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D. Pneumatic and Fluid Modules

AL2—Air Module

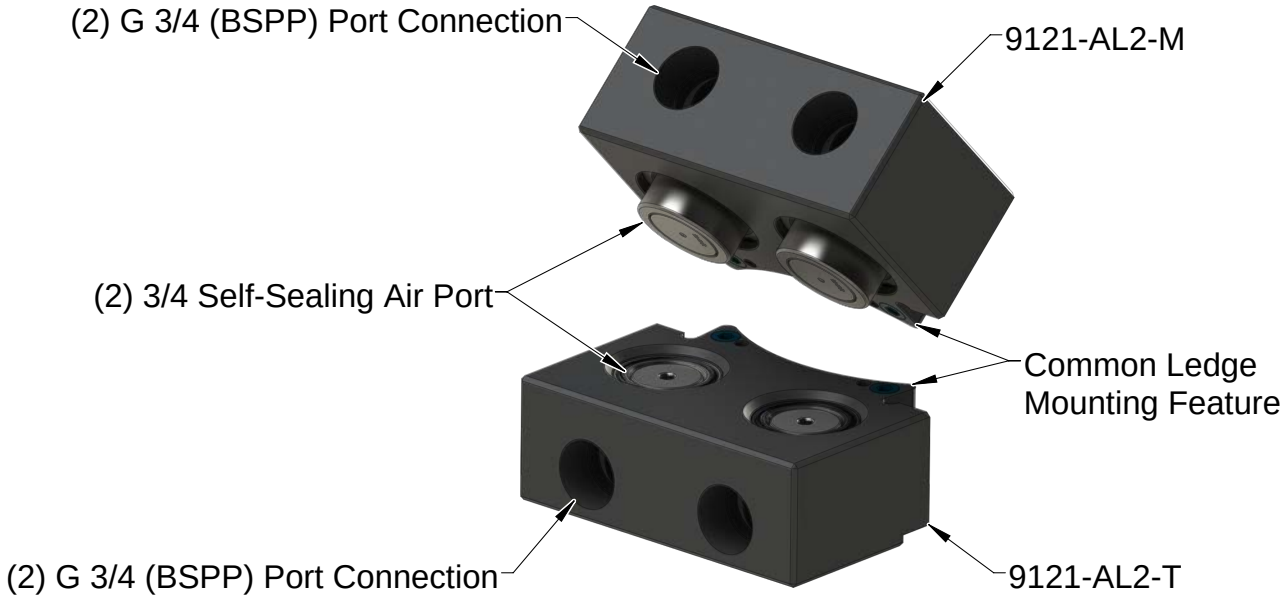
1. Product Overview

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.

Refer to *Figure 1.1*, *Section 7—Specifications*, and *Section 8—Drawings* for more information.

Figure 1.1—AL2 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.

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.

CAUTION: Do not use the Tool Changer with air pressure below 60 psi. Safe, reliable operation of the Tool Changer is dependent on a continuous supply of compressed air at a pressure of 60 to 100 psi. Robot motion should be halted if the air supply pressure is below 60 psi.

2.1 Module Installation

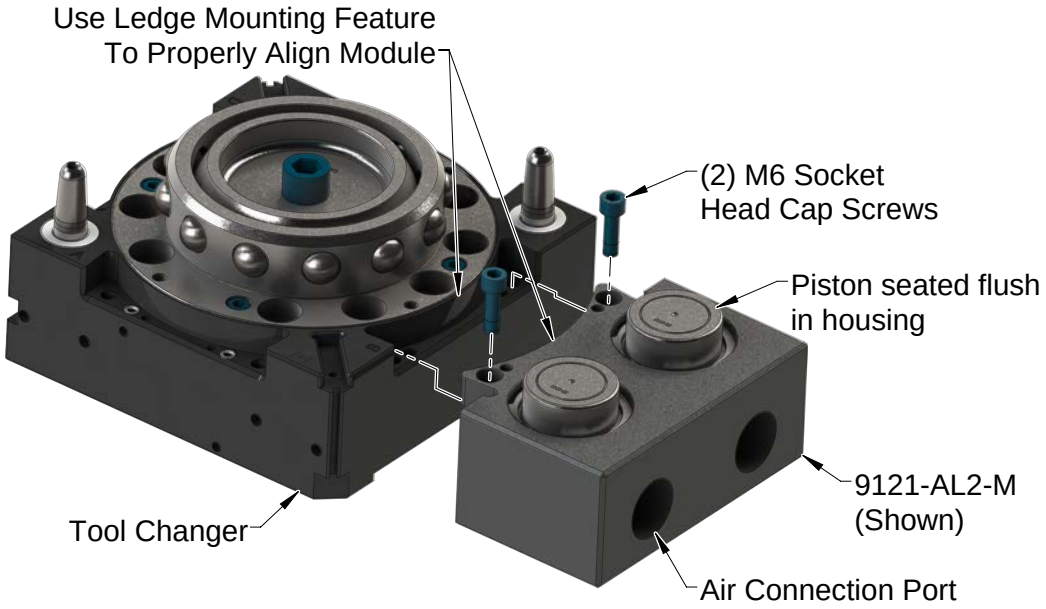
NOTICE: On the AL2, verify that the Master side valve pistons are seated flush with the valve stem; otherwise, the pistons can swivel inside the housing on the AL2. Refer to *Figure 2.1*.

