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B. Base Tool Changer

MC-6—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 body or Master plate has (3) flat sides for mounting of optional modules. Flats ‘A’, ‘B’, and ‘C’ are fully interchangeable and optional modules can be arranged to suit the application or robot dress as required.

The locking mechanism consists of a three toothed cam, a steel handle, and a Belleville-style spring. The teeth on the cam are tapered and contact corresponding lugs on the tool side. When the Master and Tool are brought together, the user pulls the handle toward the lock position. The three teeth on the cam slide on the surfaces of the 3 tool side lugs. The Belleville spring is compressed during this action and its preload supplies the force that resists gapping between Master and Tool. 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.

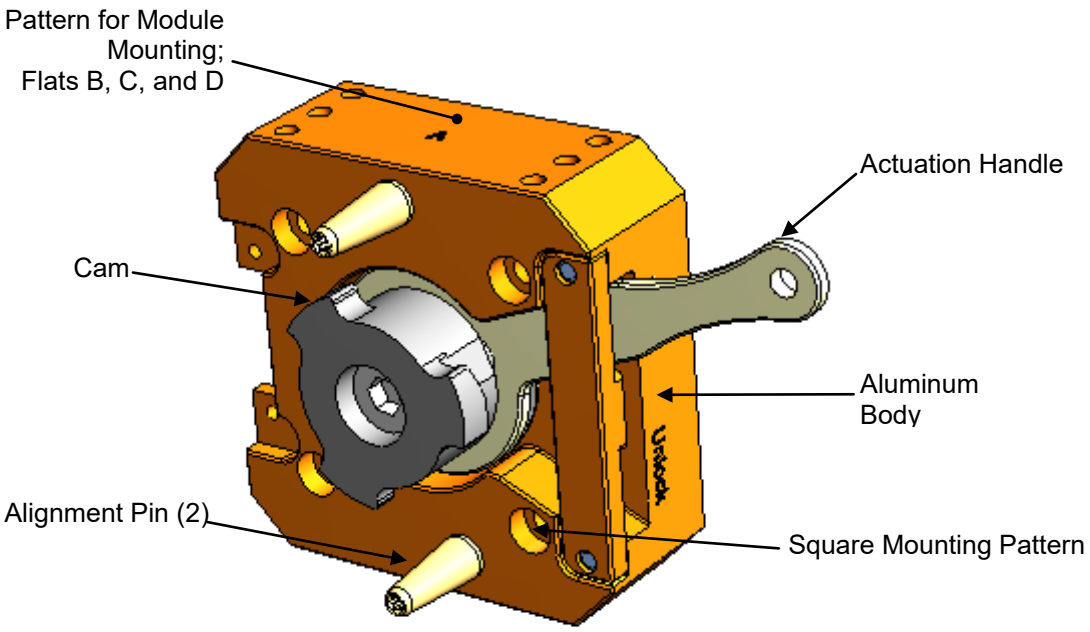


Figure 1.1—Master Plate Assembly

1.2 Tool Plate Assembly

The Tool base assembly includes an anodized aluminum body and hardened steel engagement lugs. The Tool plate has (3) flat sides for the mounting of optional modules.

