Table of Contents

D. Fluid/Air Modules D-2
FF4 Master, FF4 and AQ5 Tool D-2
FH10 Master, FH10 and AQ4 Tool D-2
1. Product Overview D-2
2. Installation D-3
2.1 Installing Modules D-3
2.2 Removing Modules D-4
3. Operation D-5
4. Maintenance D-6
5. Troubleshooting and Service Procedures D-7
5.1 Troubleshooting Procedures D-7
5.2 Service Procedures D-8
5.2.1 Master Side Self-Sealing Valve D-8
5.2.2 Tool Side Self-Sealing Valve D-10
6. Serviceable Parts D-12
7. Specifications D-12
8. Drawings D-13

D. Fluid/Air Modules

FF4 Master, FF4 and AQ5 Tool

FH10 Master, FH10 and AQ4 Tool

1. Product Overview

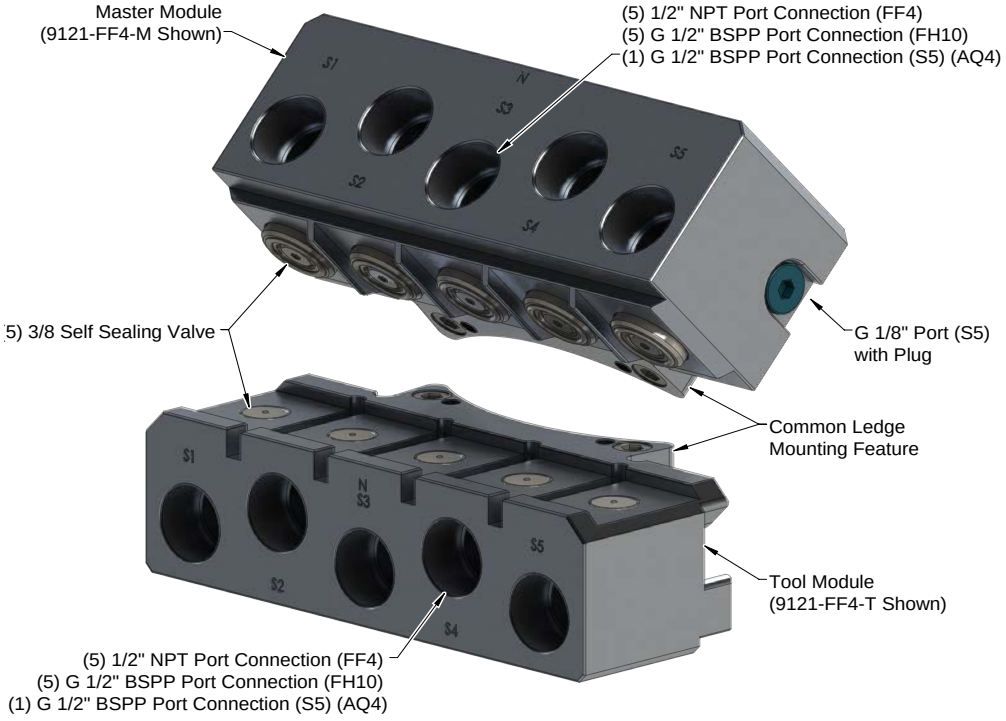
Fluid/air modules provide fluid and air utility, and are attached to the Master and Tool plates. When the Tool Changer is coupled, the Master module passes the fluid/air supply to the Tool module for use by the customer tooling. Significant forces are encountered when using these modules. Assistance from the robot may be required to overcome these forces when coupling the Tool Changer.

NOTICE: The Master and Tool modules contain self-sealing valves. Do not use self-sealing valves for vacuum utility.