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 89 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—Master Module Installation



2.2 Module Removal

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.
   a. Cover the valves with a rag for safety.
   a. 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

Air modules pass air utilities from the Master to the Tool for use by the customer's tooling. Unlike pass-through ports, self-sealing valves prevent the air circuits from discharging, which eliminates the need to close upstream circuits. Self-sealing valves and pass-through ports operate at a maximum pressure of 100 psi (6.9 bar).

NOTICE: If the air pressure is not released from the Tool side of the pass-through port, debris can be expelled at high velocity when the Tool Changer uncouples. Take all required safety precautions.

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—Preventive Maintenance Checklist

Weekly Maintenance:
☐ Clean mating surfaces using a nylon brush.
☐ Inspect modules for air leaks. Replace components as necessary.
6 months or 500,000 cycle Maintenance:
☐ On AL2 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, valve piston, and spring) of the valve assemblies in the Master and Tool modules. Refer to *Section 5.2.1—AL2 Master Side Self-Sealing Valve* or *Section 5.2.2—AL2 Tool Side Self-Sealing Valve*.
☐ Check that module mounting bolts are secure. Refer to *Section 2.1—Module Installation*.

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
Air Leakage	Damaged/Worn seals	Replace the seals as needed. Refer to *Section 5.2.1—AL2 Master Side Self-Sealing Valve* or *Section 5.2.2—AL2 Tool Side Self-Sealing Valve*.
	Debris blocking valve seal (for self-sealing valves)	Clean in and around valve components. Ensure the air stream is free of large particulates; filter as necessary.
	Bent valve stem (for self-sealing valves)	Replace the stem. Refer to *Section 5.2.2—AL2 Tool Side Self-Sealing Valve*. Check the module attachment to Tool Changer. Refer to *Section 2.1—Module Installation.* Check the robot program and ensure there is a parallel approach trajectory during Tool Changer coupling.
	Corrosion	Consult ATI for assistance.
Poor Flow	Air hose supply/return lines or connections are damaged or blocked.	Inspect the supply/return hoses and connections for damage or blockage. Clean, repair, or replace as necessary.
	Debris blocking valve seal (for self-sealing valves)	Clean in and around the valve components. Ensure the air stream is free of large particulates; filter as necessary.
Modules are unable to couple	Bent valve stem (for self-sealing valves)	Replace the stem. Refer to *Section 5.2.2—AL2 Tool Side Self-Sealing Valve*. Check the module attachment to the Tool Changer. Refer to *Section 2.1—Module Installation.* Check the robot program and ensure there is a 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 AL2 Master Side Self-Sealing Valve

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

Tools required: *Snap ring pliers*

Supplies required: *Clean rag, Magnalube*

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.
5. Remove the retaining ring using snap ring pliers.
6. Remove the valve stem, valve piston and spring, inspect for wear or damage. Replace any worn or damaged components. Refer to *Figure 5.1*.
7. Remove the O-rings form the valve piston and the valve bore in the housing.
8. Clean the valve bore and internal components with a clean dry rag.

