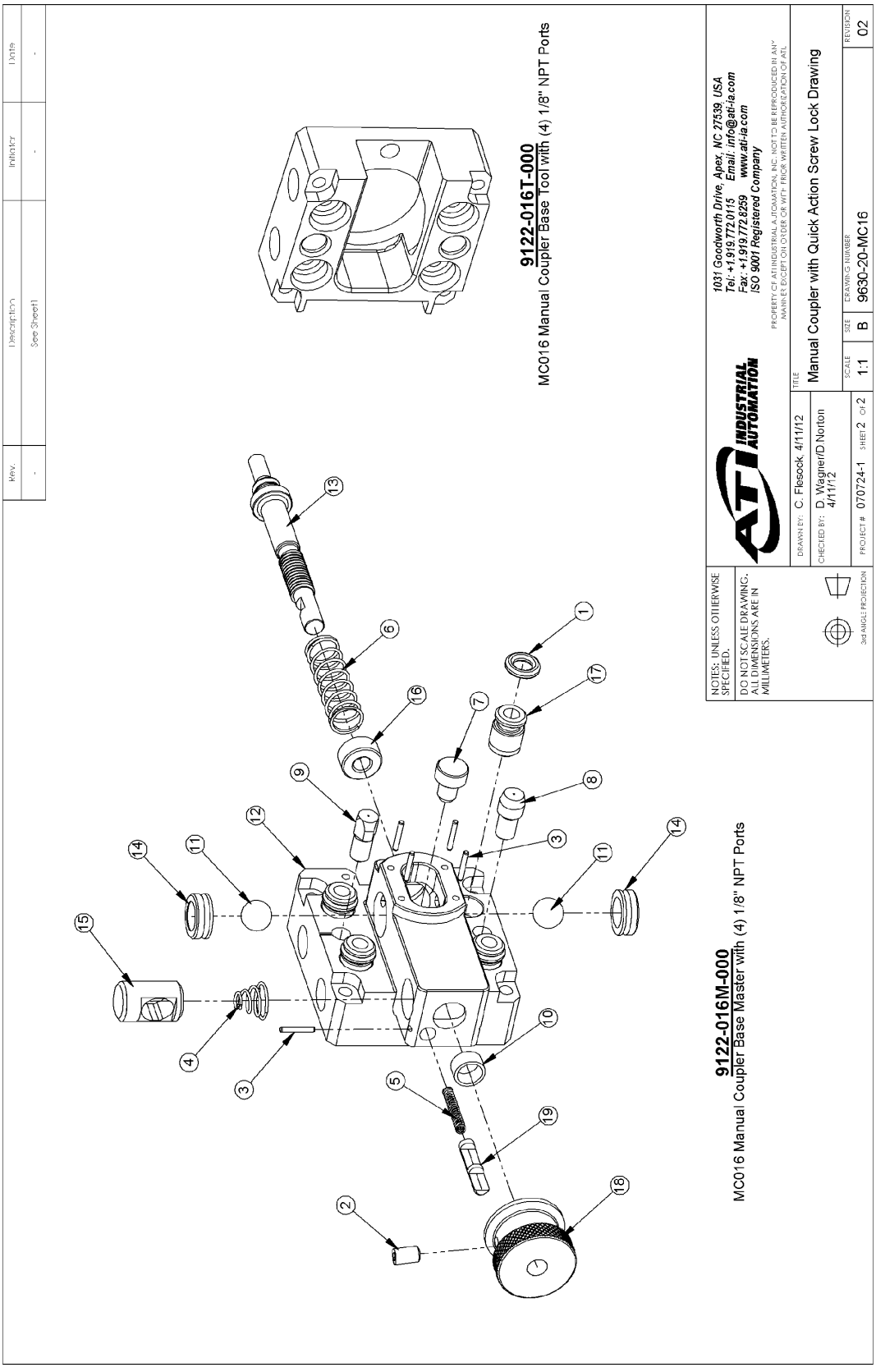
Master and Tool Plates

Suggested Payload Limit	35 lbs. (16 kg)	The mass attached to the tool Changer.
Operating Temperature Range	-20–150°F (-30–66°C)	
Static Moment Capacity (x, y)	220 in-lb (25 Nm)	Maximum recommended working load for optimum performance of the Tool Changer.
Weight (coupled, no access.)	1.35 lbs (.54 kg)	Master 0.75 lbs (0.34 kg) Tool 0.60 lbs (0.27 kg)
Mounting/Customer Interface		
	Master Plate	Custom Rectangular Pattern See *Section 8—Drawings*
	Tool Plate	Custom Rectangular Pattern See *Section 8—Drawings*
Pneumatic Pass-through Ports	(4) 1/8” NPT	Optional. Specify –NP for version with No Ports