Table 1.1—Fluid/Air Modules

Module	Description
FF4-M	Stainless Steel Fluid/Air Master module with (5) 1/2” NPT port connections and (5) 3/8” self-sealing valves
FF4-T	Stainless Steel Fluid/Air Tool module with (5) 1/2” NPT port connections and (5) 3/8” self-sealing valves
AQ5-T	Pneumatic Tool module with (1) 1/2” NPT port connection and (1) 3/8” self-sealing valve
FH10-M	Stainless Steel Fluid/Air Master module with (5) G 1/2” BSPP port connections and (5) 3/8” self-sealing valves
FH10-T	Stainless Steel Fluid/Air Tool module with (5) G 1/2” BSPP port connections and (5) 3/8” self-sealing valves
AQ4-T	Pneumatic Tool module with (1) G 1/2” BSPP port connection S5 and (1) 3/8” self-sealing valve

Figure 1.1—Fluid/Air Modules



2. Installation

Air modules are typically installed by ATI prior to shipment. Use the following steps to install or remove air modules.

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.

WARNING: 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 over stressing, pullout, or kinking the lines. Failure to do so can cause critical electrical and/or pneumatic lines to malfunction and might result in injury to personnel or damage to equipment.

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.

2.1 Installing Modules

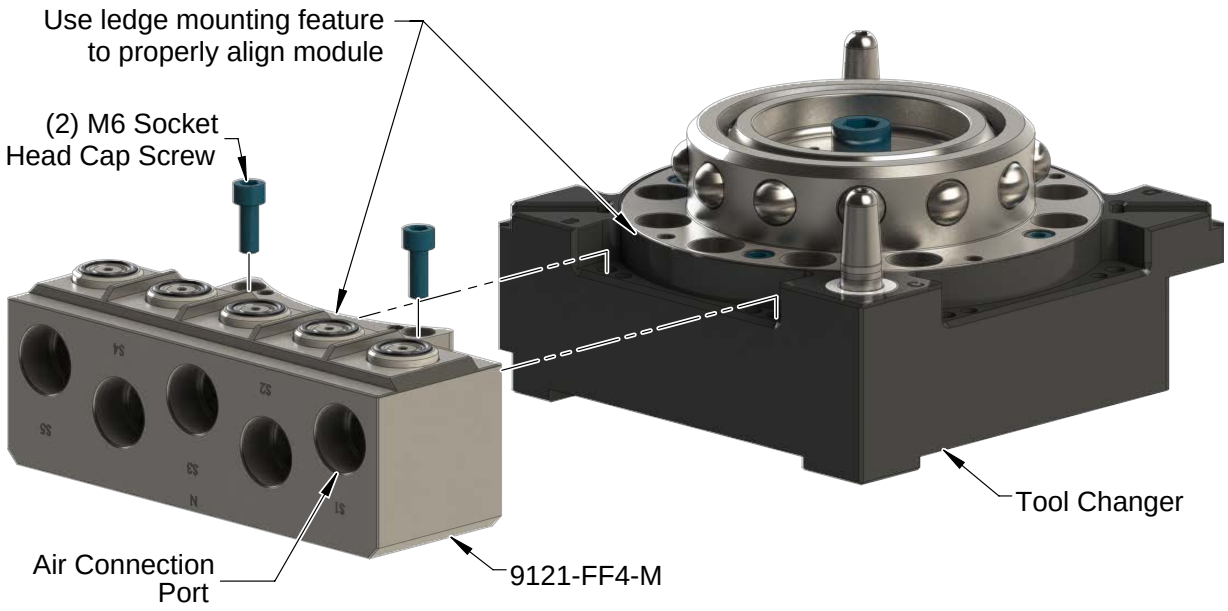
See *Figure 2.1*.

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

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. Wipe down the mounting surfaces with a clean rag.
5. Place the module into the appropriate location on the Tool Changer or Utility Coupler body. Align the module with the Tool Changer using the dowels in the bottom of the ledge feature.
6. Apply Loctite 242 to the supplied M6 socket head cap screws. Using a 5 mm hex key, install the (2) M6 socket head cap screws securing the module to the Tool Changer or Utility Coupler and tighten to 45 in-lbs (10.0 Nm).
7. Ensure the air connectors are clean and connect to the module.
8. Safely resume normal operation.

