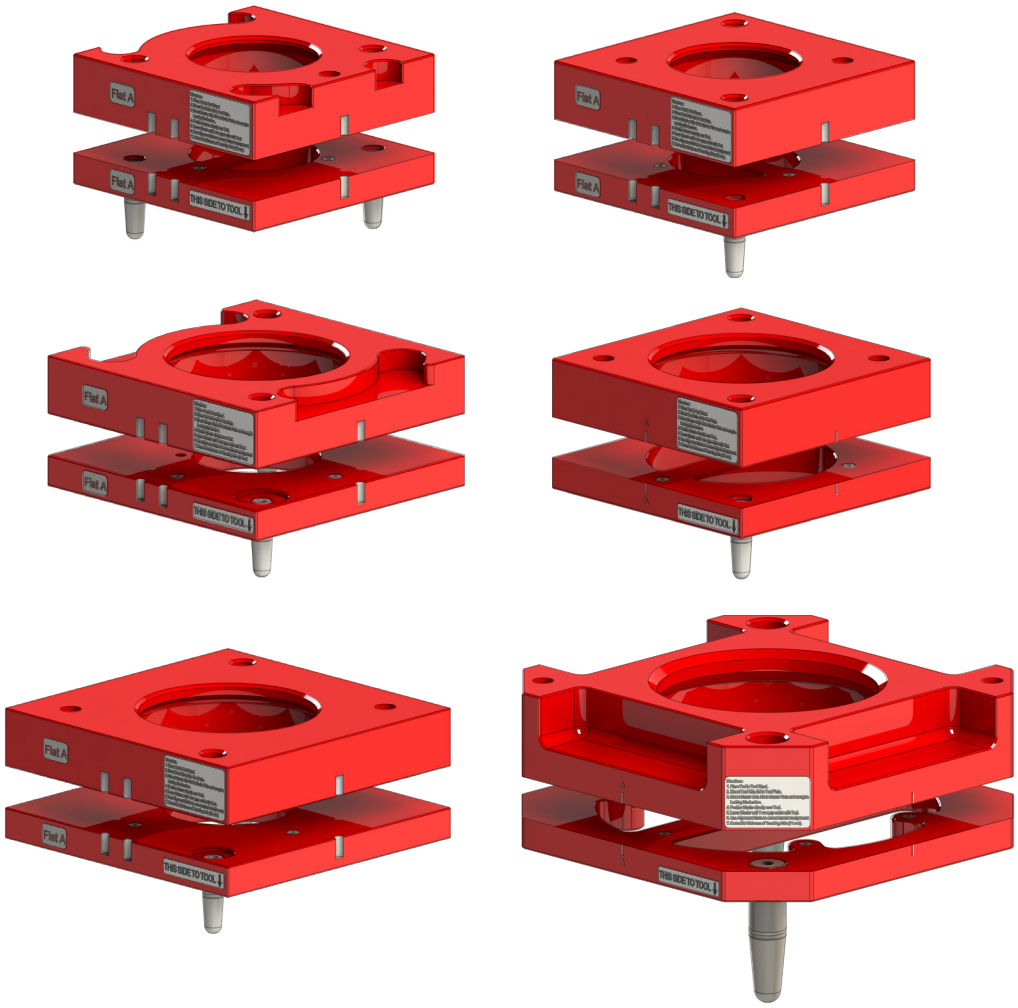
ATI INDUSTRIAL AUTOMATION

A Novanta Company

Tool Changer Teaching Aid Assemblies

Manual



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Engineered Products for Robotic Productivity

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Foreword

This manual contains basic information applicable to all ATI robotic Tool Changers. Certain Tool Changer models have their own manuals that contain more detailed information. Also, additional information about electrical, pneumatic, fluid, high-power and high-current modules and other options are available in other manuals and documents.

Please contact ATI Industrial Automation with any questions concerning your particular model.

CAUTION: This manual describes the function, application, and safety considerations of this product. This manual must be read and understood before any attempt is made to install or operate the product, otherwise damage to the product or unsafe conditions may occur.

Please contact an ATI representative for assistance, if needed:

For sale, service, technical support, and information about ATI products:

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Glossary

Term	Definition
Bearing Race	Hardened steel ring in the Tool Plate that is engaged by the locking balls during the locking process.
End-Effector	Tool used by the robot to perform a particular function.
Locking Mechanism	A pneumatic driven device that draws the Master and Tool plates together and secures the plates in a fail-safe locked condition, until the mechanism is unlocked. The locking mechanism contains the following components: locking balls, cam, ball cage, bearing race, and a pneumatic cylinder.
Master Plate	The half of the Tool Changer that the customer attaches to a robot. The Master plate contains the locking mechanism that couples and secures the Master plate to the Tool plate.
Pick-Up Position	The robot coordinate position at which the Master plate draws the Tool plate into a locked position.
Tool Stand	A fixture that holds Tools that aren't used for a portion of an automated process.
Tool Plate	The half of the Tool Changer to which the customer attaches various tools or end-effectors.
No-Touch™	An ATI Tool Changer design feature that allows the Master plate and Tool plate to couple without physical contact prior to locking.

1. Safety

The safety section describes general safety guidelines to be followed with this product, explanations of the notifications found in this manual, and safety precautions that apply to the product. More specific notifications are imbedded within the sections of the manual where they apply.

1.1 Explanation of Notifications

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

DANGER: Notification of information or instructions that if not followed will result in death or serious injury. The notification provides information about the nature of the hazardous situation, the consequences of not avoiding the hazard, and the method for avoiding the situation.

WARNING: Notification of information or instructions that if not followed could result in death or serious injury. The notification provides information about the nature of the hazardous situation, the consequences of not avoiding the hazard, and the method for avoiding the situation.

CAUTION: Notification of information or instructions that if not followed could result in moderate injury or will cause damage to equipment. The notification provides information about the nature of the hazardous situation, the consequences of not avoiding the hazard, and the method for avoiding the situation.

NOTICE: Notification of specific information or instructions about maintaining, operating, installing, or setting up the product that if not followed could result in damage to equipment. The notification can emphasize, but is not limited to: specific grease types, best operating practices, and maintenance tips.

1.2 General Safety Guidelines

Prior to purchase and installation, the customer should verify that the Tool Changer selected is rated for the maximum loads and moments expected during operation. Refer to product specifications section in each module of this manual or contact ATI for assistance. Particular attention should be paid to dynamic loads caused by robot acceleration and deceleration. These forces can be many times the value of static forces in high acceleration or deceleration situations.

The customer is responsible for ensuring that the area between the Master and Tool sides is clear of foreign objects during mating and subsequent coupling. Failure to do so may result in serious injury to personnel.

DANGER: The gap between the Master and Tool sides is a pinch point. All personnel should be prevented from placing any part of their body or clothing in the gap, especially during actuation of the locking mechanism.

The customer is responsible for understanding the function of the Tool Changer and implementing the proper fasteners and/or software to operate the Tool Changer safely. The Tool Changer should be controlled such that there is no chance of locking or unlocking in a position that would endanger personnel and/or equipment. If the Tool Changer is specified with Lock/Unlock (L/U) and Ready-to-Lock (RTL) sensing capability, the status should be monitored and interlocks applied to prevent injury to personnel and equipment.

All pneumatic fittings and tubing must be capable of withstanding the repetitive motions of the application without failing. The routing of electrical and pneumatic lines must minimize the possibility of stress/strain, kinking, rupture, etc. Failure of critical electrical or pneumatic lines to function properly may result in injury to personnel and equipment.

All electrical power, pneumatic and fluid circuits should be disconnected during servicing.

1.3 Safety Precautions

WARNING: Remove all temporary protective materials (caps, plugs, tape, etc.) on locking face of Tool Changer and modules prior to operation. Failure to do so will result in damage to Tool Changers, modules, and end-of-arm tooling and could cause injury to personnel.

WARNING: Do not perform maintenance or repair(s) on the Tool Changer or modules unless the Tool is safely supported or placed in the tool stand, all energized circuits (e.g. electrical, air, water, etc.) are turned off, pressurized connections are purged and power is discharged from circuits in accordance with the customer 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.

WARNING: During operation, the area between the Master and Tool must be kept clear. Failure to keep area clear will result in damage to Tool Changer, modules, or end-of-arm tooling and could cause injury to personnel.

WARNING: The Tool Changer is only to be used for intended applications and applications approved by the manufacturer. Using the Tool Changer in applications other than intended will result in damage to Tool Changer, modules, or end-of-arm tooling and could cause injury to personnel.

CAUTION: The Master plate locking mechanism must not be actuated without being mounted to the interface plate. Damage to the Cover Plate and O-ring may result. Always attach the Master plate to the Interface plate prior to attempting any operations.

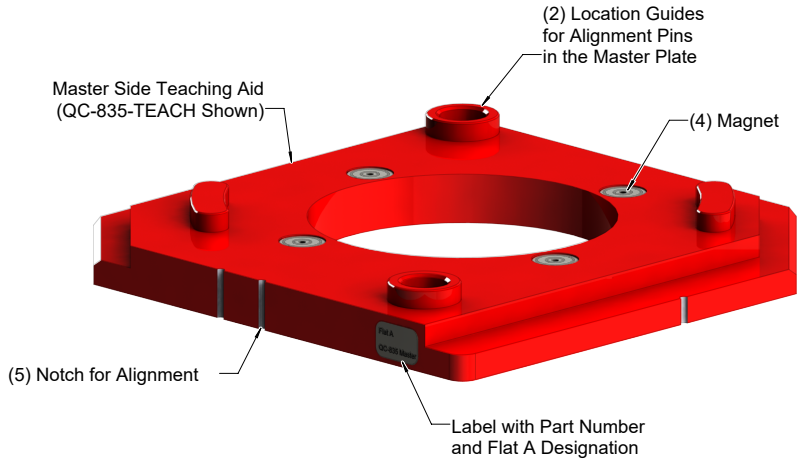
2. Product Overview

The ATI robot Teaching Aids are to be used with ATI's automatic Tool Changers. With the Teaching Aids, a user requires less time to program the robot to pick up and drop off customer tooling and ensure optimal X, Y, and Z alignment. Additionally, Teaching Aids help extend the life of the Tool Changer alignment pins and bushings by reducing unnecessary wear. ATI Teaching Aids have high-contrast alignment marks to aid the user in the setup process. When positioned, the Master Teaching Aid and Tool Teaching Aid must have a 1 mm clearance between them. This distance will ensure the No-Touch™ Locking zone for the Tool Changer is set correctly The following is a hyperlink to a video that demonstrates how to use *ATI's Teaching Aids for robotic Tool Changers.*

2.1 Master Teaching Aid

The Master Teaching Aid assembly is a red, anodized aluminum body. ATI offers two styles of Teaching Aids. The center interior will fit over the Master Tool Changer locking balls. Some of the Teaching Aids have holes bored into the Master Teaching Aid plate at the opposite corners of the alignment pin bushings. These holes provide clearance to avoid activating the RTL sensors if a user installs a Teaching Aid assembly manually.