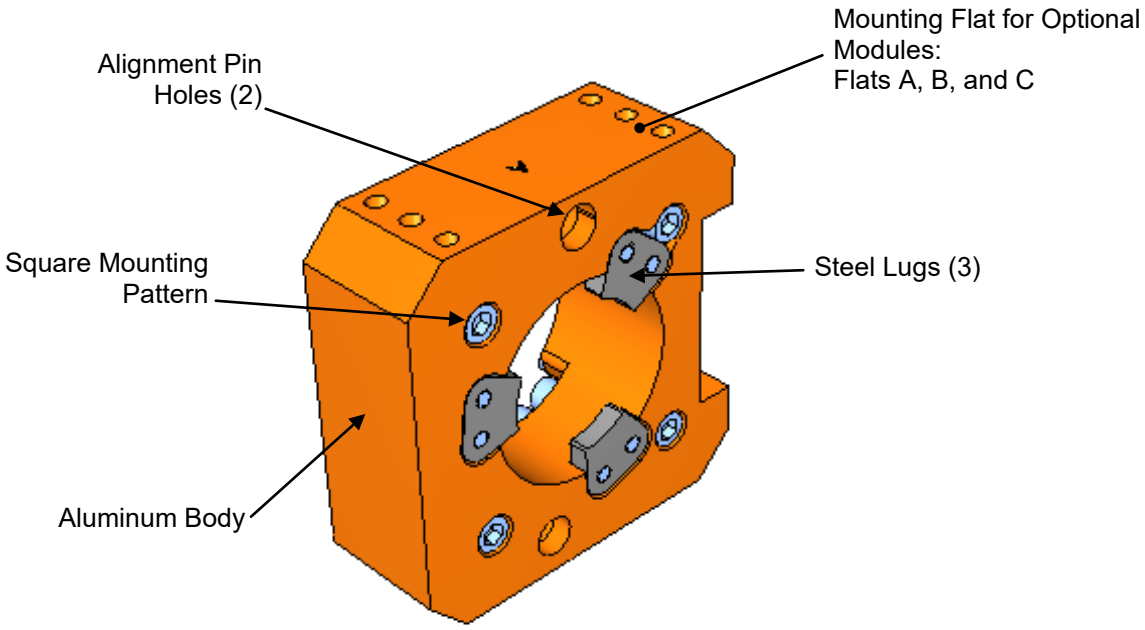


Figure 1.2—Tool Plate Assembly

1.3 Optional Modules

There are (3) flats available for the mounting of the optional modules for support of various utility pass-through, such as signal, fluid/air, and power.

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.

Modules for flats ‘A’, ‘B’, or ‘C’ are interchangeable to suit the application or the dress-out required.

The optional modules are mounted to the Master or Tool plate using a common side mounting feature. Only (4) M4 SHCS fasteners need to be unscrewed in order to remove the module from the Master/Tool plate.

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 these 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 RIP (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
Tool Plate to TIP (6061-T6 aluminum) Minimum thread engagement of 6mm (0.24") [1.5X fastener Ø]	M4–0.7 Class 12.9	12 in-lbs
Tool Plate to TIP (steel; USS ≥ 90KSI) Minimum thread engagement of 6mm (0.24") [1.5X fastener Ø]	M4–0.7 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. A robot interface plate (RIP) is utilized to adapt the Master plate to a specific robot flange that is not compatible with the Master plate mounting features. Custom RIPs are available upon request. (Refer to drawings in Section 8 of this manual 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 the application drawing).

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 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 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.

2.3.1 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 side lugs on the Tool plate. The Master plate utilizes mechanical leverage from the actuation handle 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.

ATTENTION: All tool changers are initially lubricated using *MobilGrease® XHP222 Special* grease. The end user must apply additional lubricant to the locking mechanism components and alignment pins prior to start of service (See Section 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.

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.

3.2 Fail-Safe Operation

The manual tool changer features two fail-safe features. The first feature is the handle detent feature. When the Master is locked, the lever handle is spring-loaded to bias it in a detent that will keep it locked. This detent prevents the handle from vibrating to the unlock position as well as reduces the chances of an unintentional bump towards unlock. (See Figure 3.1.)

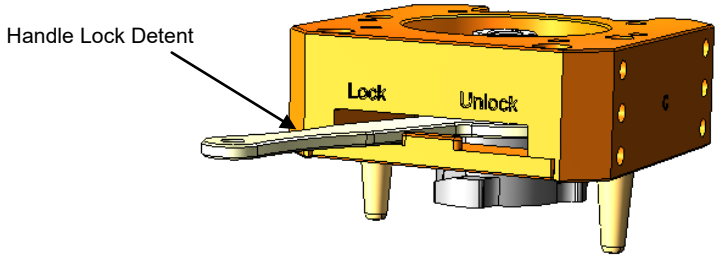


Figure 3.1

The second fail-safe feature is the 3-toothed cam, as it engages the tool side lugs, the angled surfaces bias the tool side lugs towards the Master, drawing the two sides together, then the engaging surfaces of the lugs contact the cam's flat tooth surfaces. These flats act as fail-safe features, and once engaged they help prevent the cam from vibrating loose.

3.3 Uncoupling

The tool changer should be positioned in the tool stand in the **same location** as that when coupling took place.

Actuate the handle out of the lock detent and slide it over to the unlock position. The handle should drop into an unlock detent as well. It is safe to remove the Master from the Tool only when the handle is in the **fully** unlocked position.