Figure 2.1—Module Installation



2.2 Removing Modules

Tools required: *5 mm hex key*

Supplies required: *clean rag, paint marker*

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).

NOTICE: Debris can be expelled at high velocity during the purge, take all required safety precautions.

4. All customer plumbing connections to the module must be purged.
   a. Verify that the supply lines are turned off.
   b. Cover the valves with a rag for safety.
   c. Manually actuate the self-sealing valves to purge the line pressure.
5. Use a paint marker to indicate where the module is to be re-installed.
6. Disconnect air plumbing to the module.
7. Remove the (2) M6 socket head cap screws using a 5 mm hex key.
8. Remove the module from the Tool Changer or Utility Coupler.

3. Operation

Fluid/air modules pass fluid/air utilities from the Master to the Tool for use by the customer's tooling.

Self-sealing valves prevent fluid/air circuits from discharging during tool changes.

The compressibility of gasses makes it unnecessary to isolate and discharge lines during a tool change. However, liquids are incompressible and therefore coupling lines while pressurized is to be avoided. Liquid displaced by mating coupler components increases pressure and fluid velocities such that seals can be damaged. These problems become more pronounced as the operating pressure is increased.

In all liquid coupling applications, take the following steps:

- Install connections to the ports on the fluid/air modules using flexible hoses, which are able to absorb pressure spikes and pulses. Do not use highly reinforced hoses or hard pipe.
- Turn off the supply pump to the circuit and discharge pressure in the lines prior to a tool change.
- Accumulators can be installed on both the Master and Tool side plumbing. This is particularly important on the Tool side, also with the pump turned off and Master side pressure discharged.
- During routine maintenance of the Tool Changer, the fluid/air modules should be inspected and re-lubricated. Water and most solvents will wash away lubricants necessary to prolong seal life.
- Ensure that fluids are near a neutral pH, minimize particle size.



CAUTION: Failure to follow these steps will result in premature seal failure, jetting of fluid from the couplers during tool changes, and significant pressure pulses in customer tooling.

A G1/8 plugged connection, located on the Master module, is supplied from the Master module's S5 port in order to supply a valve adapter module with an integrated solenoid valve and lock/unlock air. This function cannot be used with air adapter modules that require separate lock and unlock air supplies. The air passing through the S5 port must never drop below the Tool Changer's minimum 60 psi (4 bar) requirement. Failure to maintain the minimum pressure may result in improper and unsafe Tool Changer operation. Contact ATI's Application Engineers for more information.



CAUTION: If the G1/8 connection to the master module's S4 port is used for lock/unlock air, the pressure must always maintain above 60 psi (4 Bar) to the G1/8 connection to ensure proper, safe operation of the Tool Changer locking mechanism. If supply pressure drops below 60 psi (4 bar) the Tool Changer may not be securely locked or in a fail-safe condition, operation must be halted until the air pressure is returned to a minimum of 60 PSI and return the Tool Changer to a secure lock position. Always maintain a minimum of 60 psi (4 bar) to the G1/8 connection through the S4 port.

4. Maintenance

Perform maintenance to maximize the operational life of the 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.

A preventive maintenance schedule and checklist are provided in the following tables:

Table 4.1—Preventive Maintenance Schedule

Inspection Schedule	Action Required
Weekly	Clean and inspect
6 months or 500,000 cycles	Seal replacement

Table 4.2—Maintenance Checklist

Weekly Maintenance:
☐ Clean mating surfaces.
☐ Inspect modules for leaks. Replace components as necessary.
6 months or 500,000 cycle Maintenance:
☐ On modules with self-sealing ports, remove and replace self-sealing valve O-rings and seals in both the Master and Tool Module. During O-ring and seal replacement inspect components (valve stem, check valve piston, and spring) of the valve assemblies in the Master and Tool modules. Refer to *Section 5.2—Service Procedures*.
☐ Check that module mounting bolts are secure. Refer to *Section 2.1—Installing Modules*.

5. Troubleshooting and Service Procedures

The following section provides troubleshooting information to help diagnose conditions with the Tool Changer or air module and service procedures to help resolve these conditions.