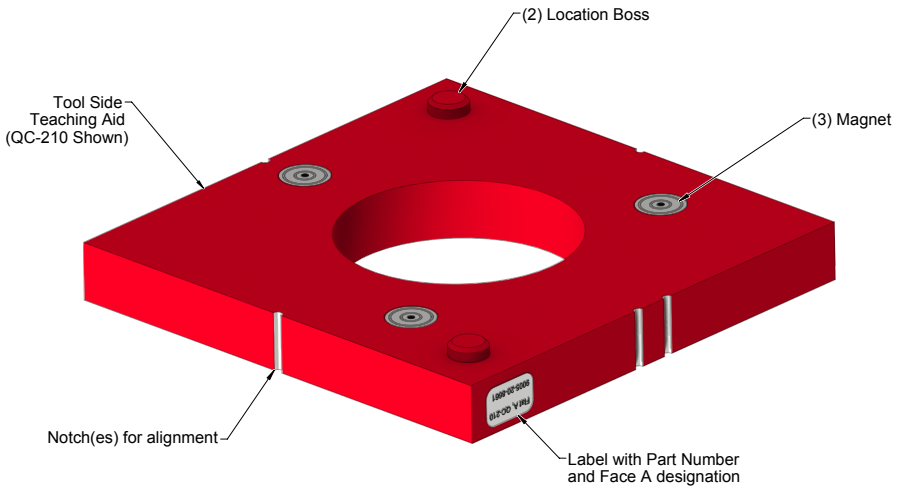
Figure 2.1—Master Teaching Aid Assembly (QC-835M Shown)



2.2 Tool Teaching Aid

The Tool Teaching Aid is a red, anodized aluminum body with hardened steel alignment pins and magnets. Magnets secure the Tool Teaching Aid to the Tool plate's bearing race.

Figure 2.2—Tool Teaching Aid Assembly (QC-210-TEACH3 Shown)



3. Installation and Alignment Procedure

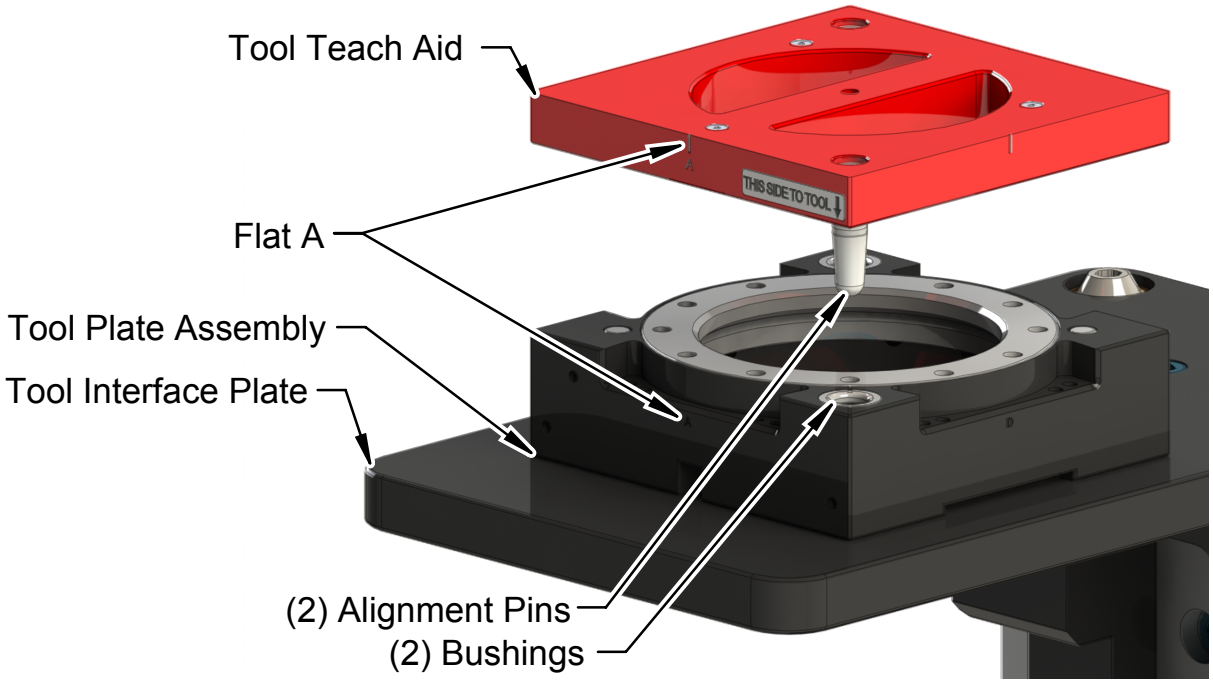
On the Master Teaching Aid, there are labels with abbreviated installation and alignment instructions. On the ATI website, *http://www.ati-ia.com/library/video_listing.aspx*, there is a video that demonstrates how to use ATI's Teaching Aids for robotic Tool Changers

ATI has three variations of Teaching Aids. For customers using the QC-29, QC-40, QC-46, QC-76, or QC-210 (QC-210-TEACH3), refer to *Section 3.2—Installing Teaching Aids With Magnets.* For customers using a Teaching Aid on the QC-1310, refer to *Section 3.3—Installing QC-1310 Teaching Aid.* All other Teaching Aid users should reference *Section 3.1—Installing Teaching Aids With Master Locking Mechanism.*

3.1 Installing Teaching Aids With Master Locking Mechanism

1. Place the Tool plate in the tool stand. Robot programs should be written with the Tool plate resting in the Tool stand.
2. Orient the Tool side Teaching Aid such that the 'A' flat corresponds to the 'A' flat on the Tool plate.
3. Mount the Tool side Teaching Aid over the Tool plate by inserting the alignment pins into the bushings of the Tool plate.

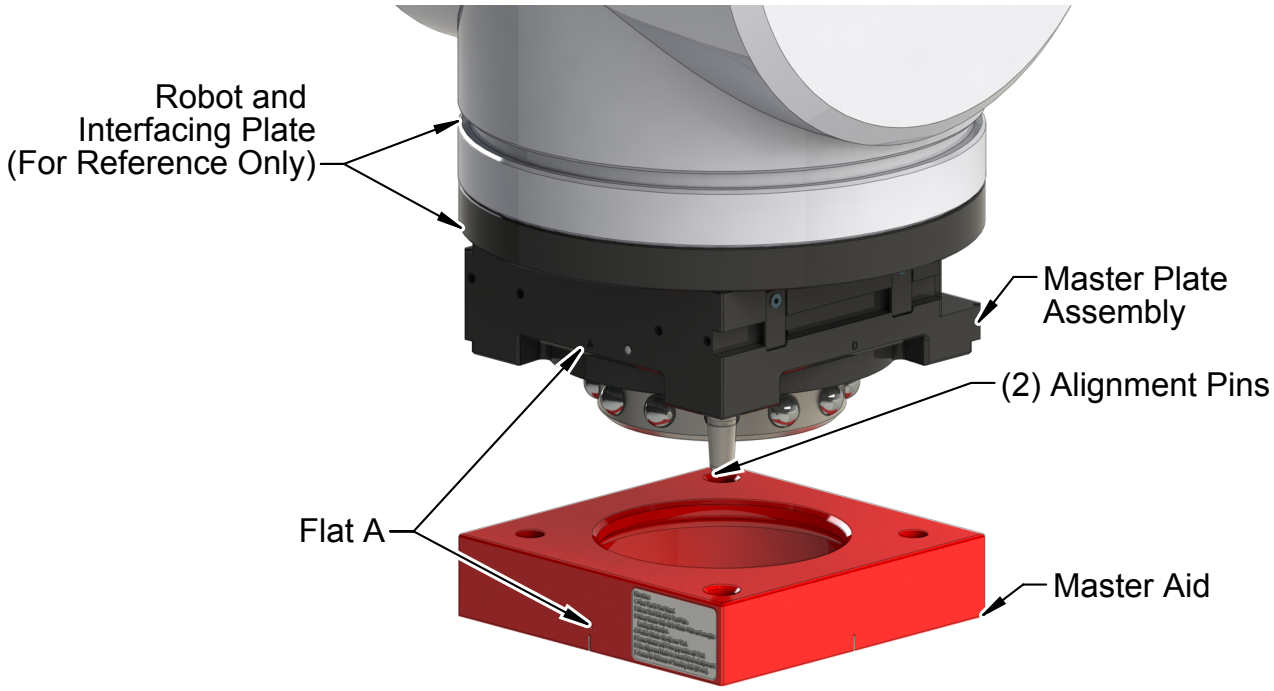
Figure 3.1—Tool Teaching Aid Assembly Installation



DANGER: The gap between the Master and Tool sides is a pinch point. Physical contact in these pinch points will result in serious or permanent injury to personnel. Prevent all personnel from placing any body part or clothing in the gap, especially during actuation of the locking mechanism.