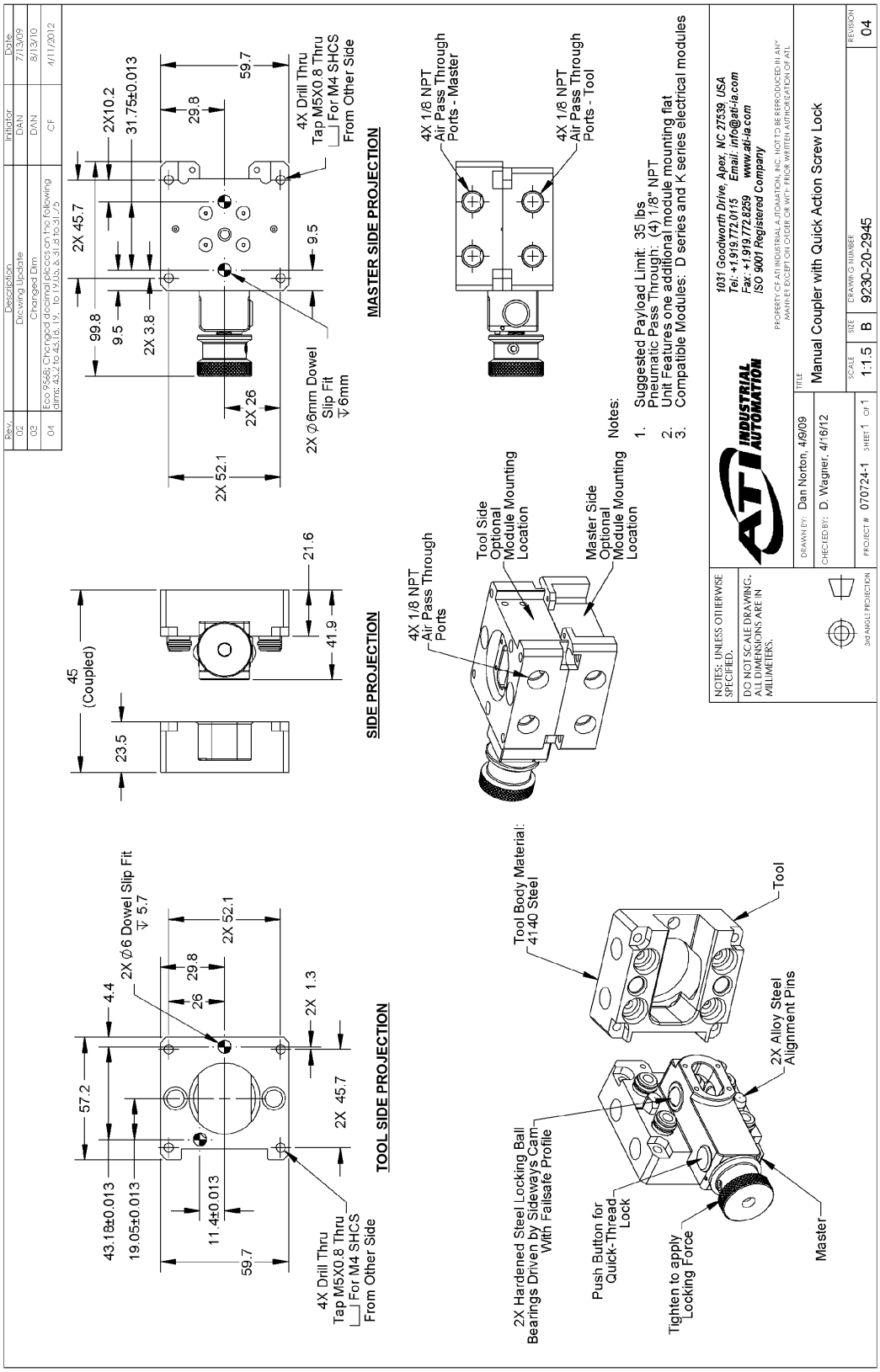
8. Drawings

8.1 MC-16 Manual Tool Changer Drawing

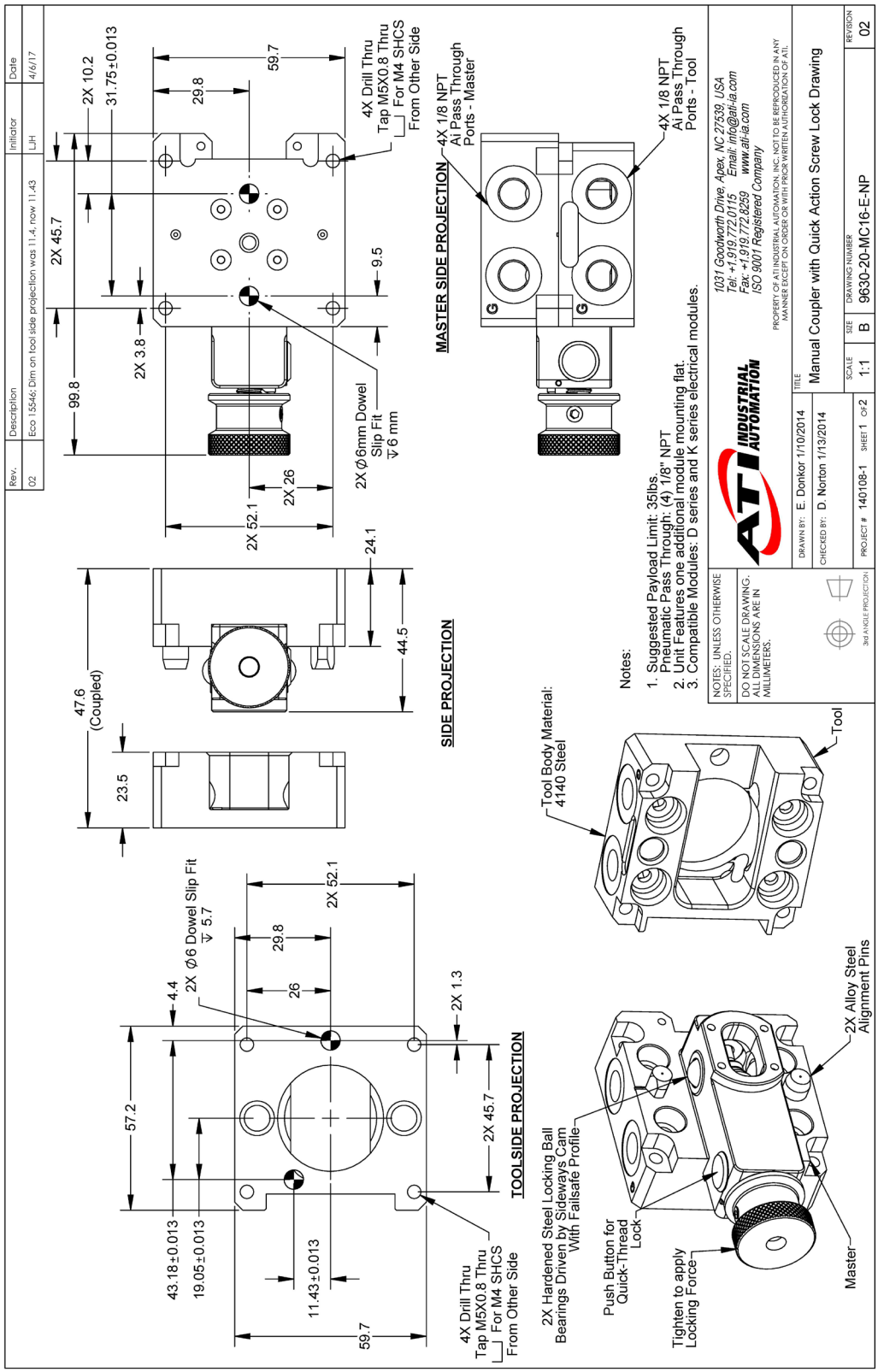


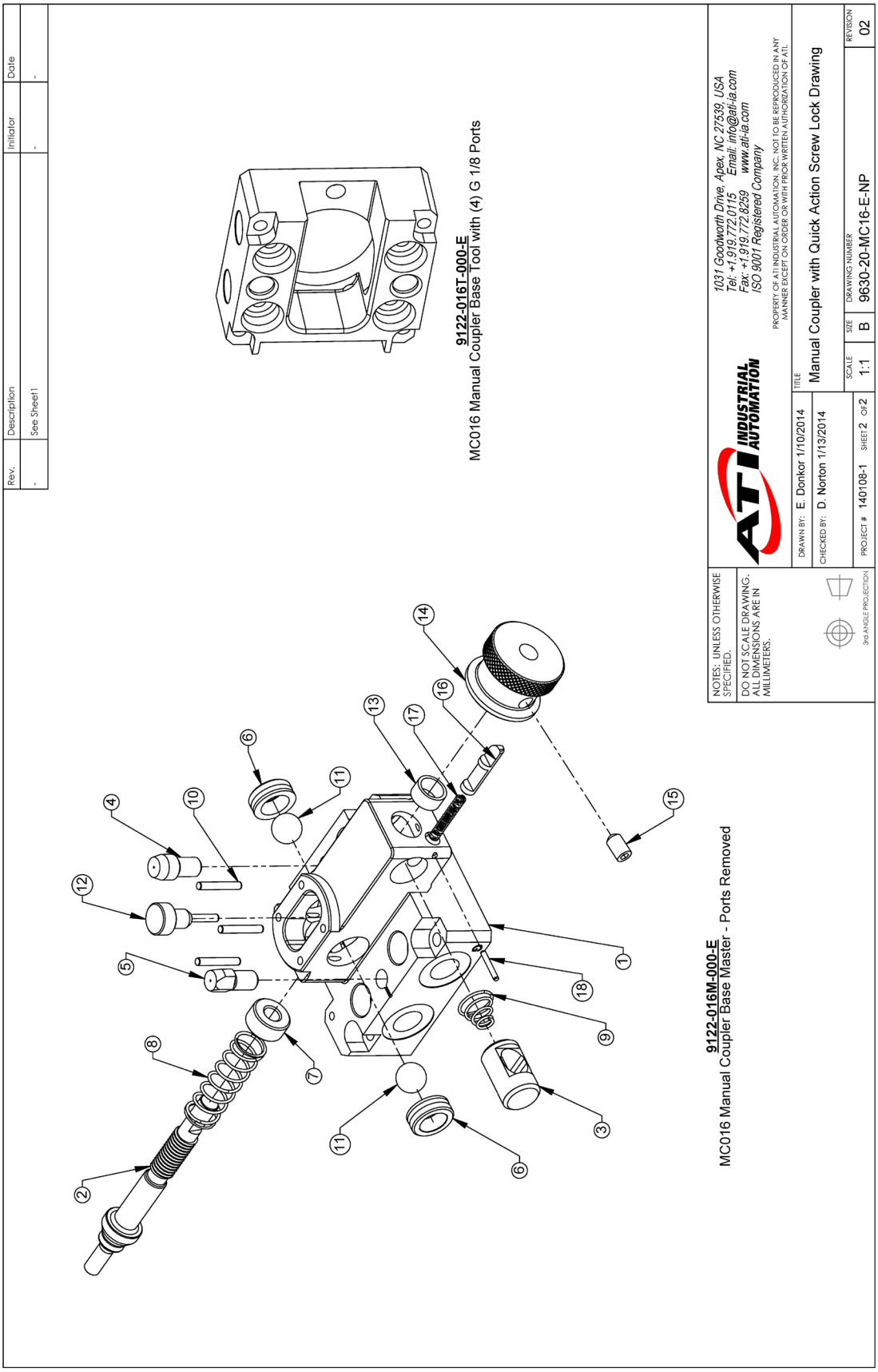

Rev.
Description
Initials
See Sheet1
9122-016T-000
MC016 Manual Coupler Base Tool with (4) 1/8" NPT Ports
9122-016M-000
MC016 Manual Coupler Base Master with (4) 1/8" NPT Ports
NOTES: UNLESS OTHERWISE SPECIFIED.
DO NOT SCALE DRAWING. ALL DIMENSIONS ARE IN MILLIMETERS.
INDUSTRIAL AUTOMATION
1031 Goodworth 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