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

Refer to the following table for troubleshooting information:

Table 5.1—Troubleshooting Procedures

Symptom	Possible Cause	Correction
Leakage	Damaged/Worn seals	Replace O-rings as needed. Refer to *Section 5.2—Service Procedures*.
	Debris blocking valve seal (for self-sealing valves)	Clean in and around valve components. Ensure fluid stream is free of large particulates; filter as necessary.
	Bent valve piston (for self-sealing valves)	Replace stem. Refer to *Section 5.2—Service Procedures*. Check module attachment to Tool Changer. Refer to *Section 2.1—Installing Modules.* Check robot program and ensure parallel approach trajectory during Tool Changer coupling.
	Corrosion	Consult ATI Applications Engineering for assistance.
Fluid spray during uncoupling	Surge/Water hammer	Decrease the pressure differential between the supply and return lines. Alternately, install a pressure compensation system; for example: an accumulator or surge suppressor as close as possible to the spraying port. Consult ATI for assistance.
Reduced flow	Flow path blockage	Inspect valve components and supply/return lines for blockage. Clean/repair as necessary.
	Debris blocking valve seal (for self-sealing valves)	Clean in and around valve components. Ensure air stream is free of large particulates; filter as necessary.
Modules unable to couple	Bent valve piston and/or dowel pin (for self-sealing valves)	Replace stem. Refer to *Section 5.2—Service Procedures*. Check module attachment to Tool Changer. Refer to *Section 2.1—Installing Modules.* Check robot program and ensure parallel approach trajectory during Tool Changer coupling.

5.2 Service Procedures

Component replacement and adjustment procedures are provided in the following section.

5.2.1 Master Side Self-Sealing Valve

Parts required: *Refer to Section 8—Drawings.*

Tools required: *2.5 mm hex key, torque wrench*

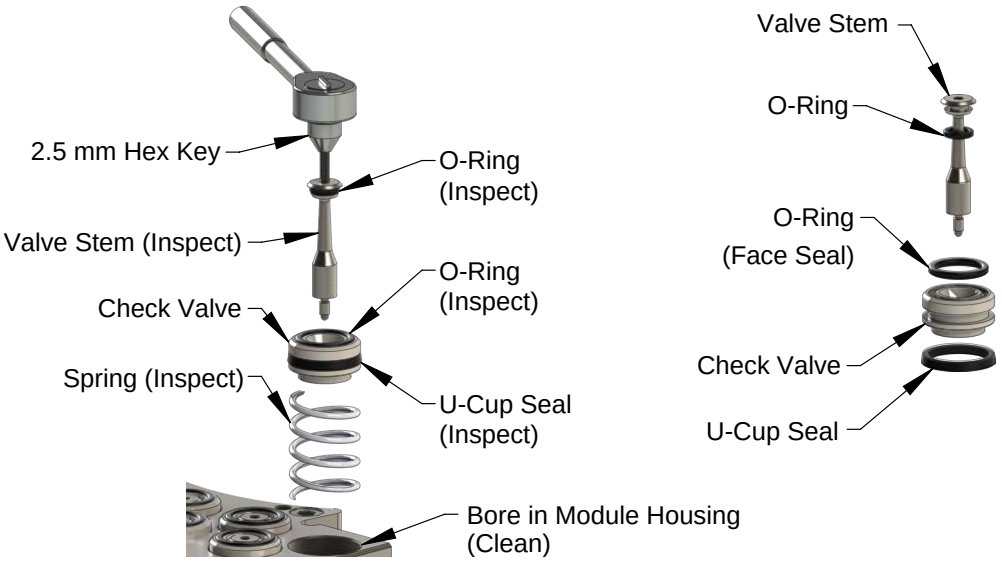
Supplies required: *Clean rag, Magnalube G lubricant*

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).

NOTICE: Debris can be expelled at high velocity during the purge, take all required safety precautions.