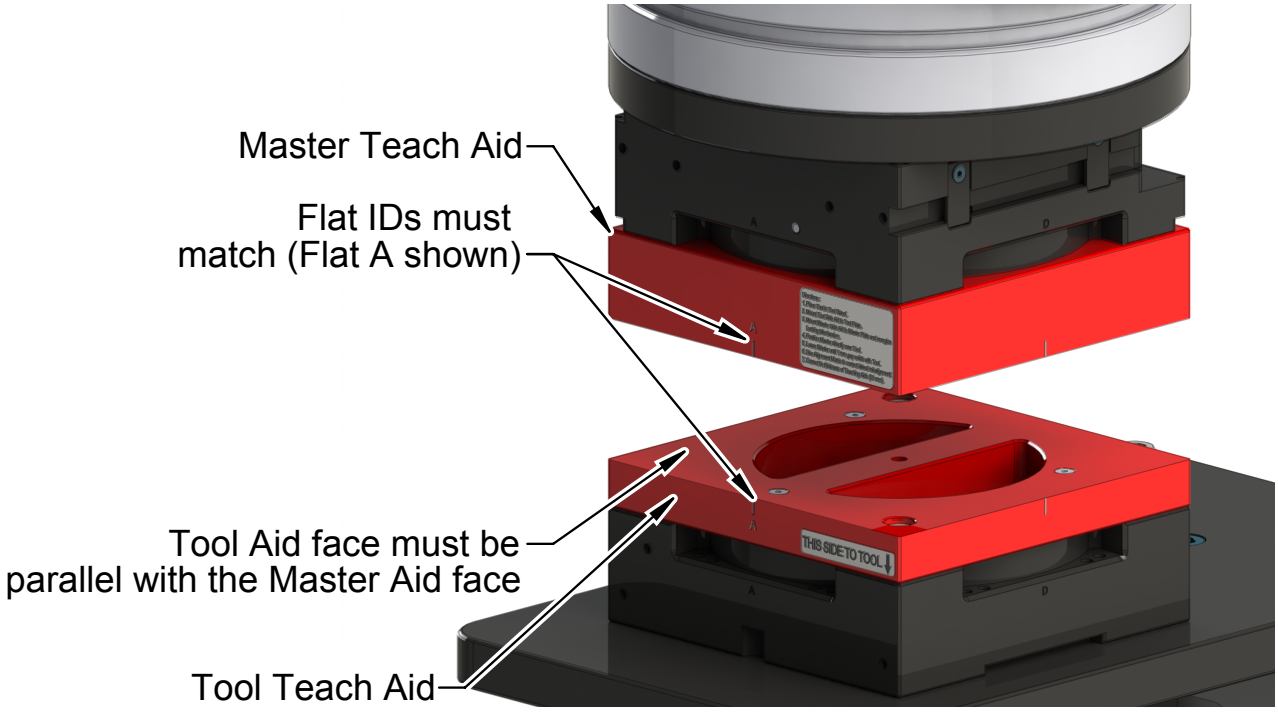
4. Verify the Tool Changer locking mechanism is in the Unlocked position.
5. Orient the Master side Teaching Aid so Flat A on the Teaching Aid corresponds to the ‘A’ flat on the Master Tool Changer plate.
6. Mount the Master side Teaching Aid to the Tool Changer Master plate by inserting the Master Tool Changer alignment pins into the corresponding holes in the Master side Teaching Aid.
7. Energize the locking mechanism to secure the Master side Teaching Aid in place.

Figure 3.2—Master Teaching Aid Assembly Installation



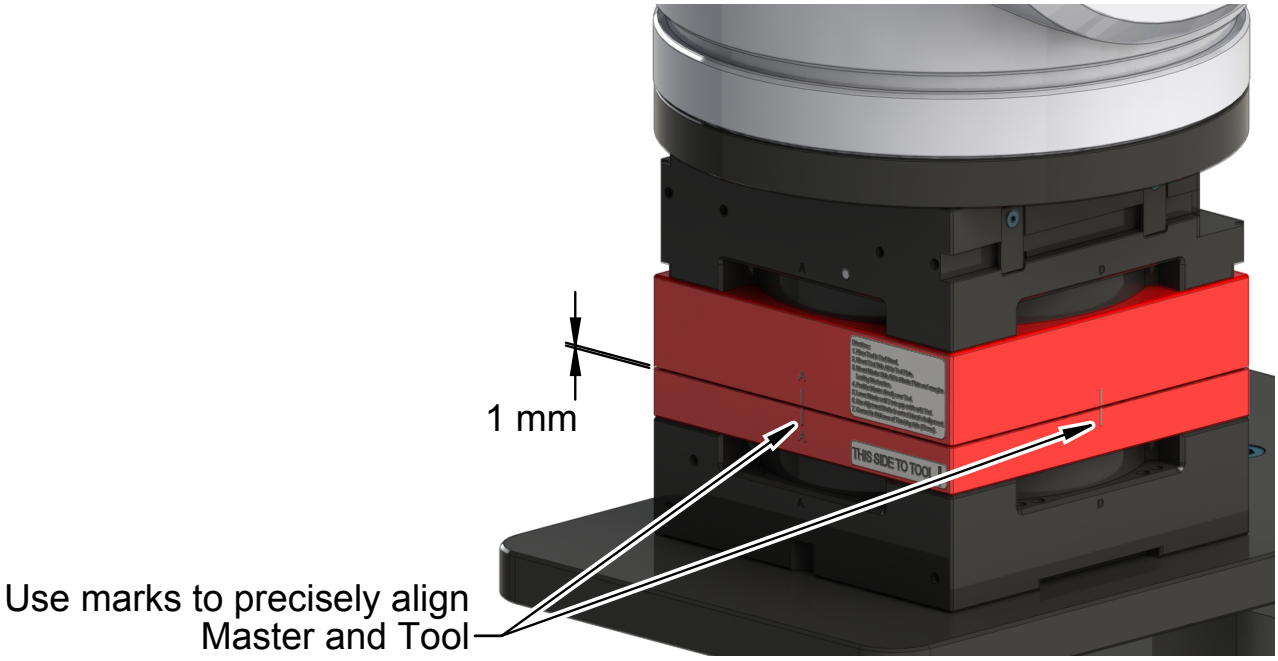
8. Position the Master plate directly over and parallel to the Tool plate. Align the Master and Tool flats. Flat A on the Master Plate should be aligned with the Flat A on the Tool plate.

Figure 3.3—Positioning the Master plate towards the Tool plate



9. Move the Master plate assembly slowly toward the Tool plate until the Master and Tool side Teaching Aids are 1 mm apart.
10. Use the alignment marks to align the Tool side and Master side Teaching Aids.

Figure 3.4—Final Alignment Position of the Teaching Aid Plate Assembly



11. Support the Master side Teaching Aid, then unlock the Tool Changer.
12. Remove the Master and Tool Teaching Aids from the Tool Changer.

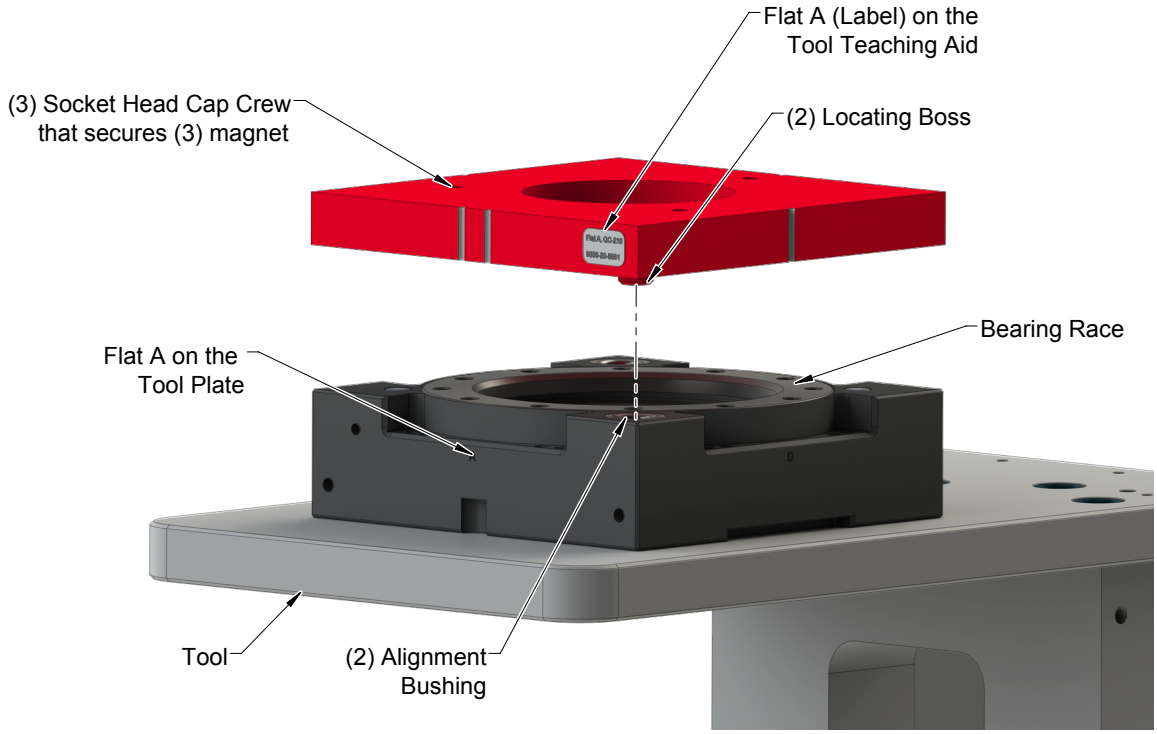
NOTICE:
- Refer to the applicable Tool Changer manual for the maximum recommended offsets.
- Depending on the customer application, the pick-up position is not always vertical.

13. Move the Tool Changer Master plate to the Tool plate until the Master plate is in the pick-up position.
14. Record the pick-up position.