4. Maintenance

ATTENTION: The cleanliness of the work environment strongly influences the trouble-free operation of the changer. The dirtier the environment, the greater the need 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.

Detailed assembly drawings are provided in Section 8 of this manual.

ATTENTION: All tool changers are initially lubricated using *MobilGrease® XHP222 Special* grease. The end user must apply additional lubricant to the locking mechanism components and alignment pins prior to start of service (See Section 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.

Application(s)	Tool Change Frequency	Inspection Schedule
General Usage Material Handling Docking Station	> 1 per hour	Weekly
	< 1 per hour	Monthly
Welding/Servo/ Deburring, Foundry Operations (Dirty Environments)	All	Weekly

Checklist

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. See Section 4.2.

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.

Mounting Hardware/Interface Connections

Inspect for proper torque and interference or wear, abrasions, cuts of hoses, and electrical cables. Tighten and correct as required.

O-rings/Rubber Bushings

Inspect for wear, abrasion, and cuts.

Exposed o-rings and rubber bushings may be subject to damage during normal operation. Replace damaged o-rings and rubber bushings as needed.

Electrical Contacts

Inspect for wear and abrasion.

Exposed contacts may be subject to damage during normal operation.

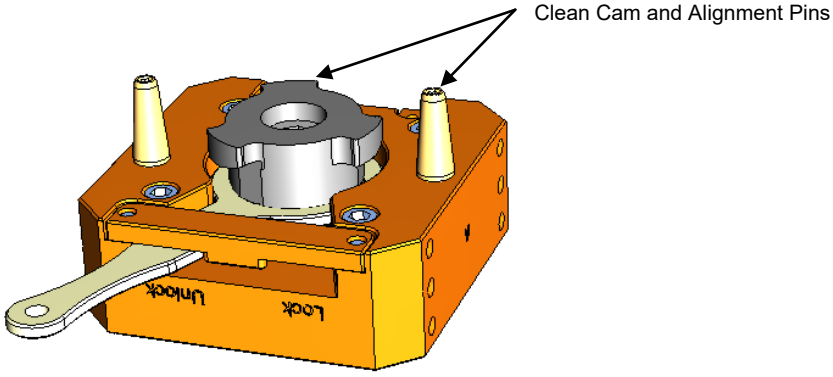
Clear debris from the area of the contacts using compressed air.

Do not directly clean contacts as abrasion may occur and the performance of the contact may be compromised.

4.2 Cleaning, Lubrication, Adjustment and Replacement

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 and the alignment pins.



3. Apply a liberal coating of lubricant to the cam teeth 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 lugs and the bushings/alignment holes.
2. No re-lubrication is necessary on the Tool plate components.

4.2.3 Alignment Pin Replacement

1. Unscrew the alignment pin sub-assembly from the Master plate using a 2.5mm hex key. Note: If for any reason the pin cannot be removed using the hex socket in the tip, it may be necessary to remove it by other means such as Vise Grip pliers. Another approach is to use the access hole in the back side of the Master plate. In this case a 3mm hex key will be needed.
2. Once the alignment pin has been removed, verify that the sub-assembly (pin and set screw) is intact. If the set screw portion of the sub-assembly did not come out, it will be necessary to remove it separately using the access hole in the back side of the Master plate.
3. Apply Loctite® 242 (or similar thread locking compound) to the M6 set screw in the new alignment pin.
4. Install the alignment pin into the bushing and screw it into place. Apply 18 in-lb of torque to fully tighten it.

5. Troubleshooting

Check these conditions for all symptoms prior to troubleshooting:

- Proper pneumatic and electrical connections have been made to the Quick-Change.
- Mounting screws are properly installed.

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 handle 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	9122-006HM-0-0-0	Complete MC-6 Master Assembly, No Options
	3700-20-1373	Alignment Pin
	For Other Components see Section 8	
Tool Plate	9122-006HT-0-0-0	Complete MC-6 Tool Assembly, No Options
	3700-20-5530	Tool Engagement Lug
	3500-1062020-15	M4 x 20mm SHCS for attaching Engagement Lug
	For Other Components see Section 8	