4. Purge and disconnect all customer plumbing connections to the module.
   a. Turn the supply lines off.
   b. Cover the valves with a rag for safety.
   c. Manually actuate the module's self-sealing valves to purge the line pressure. Note: Debris can be expelled at high velocity during the purge, take all required safety precautions.
5. Depending on the type of service or repair, connections to the module might also need to be disconnected.
6. Remove the valve stem using a 2.5 mm hex key. Do not strip the hex on the valve stem during removal.
7. Remove the check valve piston and spring. Clean any lubrication from the check valve piston, valve stem, spring, and bore in the module housing using a clean rag.
8. Inspect the valve stem for straightness, and replace, if bent.
9. Inspect the o-rings and u-cup seal on the valve stem and check valve piston for wear and damage. Replace components that are damaged or worn.
10. Inspect the spring in the assembly and replace if damaged or worn.

Figure 5.1—Master Self-Sealing Valve

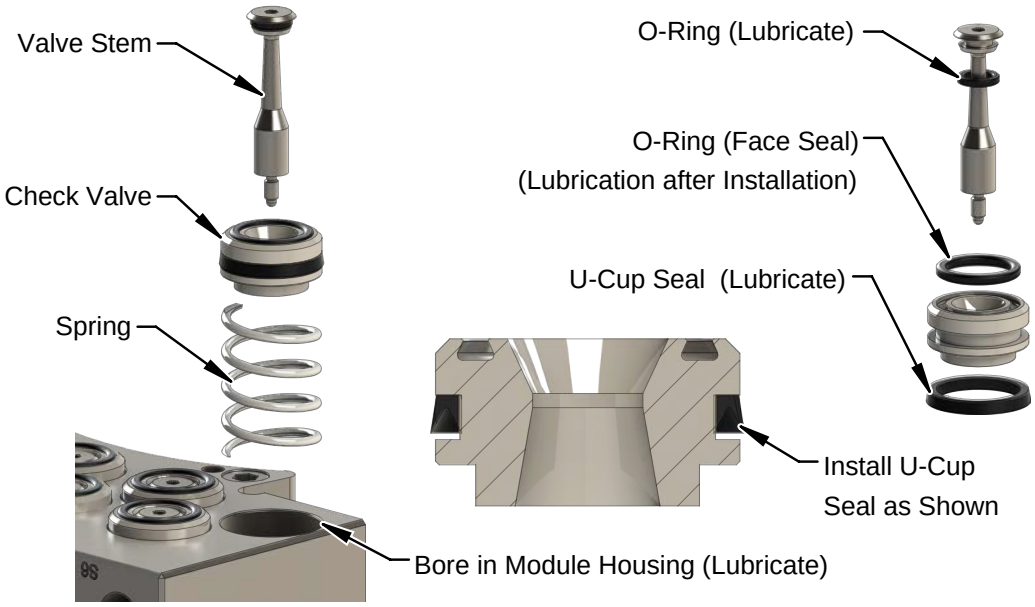


11. Lubricate the bore in the module housing with Magnalube G (Teflon/Petroleum based grease).

NOTICE: Do not lubricate the O-ring face seal until after installation. Lubricating the O-ring before installation can cause the O-ring to blow out during coupling and uncoupling.

12. If replacing seals, lubricate the valve stem O-ring and the check valve piston U-cup seal with Magnalube G (Teflon/Petroleum based grease).
13. Install the O-ring on the valve stem.
14. Install the U-cup seal on the check valve. Do not get lubrication in the face seal groove in the check valve.
15. Install the non-lubricated O-ring (face seal) into the check valve.
16. Install the spring into the bore in the module housing, seat the check valve on the spring.
17. If the threaded end of the valve stem does not have pre-applied adhesive, apply Loctite 7649 primer and then Loctite 222 or similar thread locker to the threaded end of the valve stem. If the module housing is stainless steel, also add Loctite 7649 primer to the housing threads.