3.2 Installing Teaching Aids With Magnets

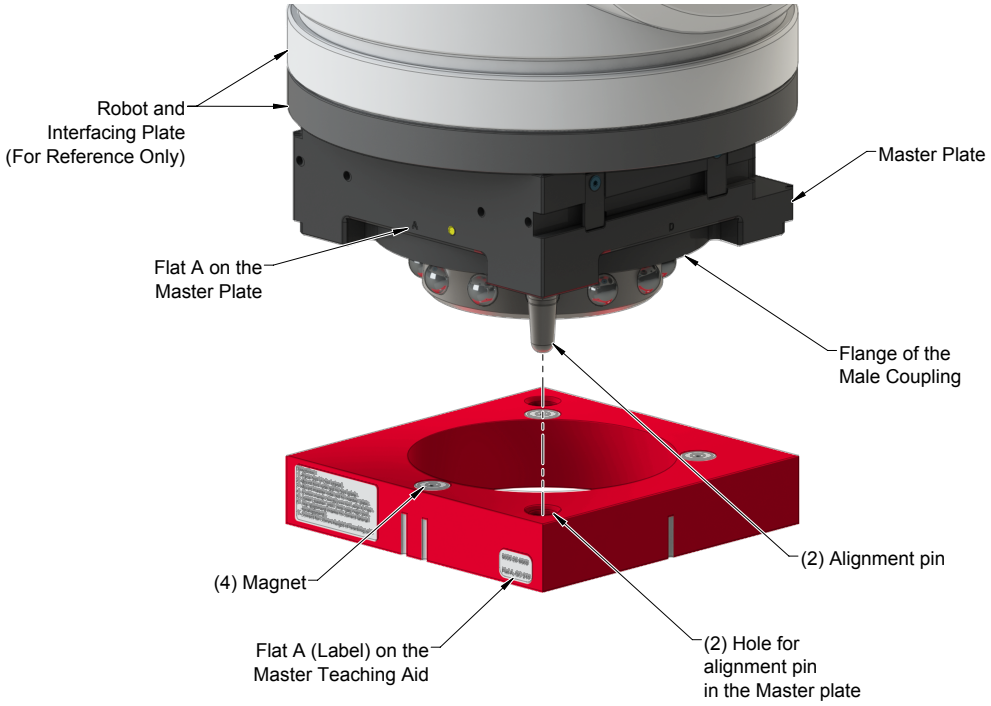
1. Place the Tool plate in the tool stand. Robot programs should be written with the Tool plate resting in the Tool stand.
2. Orient the Tool Side Teaching Aid such that the 'A' flat corresponds to the 'A' flat on the Tool plate.
3. Mount the Tool Side Teaching Aid over the Tool plate by inserting the (2) locating bosses into the alignment bushings. The magnets in the Teaching Aid attach to the Tool plate.

Figure 3.5—Tool Teaching Aid Installation



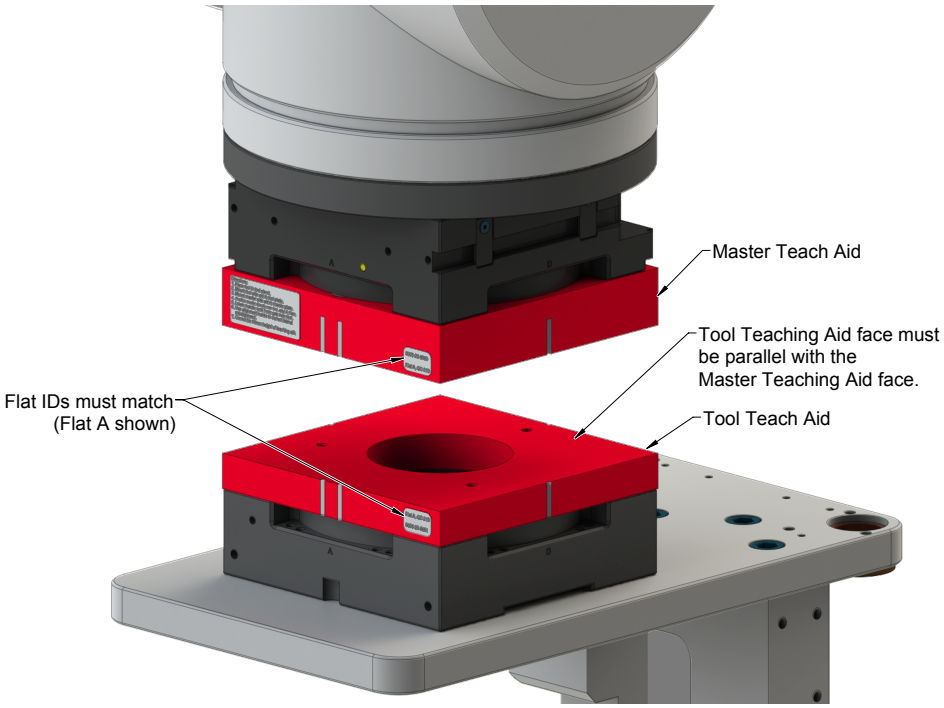
4. Align the Master plate flat A to the Master Side Teaching Aid Flat A.
5. Mount the Master Side Teaching Aid to the Tool Changer Master plate by inserting the Tool Changer alignment pins into the corresponding holes in the Teaching Aid. The magnets secure the Teaching Aid to the Master plate.

Figure 3.6—Master Side Teaching Aid Installation



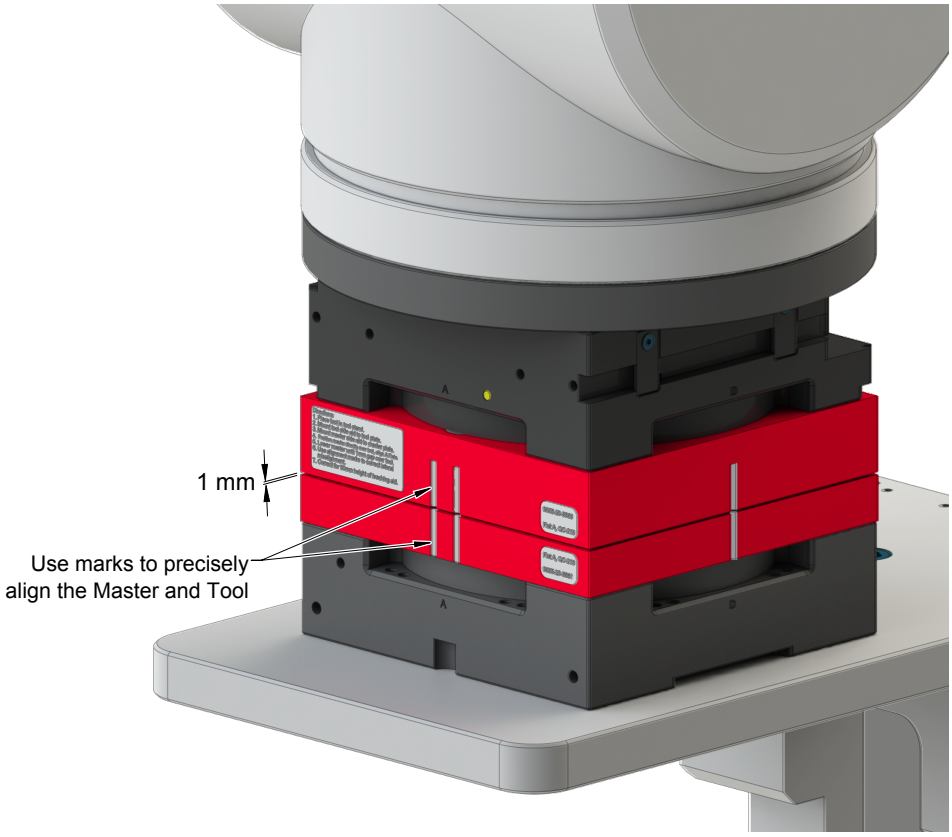
6. Position the Master plate directly over and parallel to the Tool plate. Align the Master and Tool flats; for example: Master plate flat A is aligned with Tool plate flat A.

Figure 3.7—Positioning the Master Plate Towards the Tool Plate



7. Move the Master plate slowly toward the Tool plate until the Master Side and Tool Side Teaching Aids are 1 mm apart.
8. Use the alignment marks or flats to align the Tool Side and Master Side Teaching Aids.

Figure 3.8—Final Alignment Position of the Teaching Aids



9. Record the robot coordinates.
10. Move the Master plate away from the Tool plate so that the Master Side and Tool Side Teaching Aids can be removed from the Tool Changer.
11. To account for the thickness of the Tool and Master Side Teaching Aids, the user must calculate a correction so that the "pick-up" and "replacement" coordinates are correct. Perform the applicable calculation from *Table 3.1* to determine the pick-up and replacement location.

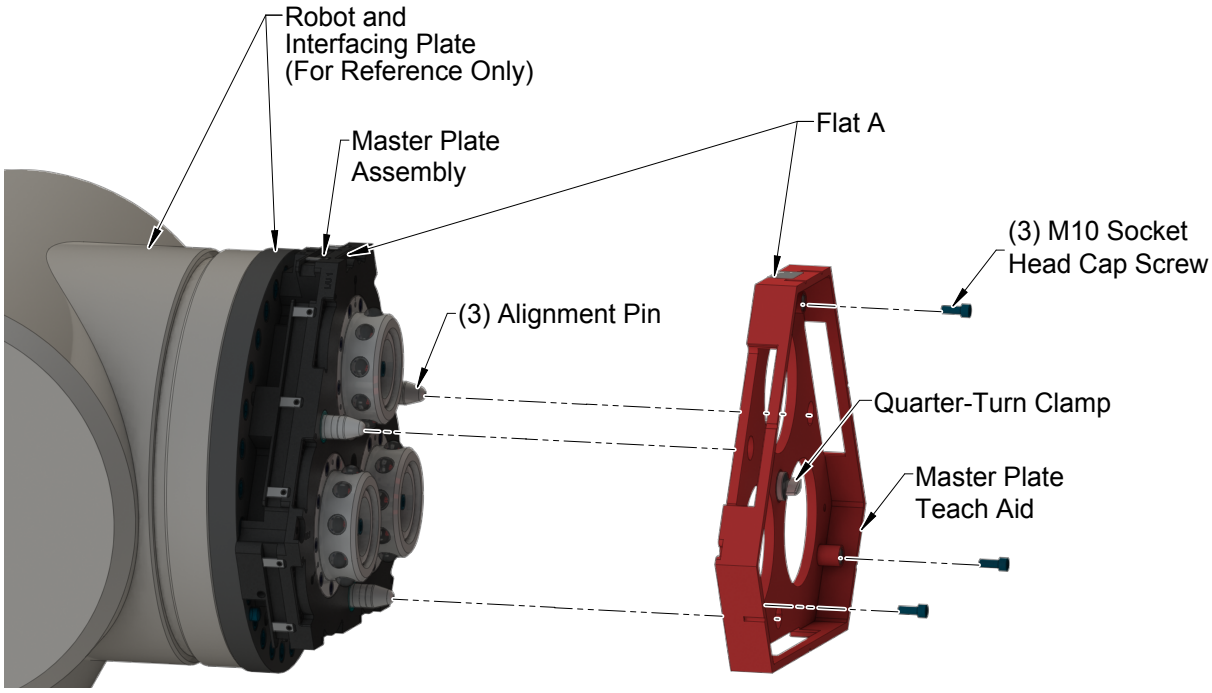
Table 3.1—Calculating the Correct "Pick-Up" Coordinate