Figure 5.1—Master Self-Sealing Valve

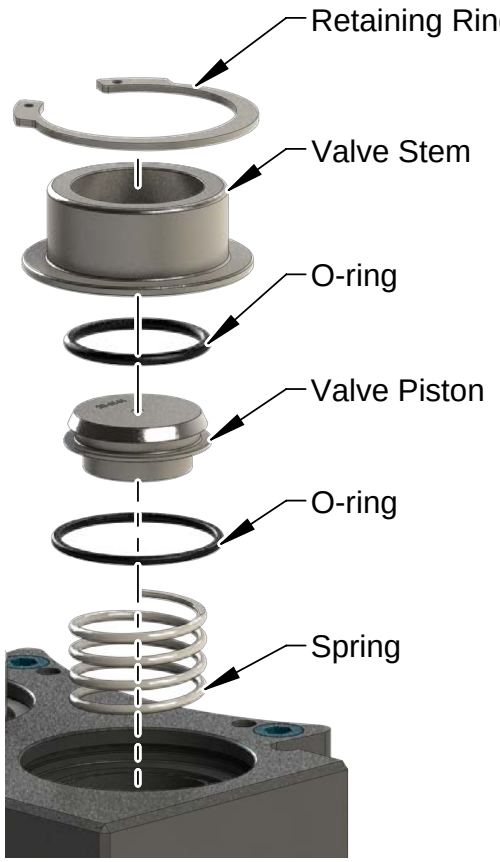
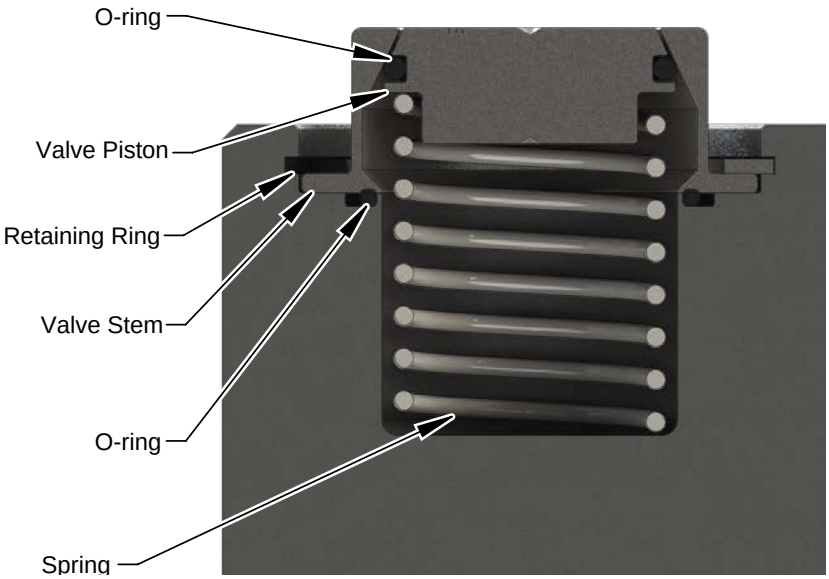


Figure 5.2—Master Self-Sealing Valve Cross Sectional View



9. Lubricate the replacement O-rings and valve piston with Magnalube.
10. Place the larger O-ring on the seat of the valve bore. Refer to *Figure 5.2*.
11. Place the smaller O-ring in the groove of the valve piston.
12. Place the spring to the bottom boss of the valve piston, and insert into the valve bore.
13. Place the valve stem in the bore of the housing so that the stem's flange rests on the seat of the housing. The valve piston should be flush with the top rim of the valve stem.
14. Using snap ring pliers, secure the self-sealing valve assembly by installing the retaining ring in the groove of the housing.
15. Safely resume normal operation.

5.2.2 AL2 Tool Side Self-Sealing Valve

Parts required: *Refer to Section 6.1—AL2 Tool Valve Serviceable Parts.*

Tools required: *Spanner wrench (legacy product) or 5 mm hex key (latest product revision)*

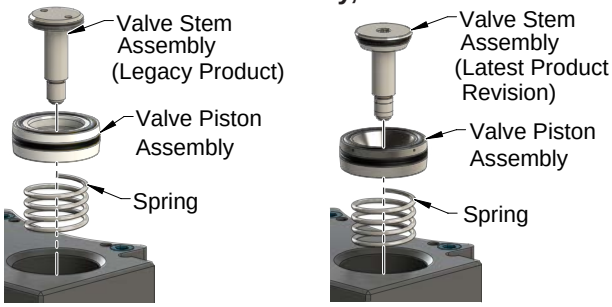
Supplies required: *Clean rag, Magnalube G lubricant, Loctite 242*

16. Place the Tool in a secure location.
17. Uncouple the Master and Tool plates.
18. Turn off and de-energize all energized circuits, for example, electrical, air, and water.