PROPERTY OF ATI INDUSTRIAL AUTOMATION, INC. NOT TO BE REPRODUCED IN ANY MANNER EXCEPT ON ORDER OR WITH PRIOR WRITTEN AUTHORIZATION OF ATI.
DRAWN BY: C. Flesock 4/11/12
CHECKED BY: D. Wagner/D Norton 4/11/12
3rd ANGLE PROJECTION
PROJECT # 070724-1 SHEET 2 OF 2
TITLE
Manual Coupler with Quick Action Screw Lock Drawing
SCALE 1:1
SIZE B
DRAWING NUMBER 9630-20-MC16
REVISION 02

8.2 MC-16 Manual Coupler Outer Dimensions



8.1 MC-16 with Quick Action Screw Lock – Euro – Ports Removed




Rev.
Description
Initiator
Date
-
See Sheet1
-
-
9122-016T-000-E
MC016 Manual Coupler Base Tool with (4) G 1/8 Ports
9122-016M-000-E
MC016 Manual Coupler Base Master - Ports Removed
NOTES: UNLESS OTHERWISE SPECIFIED.
DO NOT SCALE DRAWING. ALL DIMENSIONS ARE IN MILLIMETERS.
3rd ANGLE PROJECTION
DRAWN BY: E. Donkor 1/10/2014
CHECKED BY: D. Norton 1/13/2014
PROJECT # 140108-1
SHEET 2 OF 2
TITLE
Manual Coupler with Quick Action Screw Lock Drawing
SCALE 1:1
SIZE B
DRAWING NUMBER 9630-20-MC16-E-NP
REVISION 02
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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8.2 Manual Coupler Ratchet Knob