Teach Aid	Cause
(QC-29) 9120-029-TEACH	'Z' Pick-up Coordinate = ('Z' coordinate from Step *9)*-(40 mm)
(QC-40) 9120-40-TEACH	'Z' Pick-up Coordinate = ('Z' coordinate from Step *9)*-(40 mm)
(QC-46) 9120-46-TEACH	'Z' Pick-up Coordinate = ('Z' coordinate from Step *9)*-(41 mm)
(QC-76) 9120-76-TEACH	'Z' Pick-up Coordinate = ('Z' coordinate from Step *9)*-(40 mm)
(QC-210) 9120-210-TEACH3	'Z' Pick-up Coordinate = ('Z' coordinate from Step *9)*-(50 mm)
(QC-830) 9120-830-TEACH	'Z' Pick-up Coordinate = ('Z' coordinate from Step *9)*-(40 mm)
(QC-835) 9120-835-TEACH	'Z' Pick-up Coordinate = ('Z' coordinate from Step *9)*-(40 mm)
(QC-850) 9120-850-TEACH	'Z' Pick-up Coordinate = ('Z' coordinate from Step *9)*-(40 mm)

3.3 Installing QC-1310 Teaching Aid

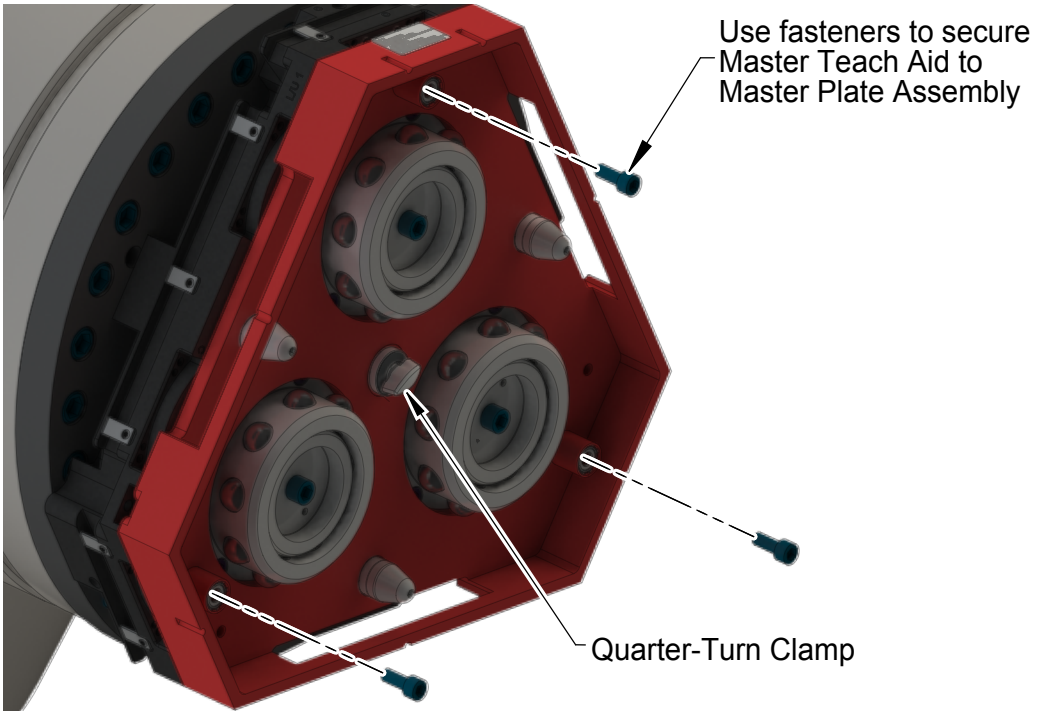
1. Position the robot and Master Tool changer so the Master plate is perpendicular to the floor. Refer to *Figure 3.9*.
2. Orient the Master side Teaching Aid so Flat A aligns with Flat A on the Master plate.
3. Mount the Master side Teaching Aid to the Master plate by inserting the Tool Changer alignment pins into the corresponding holes in the Master side Teaching Aid.

Figure 3.9—Master Teaching Aid Assembly Installation



4. Secure the Teach Aid to the Master Plate with the quarter-turn clamp in the center of the Master Teach aid body and the (3) Teach Aid fasteners:
    a. Lock the quarter-turn clamp into the receptacle by turning the clamp 1/4 of a turn, approximately 90 degrees.
    b. Tighten fasteners to 35 ft-lb.

Figure 3.10—Secure Teach Aid to Master Plate



5. Place the Tool plate in the tool stand. Robot programs should be written with the Tool plate resting in the Tool stand.
6. Orient the Tool side Teaching Aid so Flat A on the Teach Aid aligns with Flat A on the Tool plate.
7. Mount the Tool side Teaching Aid over the Tool plate by inserting the Tool Teach Aid alignment pins into the Tool Plate Assembly bushings.
8. Secure the Tool Teaching Aid to the Tool plate using the (3) M10 Socket Head Cap Screws. Tighten to 35 ft-lb.

Figure 3.11—Tool Teaching Aid Assembly Installation

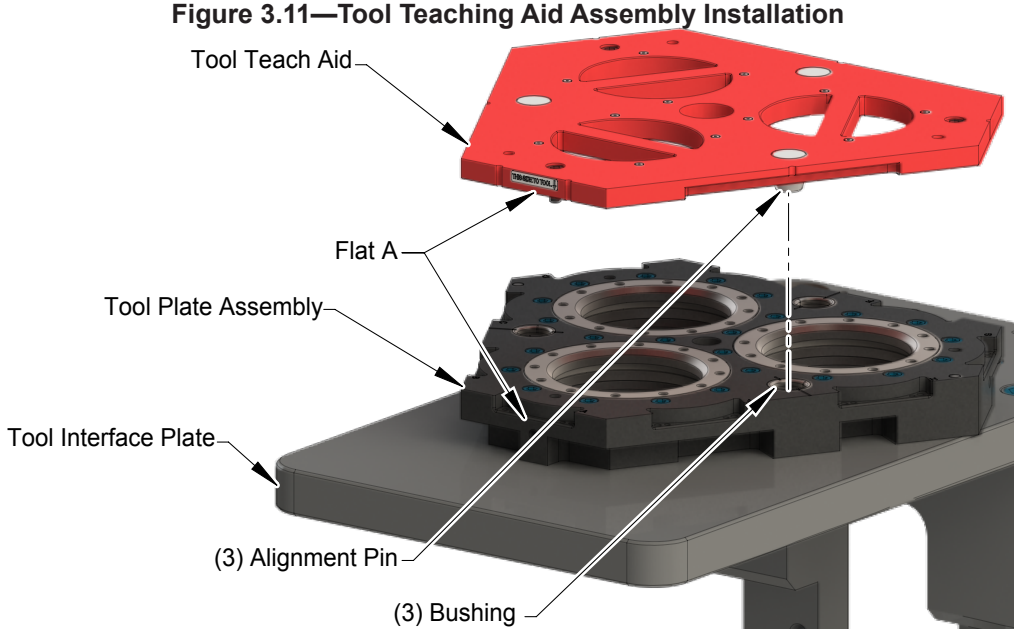
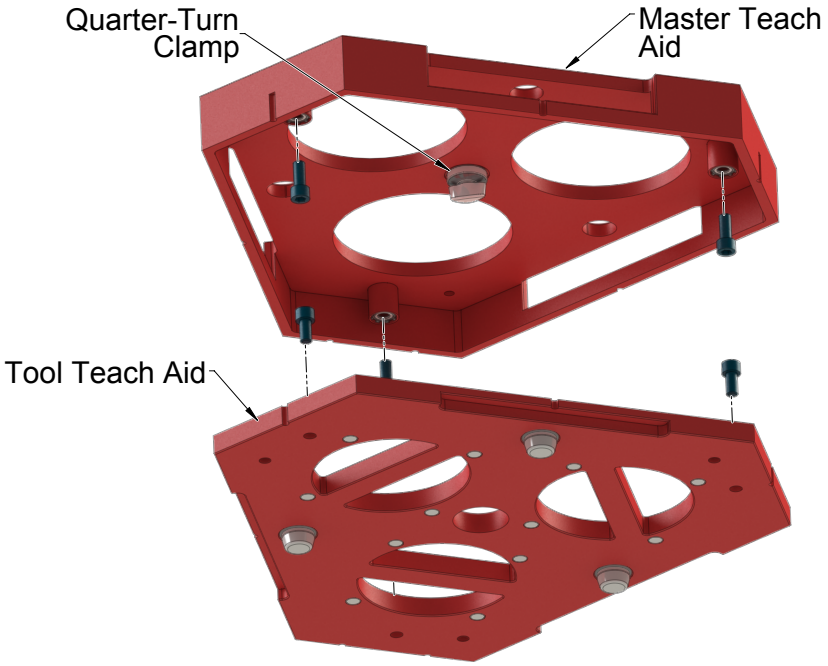