Figure 5.2—Master Self-Sealing Valve Installation



18. Install the valve stem. The check valve piston must be pushed down flush with the mating surface of the Master housing in order to install the threaded end of the valve stem. Do not damage the U-cup seal around the check valve piston. A small, flat-head screwdriver can be used to ensure that the U-cup seal is fully located in the recess and not folded over itself prior to screwing in the valve stem. Tighten the stem to 10 in-lbs (1.1 Nm).
19. Lubricate the installed O-ring (face seal) with Magnalube G (Teflon/Petroleum based grease).
20. Safely resume normal operation.

5.2.2 Tool Side Self-Sealing Valve

Tools required: *10 mm hex key, Torque wrench*

Supplies required: *Clean rag, Magnalube G lubricant*

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).

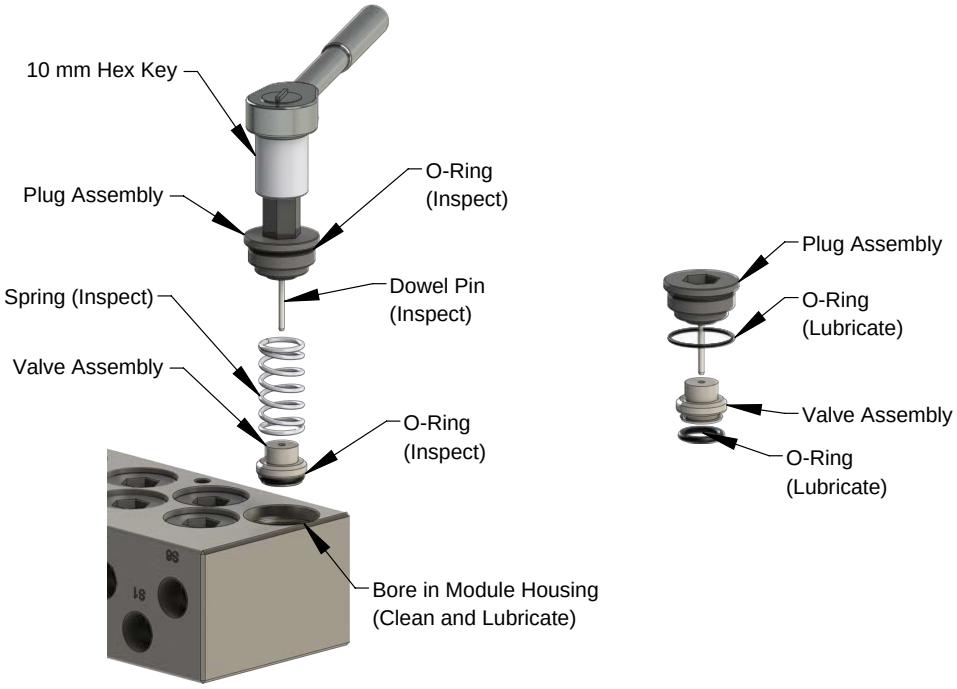
NOTICE: Debris can be expelled at high velocity during the purge, take all required safety precautions.

4. All customer plumbing connections to the module must be purged.
   a. Verify that the supply lines are turned off.
   b. Cover the valves with a rag for safety.
   c. Manually actuate the self-sealing valves to purge the line pressure.
5. If required disconnect connections to the module.

NOTICE: You might need to remove the Tool side module to access the plug.

6. Remove the plug assembly from the bottom of the air module using a 10 mm hex key.
7. Remove the spring and valve assembly from the housing.