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

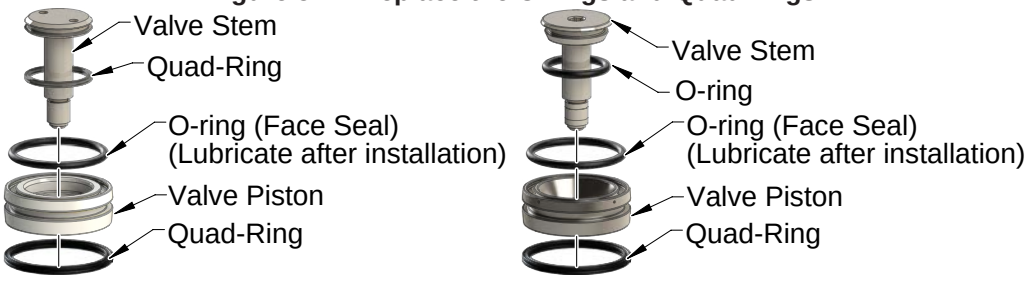
19. Purge and disconnect all customer plumbing connections to the module.
    a. Turn the supply lines off.
    b. Cover the valves with a rag for safety.
    c. Manually actuate the module's self-sealing valves to purge the line pressure.
20. Use a spanner wrench or 5 mm hex key to remove the valve stem assembly, the valve piston assembly, and spring from the housing.

Figure 5.3—Remove Valve Stem Assembly, Valve Piston Assembly, and Spring



21. Inspect the valve stem, valve piston, and the spring for wear or damage; replace all worn or damaged components.
22. Remove all O-ring and Quad-ring seals from the valve stem and piston assemblies.

Figure 5.4—Replace the O-rings and Quad-rings



NOTICE: Do not lubricate the O-ring face seal for the valve piston prior to installation.

23. Lubricate the replacement valve Piston Quad-ring and the valve stem Quad-ring or O-ring.
24. Install the O-ring face seal into the top groove in the valve piston. Then lubricate the O-ring.
25. Clean the check port with a clean dry rag. Assemble the components in the order shown.
26. Apply Loctite 242 on the valve stem's threads. Push down, compressing the spring, and thread the valve stem into the housing. Tighten to 110 in-lbs (12.4 Nm) using a spanner wrench or 5 mm hex key.
27. Safely resume normal operation.

6. Serviceable Parts

Refer to *Section 8—Drawings*.

6.1 AL2 Tool Valve Serviceable Parts

Refer to *Section 8—Drawings* for serviceable items on the latest product versions. For the legacy product versions, refer to the following figure and table.

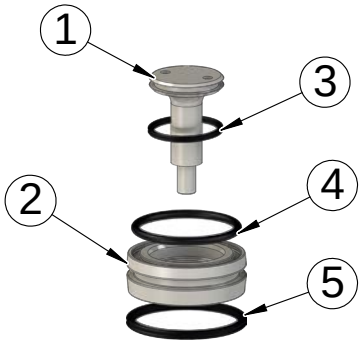


Table 6.1—AL2 Tool Valve Piston, Valve Stem, and Seals (Old Design)			
Item No.	**Qty**	**Part Number**	**Description**
1	2	3700-20-9607	Tool Valve Stem
2	2	3700-20-6807	Tool 3/4” Valve Piston
3	2	3410-0001096-01[1]	4 lobed, low friction seal, Buna N D70, 13/16” ID
4	2	3410-0001341-01[1]	O-Ring, 1-3/16 ID x 3/32 W, AS568-123 Buna-N, D90
5	2	3410-0001099-01[1]	4 lobed, low friction seal, Buna N D70, 1-5/16”ID

Notes:
1. Seals are supplied in a kit 9121-AD2-T-Seal.

7. Specifications

Table 7.1—Master Module Specifications	
9121-AL2-M	Pneumatic Master module with (2) G 3/4 self-sealing ports
Materials of Construction:	Various - Stainless Steel valve components, aluminum housing, Buna-N seals
Self-Sealing Air Ports:	
Quantity	2
Air Pressure	Maximum pressure of 100 psi (6.9 bar)
Cv, Min	8.0 est.
Customer Port Connection	G 3/4
Weight:	2.7 lbs. (1.2 kg)

Table 7.2—Tool Module Specifications	
9121-AL2-T	Pneumatic Tool module with (2) G 3/4 self-sealing port
Materials of Construction:	Various - aluminum housing
Self-Sealing Air Ports:	
Quantity	2
Air Pressure	Maximum pressure of 100 psi (6.9 bar)
Cv, Min	8.0 est.
Customer Port Connection	G 3/4
Weight:	2.3 lbs. (1.0 kg)

8. Drawings

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