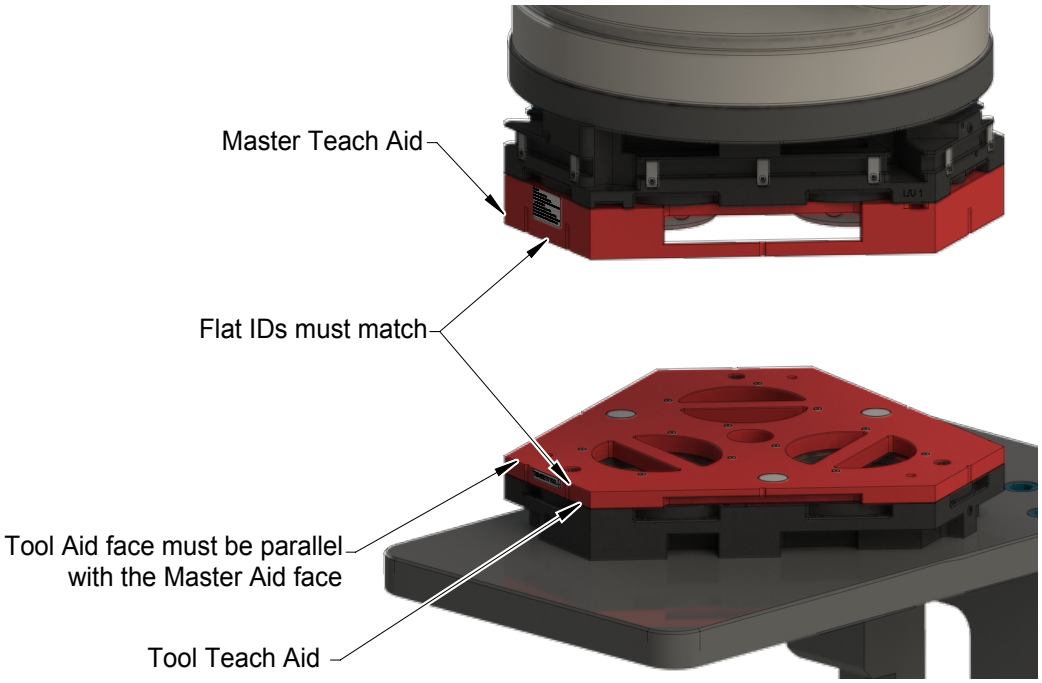
Figure 3.12—Master and Tool Teach Aid Assembly Installation



9. Position the mated Master Plate and Master Aid directly over and parallel to the Tool Teach Aid and Tool Plate. Align the Master and Tool flats; for example: the 'A' flat on the Master plate is aligned with the 'A flat' on the Tool plate.
10. Verify the Tool Changer locking mechanism is in the Unlocked position.

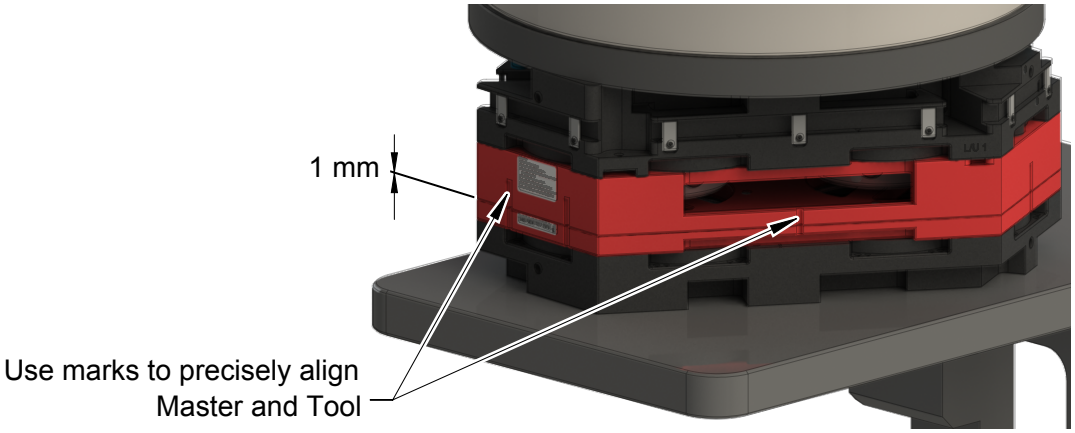
DANGER: The gap between the Master and Tool sides are pinch points. Physical contact in these pinch points will result in serious or permanent injury to personnel. Prevent all personnel from placing any body part or clothing in the gap, especially during actuation of the locking mechanism.

Figure 3.13—Positioning the Master Plate towards the Tool Plate



11. Move the Master plate assembly slowly toward the Tool plate until the Master and Tool side Teaching Aids are 1 mm apart.
12. Use the alignment marks to align the Tool side and Master side Teaching Aids. Store this position for later use.

Figure 3.14—Final Alignment Position of the Teaching Aid Plate Assembly



13. Support the Master-side Teaching Aid and unlock the Tool Changer.
14. Move the robot and Master plate away from the Aids and Tool plate.

NOTICE:
- Refer to the applicable Tool Changer manual for the maximum recommended offsets.
- Depending on the customer application, the pick-up position is not always vertical.

15. Move the Tool Changer Master plate towards the Tool plate until the Master plate is in the previously stored position.
16. Move the Master plate towards the Tool plate by the thickness of the Teach Aids as communicated on the labels provided on the Teach Aid.

CAUTION: Ensure the Master plate locking mechanism in unlocked prior to entering the Tool plate

17. Record the pick-up position.

4. Maintenance

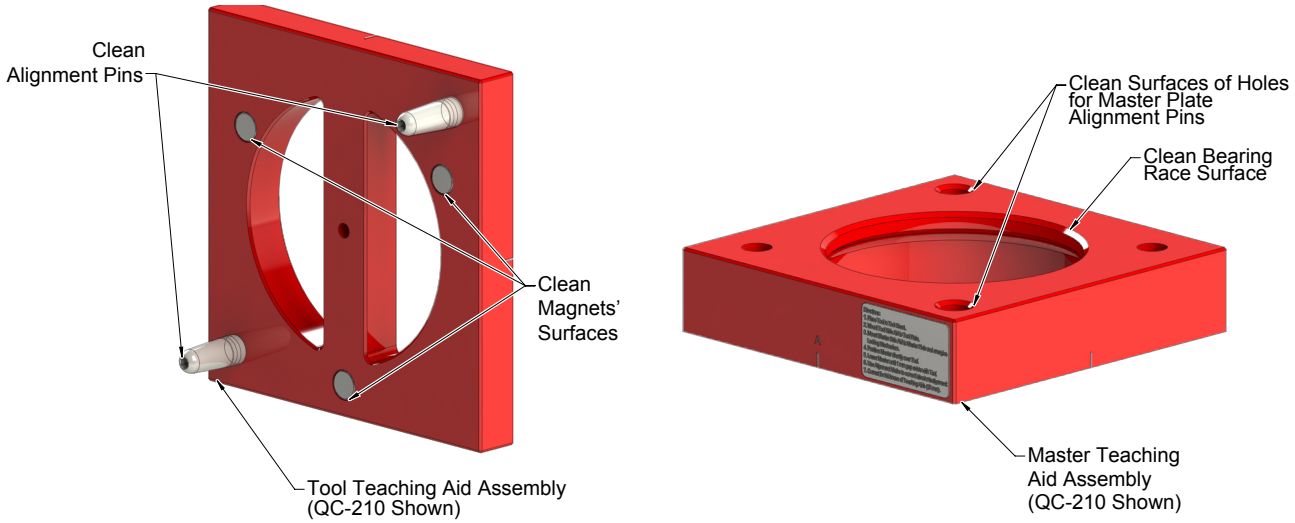
WARNING: Do not perform maintenance or repair(s) on the Tool Changer or modules unless the Tool is safely supported or placed in the tool stand, all energized circuits (e.g. electrical, air, water, etc.) are turned off, pressurized connections are purged and power is discharged from circuits in accordance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

If the Tool Changer is used in environments susceptible to contamination; for example: welding or deburring applications, limit the exposure of the Tool Changer and Teaching Aid to this environment. Cover idle Tool assemblies and Teaching Aids to prevent debris from settling on the mating surface. Keep the Tool Changer's Master plate assembly exposed to this environment for a short period of time, during the Tool change and down time.

Under normal conditions, no special maintenance is necessary. If needed, inspect and clean the following:

- Inspect the flat head socket head screws in the Tool Teaching Aid to verify that they are tight. If loose, refer to *5.2.1*.
- Use a clean rag to thoroughly remove existing lubricant and debris from the bearing race and bores for Master Plate Alignment Pins from the Master Teaching Aid. Refer to *Figure 4.1*.
- Use a clean rag to thoroughly remove any existing lubricant and debris from the alignment pins and magnets. Refer to *Figure 4.1*.

Figure 4.1—Cleaning of Master and Tool Teaching Aid Assemblies



5. Troubleshooting and Service Procedures

Troubleshooting and service information to help identify symptoms and resolve problems are available in the following sections.

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

5.1 Troubleshooting Procedures

Troubleshooting information is in the following table.

Table 5.1—Troubleshooting

Symptom	Cause	Resolution
Master Teaching Aid plate will not lock with the Tool Changer Master.	The bearing race has debris.	Clean bearing race and aliment pin bushings. Refer to *Section 4—Maintenance*.
	Refer to applicable Tool Changer or control module.	
Tool Changer Master plate will not unlock and release the Master Teaching Aid plate.	The control module on the Tool Changer has safety features that may not allow the Master plate to unlock.	Refer to the applicable Tool Changer or control module manual
Tool Teaching Aid plate is not secure to the Tool Changer Tool plate.	The surfaces of the Tool Teaching Aid plate have debris.	Clean Tool Teaching Aid assembly surfaces in accordance with *Section 4—Maintenance*..
	The fasteners that secure the magnets to the Tool Teaching Aid plate are loose.	Tighten fasteners. Refer to *Section 5.2.1—Adjustment or Installation of Magnets in Teaching Aid Assembly*.

5.2 Service Procedures

Instructions for component replacement and adjustment are in the following section.