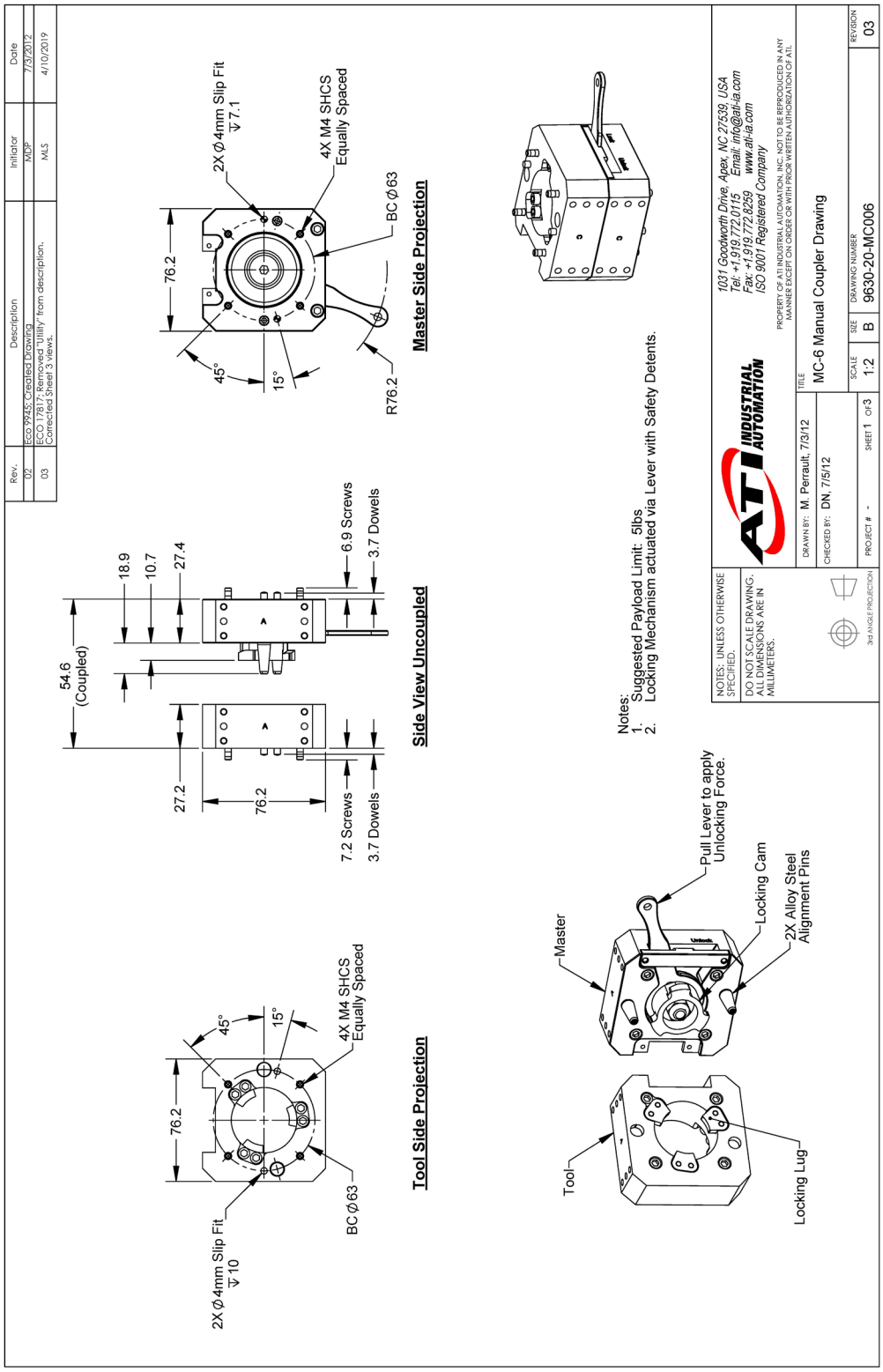
7. Specifications

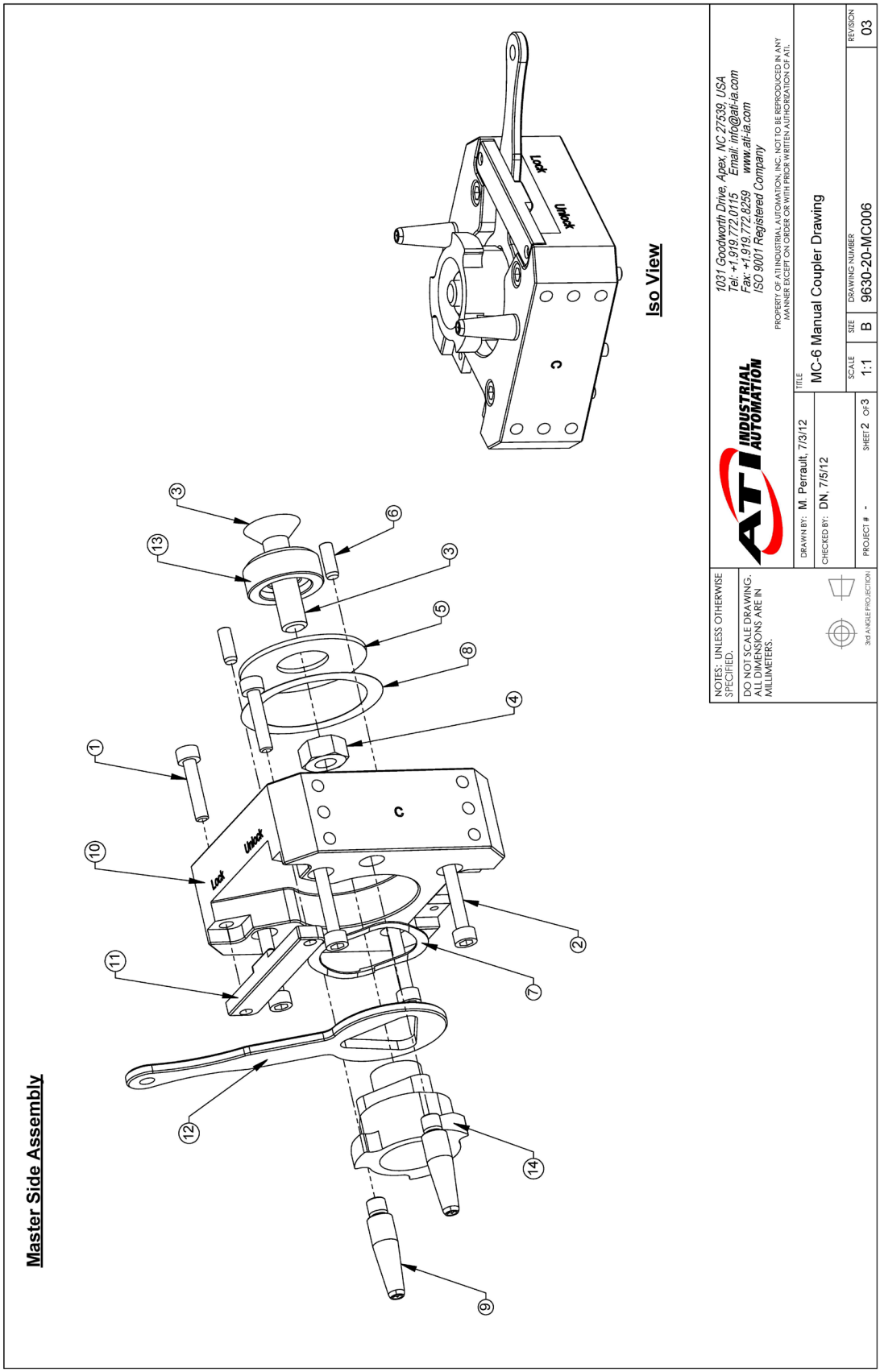
Master and Tool Plates

Suggested Payload Limit	5 lbs. (2.25kg)	The mass attached to the tool changer.
Operating Temperature Range	-20–150°F (-30–66°C)	
Static Moment Capacity (x, y)	120 in-lb 13.6 (Nm)	Maximum recommended working load for optimum performance of the tool changer.
(z)	120 in-lb 13.6 (Nm)	Torsion
Weight (coupled, no access.)	1.6 lbs. (.72 kg)	Master .45 kg / Tool .27 kg
Mounting/Customer Interface		
	Master Plate	Custom Square Pattern
	Tool Plate	Custom Square Pattern