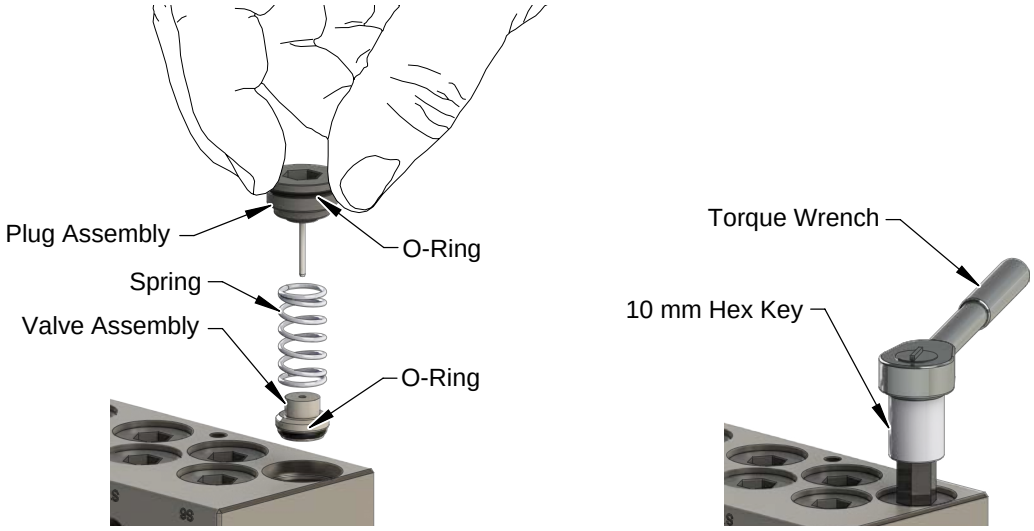
Figure 5.3—Tool Self-Sealing Valve (Disassembly)



8. Clean all lubrication from the plug assembly, valve assembly, spring, and bore in the housing using a clean rag.
9. Inspect the dowel pin that is contained in the plug assembly for straightness. Replace the plug assembly if the dowel pin is bent.
10. Inspect the O-rings on the plug and valve assemblies, replace if worn or damaged.
11. Inspect the spring in the assembly and replace if worn or damaged.

12. If replacing the O-rings, lubricate both new O-rings with Magnalube G (Teflon/ Petroleum based grease).
13. Install the O-rings on the plug assembly and the valve assembly.

Figure 5.4—Tool Self-Sealing Valve (Assembly)



14. Install the check valve piston, make sure it is seated properly in the housing.
15. Install the spring into the housing, make sure it is installed over the step on the check valve.

> **CAUTION:** Do not use excess force when installing the plug assembly into the housing. Using excessive force can damage the O-ring and strip the threads on the plug assembly. Thread the plug assembly into the Tool housing by hand, until several threads are engaged into the housing. Then use a 10 mm hex key to complete the installation. Torque the plug to 30 in-lbs (3.39 Nm).

16. Carefully install the plug assembly aligning the dowel pin into the check valve piston. Thread the plug assembly into the housing by hand until several threads are engaged in the housing.
17. Tighten the plug assembly using a 10 mm hex key to 30 in-lbs (3.39 Nm).
18. Verify the check valve piston is seated properly in the housing.
19. Safely resume normal operation.

6. Serviceable Parts

Refer to *Section 8—Drawings*.

7. Specifications

Table 7.1—Master Module Specifications

Module	Materials of Construction	Weight	(Qty) Port Connection	Type (C_v)	Pressure (Maximum)
FF4-M	Stainless Steel housings and valve components, Nitrile-N Rubber seals, PVC plug.	7.04 lbs (3.19 kg)	(5) ½" NPT	Self-sealing (1.6)	100 psi (6.9 bar)
FH10-M	Stainless Steel housings and valve components, Nitrile-N Rubber seals, PVC plug.	7.16 lbs (3.25 kg)	(5) G ½" BSPP		

Table 7.2—Tool Module Specifications

Module	Materials of Construction	Weight	(Qty) Port Connection	Type (C_v)	Pressure (Maximum)
FF4-T	Anodized aluminum housing and stainless steel valve components, Nitrile seals, PVC port plug	2.04 lbs (0.93 kg)	(5) ½" NPT	Self-sealing (1.6)	100 psi (6.9 bar)
AQ5-T		2.04 lbs (0.93 kg)	(1) ½" NPT		
FH10-T		5.13 lbs (2.33 kg)	(5) G ½" BSPP		
AQ4-T		2.04 lbs (0.93 kg)	(1) G ½" BSPP		

8. Drawings

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