5.2.1 Adjustment or Installation of Magnets in Teaching Aid Assembly

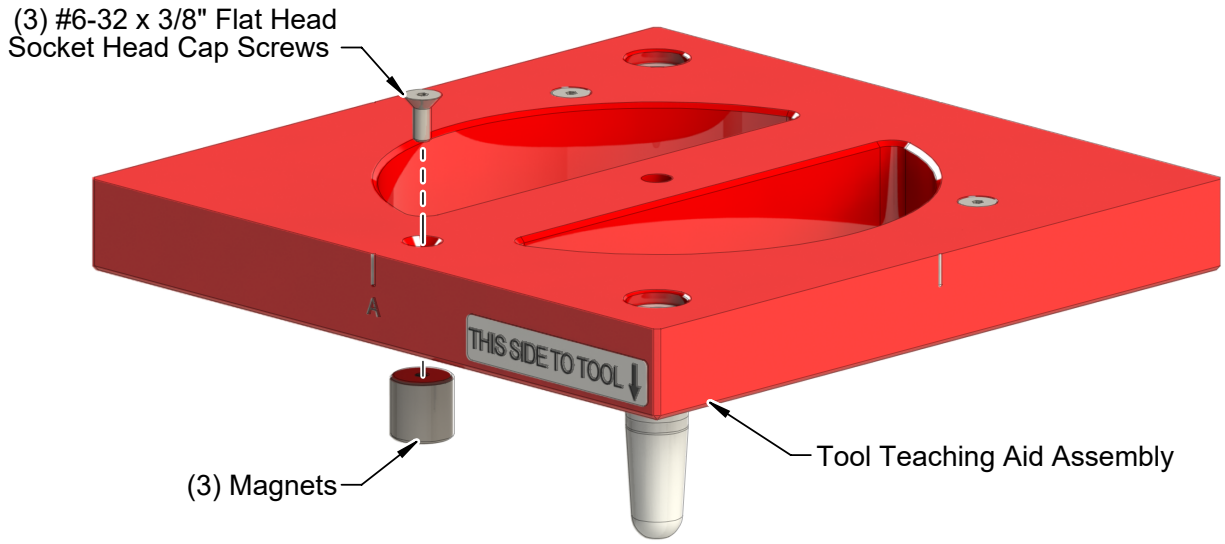
Parts required: *Refer to Section 6—Serviceable Parts.*

Tools required: *5/64" or 3/32 hex key, torque wrench*

Supplies required: *Loctite Primer 7649®, Loctite 262®, and 3/32 (for 4-40 Socket Head Cap Screw) torque wrench (if applicable).*

1. Using the appropriate Allen wrench, remove the fasteners from the Teaching Aid plate. Refer to *Figure 5.1*.
2. Remove the existing magnet.
3. Place new magnet in the Tool Teaching Aid plate.
4. Apply Loctite Primer 7649® and Loctite 262® to the fastener threads.
5. Using a hex key, secure the magnet in the Tool side Teaching Aid with the appropriate fastener. Refer to *Table 7.3* for torque specifications.

Figure 5.1—Adjustment or Installation of Magnets



6. Serviceable Parts

6.1 Master Teaching Aid Serviceable Parts

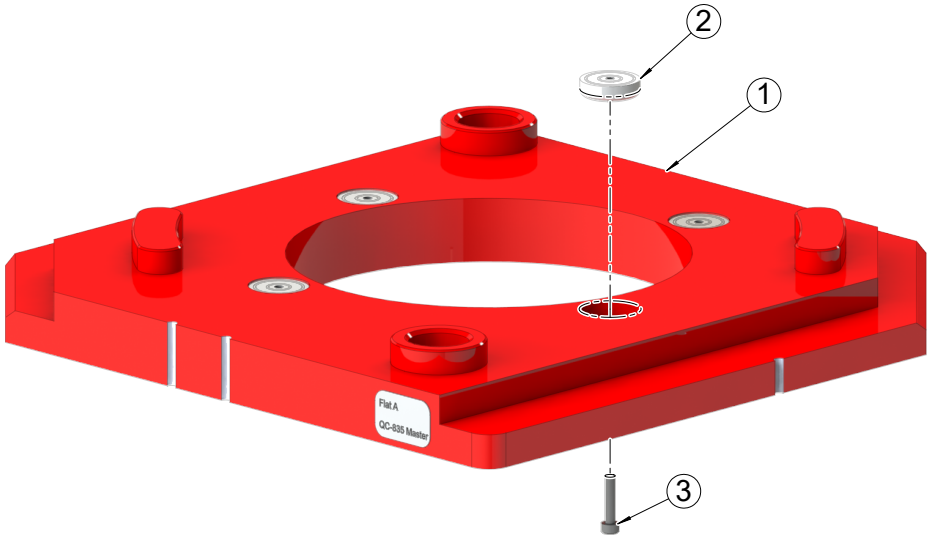


Table 6.1—Master Side Teaching Aid				
Item No.	**Configuration**	**Qty**	**Part Number**	**Description**
2	QC-29-TEACH	3	3710-20-1495	Magnet, 16mm OD x 5mm tall, M3 C'bore
3		3	3500-1057006-15A	M3-05 x 6mm socket head cap screw
-	QC-40-TEACH	-	9005-20-8801	Master side Teaching Aid assembly
1		1	3700-20-11094	Master side Teaching Aid
2		2	3710-20-3484	Magnet, 0.625" x 0.18"
3		2	3500-1010062-11	4-40 x 5/8" socket head cap screw, stainless steel
-	QC-46-TEACH	-	9005-20-9210	Master side Teaching Aid assembly
1		1	3700-20-11652	Master side Teaching Aid
2		3	3710-20-3484	Magnet, 0.625" x 0.18"
3		3	3500-1010062-11	4-40 x 5/8" socket head cap screw, stainless steel
2	QC-76-TEACH	3	3710-20-1495	Magnet, 16mm OD x 5mm tall, M3 C'bore
3		3	3500-1057006-15A	M3-05 x 6mm socket head cap screw

Table 6.1—Master Side Teaching Aid				
Item No.	**Configuration**	**Qty**	**Part Number**	**Description**
-	QC-210-TEACH3	-	9005-20-8660	Master side Teaching Aid assembly
1		1	3700-20-10468	Master side Teaching Aid
2		3	3710-20-3484	Magnet, 0.625” x 0.18”
3		3	3500-1010100-21	4-40 x 1 socket head cap screw, stainless steel
-	QC-830-TEACH	-	9128-830M-TEACH	Master side Teaching Aid assembly
1		1	3700-20-11844	Master side Teaching Aid body
2		4	3710-20-3484	Magnet, 0.625” x 0.18”
3		4	3500-1010050-21	4-40 x 1/2 socket head cap screw, stainless steel
-	QC-835-TEACH	-	9128-835M-TEACH	Master side Teaching Aid assembly
1		1	3700-20-11814	Master side Teaching Aid body
2		4	3710-20-3484	Magnet, 0.625” x 0.18”
3		4	3500-1010050-21	4-40 x 1/2 socket head cap screw, stainless steel
-	QC-850-TEACH	-	9128-850M-TEACH	Master side Teaching Aid assembly
1		1	3700-20-11816	Master side Teaching Aid body
2		4	3710-20-3484	Magnet, 0.625” x 0.18”
3		4	3500-1010050-21	4-40 x 1/2 socket head cap screw, stainless steel

6.2 Tool Teaching Aid Serviceable Parts

Figure 6.1—Tool Teaching Aid Plate (QC-210 Shown)

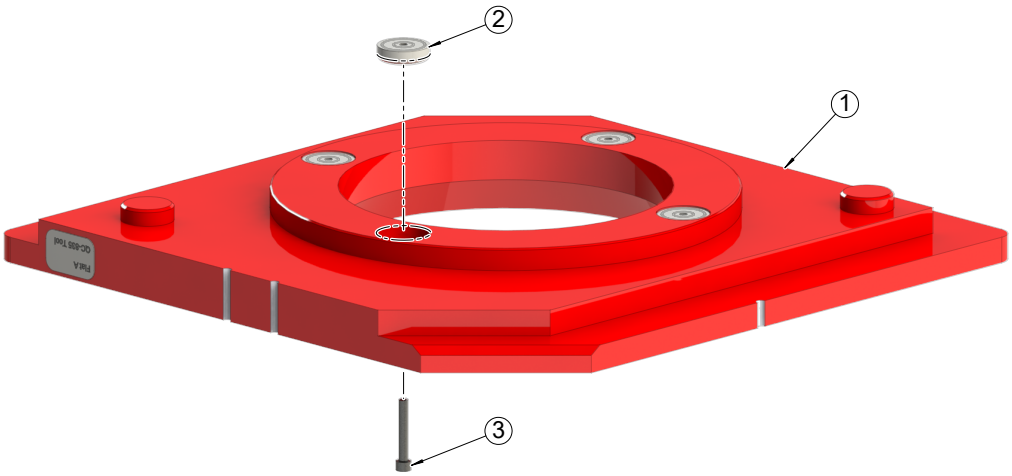


Table 6.2—Tool Side Teaching Aid				
Item No.	**Configuration**	**Qty**	**Part Number**	**Description**
2	QC-29	3	3710-20-1495	Magnet, 16mm OD x 5mm tall, M3 C'bore
3		3	3500-1057006-15A	M3-05 x 6mm socket head cap screw
-	QC-40	-	9005-20-8803	Tool side Teaching Aid assembly
1		1	3700-20-11095	Tool side Teaching Aid
2		2	3710-20-3484	Magnet, 0.625" x 0.18"
3		2	3500-1010050-21	4-40 x 1/2" socket head cap screw, stainless steel
-	QC-46	-	9005-20-9211	Tool side Teaching Aid assembly
1		1	3700-20-11653	Tool side Teaching Aid
2		3	3710-20-3484	Magnet, 0.625" x 0.18"
3		3	3500-1010062-11	4-40 x 5/8" socket head cap screw, stainless steel
2	QC-76	3	3710-20-1495	Magnet, 16mm OD x 5mm tall, M3 C'bore
3		3	3500-1057006-15A	M3-05 x 6mm socket head cap screw