8. Drawings

8.1 MC-6 Manual Tool Changer Drawing




Master Side Assembly
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NOTES: UNLESS OTHERWISE SPECIFIED.
DO NOT SCALE DRAWING. ALL DIMENSIONS ARE IN MILLIMETERS.
DRAWN BY: M. Perrault, 7/3/12
CHECKED BY: DN, 7/5/12
PROJECT # -
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REVISION 03
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
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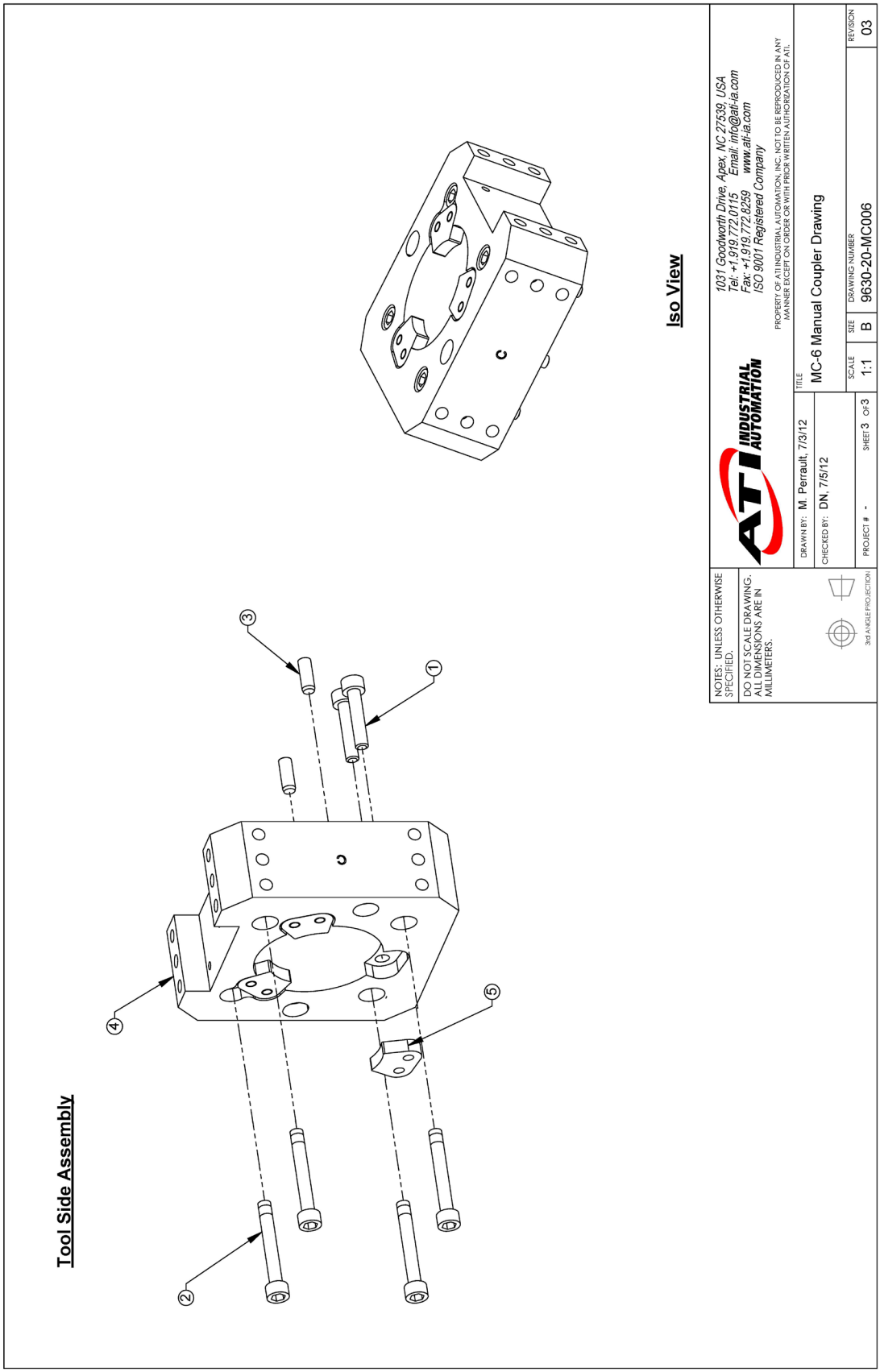
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CHECKED BY: DN. 7/5/12
PROJECT # -
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SIZE B
DRAWING NUMBER 9630-20-MC006
REVISION 03
1031 Goodworth Drive, Apex, NC 27539, USA
Tel: +1.919.772.0115 Email: info@ati-ia.com
Fax: +1.919.772.8259 www.ati-ia.com
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