Table 6.2—Tool Side Teaching Aid				
Item No.	**Configuration**	**Qty**	**Part Number**	**Description**
2	QC-110	3	3710-20-3355	Encased Alinco 5 Magnet 1/2” Dia, 1/2” Thick, 6-32 Hole, 1.4 Pull lbs
3		3	3500-1215037-21	#6-32 x 3/8” Stainless Steel Flat Head Socket Cap Screw
2	QC-160	4	3710-20-3484	Encased Alinco 5 Magnet 1/2” Dia, 1/2” Thick, 6-32 Hole, 1.4 Pull lbs
3		4	3500-1010062-11	#6-32 x 3/8” Stainless Steel Flat Head Socket Cap Screw
-	QC-210-TEACH3		9005-20-8661	Tool side Teaching Aid Assembly
1		1	3700-20-11653	Tool side Teaching Aid
2		3	3710-20-3484	Magnet, 0.625” x 0.18”
3		3	3500-1010050-21	4-40 x 1/2” socket head cap screw, stainless stee
2	QC-213	4	3710-20-3355	Encased Alinco 5 Magnet 1/2” Dia, 1/2” Thick, 6-32 Hole, 1.4 Pull lbs
3		4	3500-1215037-21	#6-32 x 3/8” Stainless Steel Flat Head Socket Cap Screw
2	QC-310	6	3710-20-3355	Encased Alinco 5 Magnet 1/2” Dia, 1/2” Thick, 6-32 Hole, 1.4 Pull lbs
3		6	3500-1215037-21	#6-32 x 3/8” Stainless Steel Flat Head Socket Cap Screw
2	QC-510	8	3710-20-3355	Encased Alinco 5 Magnet 1/2” Dia, 1/2” Thick, 6-32 Hole, 1.4 Pull lbs
3		8	3500-1215037-21	#6-32 x 3/8” Stainless Steel Flat Head Socket Cap Screw
-	QC-830	-	9120-830T-TEACH	QC-830 Tool side Teaching Aid
1		1	3700-20-11845	QC-830 Tool side Teaching Aid body
2		4	3710-20-3484	Magnet, .625” x .18”
3		4	3500-1010062-11	4-40 x 3/4” Socket Head Cap Screw
-	QC-835	-	9120-835T-TEACH	QC-835 Tool side Teaching Aid
1		1	3700-20-11813	QC-835 Tool side Teaching Aid body
2		4	3710-20-3484	Magnet, .625” x .18”
3		4	3500-1010062-11	4-40 x 3/4” Socket Head Cap Screw

Table 6.2—Tool Side Teaching Aid				
Item No.	**Configuration**	**Qty**	**Part Number**	**Description**
-	QC-850	-	9120-850T-TEACH	QC-850 Tool side Teaching Aid
1		1	3700-20-11845	QC-850 Tool side Teaching Aid body
2		4	3710-20-3484	Magnet, .625” x .18”
3		4	3500-1010075-21	4-40 x 3/4” Socket Head Cap Screw
2	QC-1210	9	3710-20-3355	Encased Alinco 5 Magnet 1/2” Dia, 1/2” Thick, 6-32 Hole, 1.4 Pull lbs
3		9	3500-1215037-21	#6-32 x 3/8” Stainless Steel Flat Head Socket Cap Screw

7. Specifications

Table 7.1—Teaching Aid Specifications				
Part Number	**Description**	**Material**	**Weight**	**Stack Height**
9120-029-TEACH	**QC-29 Teaching Aids**	6061-T6 Aluminum	1.9 lb (0.88 kg)	1.57 in (40 mm)
9120-029M-TEACH	QC-29 Master Side Teaching Aid	6061-T6 Aluminum	N/A	N/A
9120-029T-TEACH	QC-29 Tool Side Teaching Aid	6061-T6 Aluminum	N/A	N/A
9120-40-TEACH	**QC-40 Teaching Aids**	6061-T6 Aluminum	1.6 lb (0.73 kg)	1.57 in (40 mm)
9005-20-8801	QC-40 Master Side Teaching Aid	6061-T6 Aluminum	N/A	N/A
9005-20-8803	QC-40 Tool Side Teaching Aid	6061-T6 Aluminum	N/A	N/A
9120-46-TEACH	**QC-46 Teaching Aids**	6061-T6 Aluminum	3.3 lb (1.51 kg)	1.6 in (41 mm)
9005-20-9210	QC-46 Master Side Teaching Aid	6061-T6 Aluminum	N/A	N/A
9005-20-9211	QC-46 Tool Side Teaching Aid	6061-T6 Aluminum	N/A	N/A
9120-76-TEACH	**QC-76 Teaching Aids**	6061-T6 Aluminum	4.2 lb (1.9 kg)	1.57 in (40 mm)
9120-076M-TEACH	QC-76 Master Side Teaching Aid	6061-T6 Aluminum	N/A	N/A
9120-076T-TEACH	QC-76 Tool Side Teaching Aid	6061-T6 Aluminum	N/A	N/A
9120-110-TEACH	**QC-110 Teaching Aids**	6061-T6 Aluminum	5.9 lb (2.68 kg)	2.2 in (55 mm)
9005-20-2328	QC-110 Master Side Teaching Aid	6061-T6 Aluminum	N/A	N/A
9005-20-2329	QC-110 Tool Side Teaching Aid	6061-T6 Aluminum	N/A	N/A
9120-160-TEACH	**QC-160 Teaching Aids**	6061-T6 Aluminum	7 lb (3.18 kg)	2.2 in (55 mm)
9005-20-2316	QC-160 Master Side Teaching Aid	6061-T6 Aluminum	N/A	N/A
9005-20-2317	QC-160 Tool Side Teaching Aid	6061-T6 Aluminum	N/A	N/A
9120-210-TEACH3	**QC-210 Teaching Aids**	6061-T6 Aluminum	4.3 lb (2.0 kg)	2 in (51 mm)
9005-20-8660	QC-210 Master Side Teaching Aid	6061-T6 Aluminum	N/A	N/A
9005-20-8661	QC-210 Tool Side Teaching Aid	6061-T6 Aluminum	N/A	N/A
9120-213-TEACH	**QC-213 Teaching Aids**	6061-T6 Aluminum	8.9 lb (4.04 kg)	2.2 in (55 mm)
9005-20-2360	QC-213 Master Side Teaching Aid	6061-T6 Aluminum	N/A	N/A
9005-20-2359	QC-213 Tool Side Teaching Aid	6061-T6 Aluminum	N/A	N/A

Table 7.2—Teaching Aid Specifications				
Part Number	**Description**	**Material**	**Weight**	**Stack Height**
9120-310-TEACH	**QC-310 Teaching Aids**	6061-T6 Aluminum	12.6 lb (5.72 kg)	2.6 in (66 mm)
9005-20-1427	QC-310 Master Side Teaching Aid	6061-T6 Aluminum	N/A	N/A
9005-20-1426	QC-310 Tool Side Teaching Aid	6061-T6 Aluminum	N/A	N/A
9120-510-TEACH	**QC-510 Teaching Aids**	6061-T6 Aluminum	17 lb (7.71 kg)	2.4 in (61 mm)
9005-20-2448	QC-510 Master Side Teaching Aid	6061-T6 Aluminum	N/A	N/A
9005-20-2449	QC-510 Tool Side Teaching Aid	6061-T6 Aluminum	N/A	N/A
9120-830-TEACH	**QC-830 Teaching Aids**	6061-T6 Aluminum	4.1 lb (1.84 kg)	1.57 in (40 mm)
9120-830M-TEACH	QC-830 Master Side Teaching Aid	6061-T6 Aluminum	N/A	N/A
9120-830T-TEACH	QC-830 Tool Side Teaching Aid	6061-T6 Aluminum	N/A	N/A
9120-835-TEACH	**QC-835 Teaching Aids**	6061-T6 Aluminum	6.3 lb (2.85 kg)	1.57 in (40 mm)
9120-835M-TEACH	QC-835 Master Side Teaching Aid	6061-T6 Aluminum	N/A	N/A
9120-835T-TEACH	QC-835 Tool Side Teaching Aid	6061-T6 Aluminum	N/A	N/A
9120-850-TEACH	**QC-850 Teaching Aids**	6061-T6 Aluminum	9.2 lb (4.17 kg)	1.57 in (40 mm)
9120-850M-TEACH	QC-850 Master Side Teaching Aid	6061-T6 Aluminum	N/A	N/A
9120-850T-TEACH	QC-850 Tool Side Teaching Aid	6061-T6 Aluminum	N/A	N/A
9120-1210-TEACH	**QC-1210 Teaching Aids**	6061-T6 Aluminum	15.9 lb (7.21 kg)	2.8 in (70 mm)
9005-20-2286	QC-1210 Master Side Teaching Aid	6061-T6 Aluminum	N/A	N/A
9005-20-2285	QC-1210 Tool Side Teaching Aid	6061-T6 Aluminum	N/A	N/A
9120-1310-TEACH	**QC-1310 Teaching Aids**	6061-T6 Aluminum	25.3 lb (11.48 kg)	2.8 in (71 mm)
9005-20-8674	QC-1310 Master Side Teaching Aid	6061-T6 Aluminum	N/A	N/A
9005-20-8675	QC-1310 Tool Side Teaching Aid	6061-T6 Aluminum	N/A	N/A

Table 7.3—Fastener Torque Specifications			
Teach Aid	**Fastener P/N**	**Fastener Description**	**Torque**
QC-40-TEACH	3500-1010062-11	4-40 X 5/8”, Socket Head Cap Screw, Stainless Steel	12 in-lbs (0.8 Nm)
QC-46-TEACH			
QC-210-TEACH3	3500-1010100-21	4-40 X 1 Socket Head Cap Screw, Stainless Steel	
QC-110-TEACH	3500-1215037-21	#6-32 X 3/8” Stainless Steel Flat Head Socket Head Cap Screw	15 in-lbs (1.69 Nm)
QC-160-TEACH			
QC-210-TEACH			
QC-213-TEACH			
QC-310-TEACH			
QC-510-TEACH			
QC-1210-TEACH			

8. Drawings

Drawings are available on the *ATI website* or by contacting an ATI representative.