Table of Contents

D. Pneumatic and Fluid Modules

ADx—Air Module

1. Product Overview

ADx modules provide air services when attached to the Master and Tool plates.

1.1 ADx Modules With Self-Sealing Air Ports: AD2, AD3, AD4, and AD5

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 *Section 7—Specifications* and *Section 8—Drawings* for more information.

Table 1.1—ADx Self-Sealing Air Port Modules

Module	Description
AD2	(2) 3/4 NPT self-sealing ports (Master and Tool side)
AD3	(2) 1 NPT self-sealing ports (Master and Tool side)
AD4	(2) G 1 (BSPP) self-sealing ports (Master and Tool side)
AD5	(3) 1 NPT self-sealing ports (Master and Tool side)

Note:
1. Do not attempt to couple modules of different types to each other.

Figure 1.1—AD2, AD3, and AD4 Modules

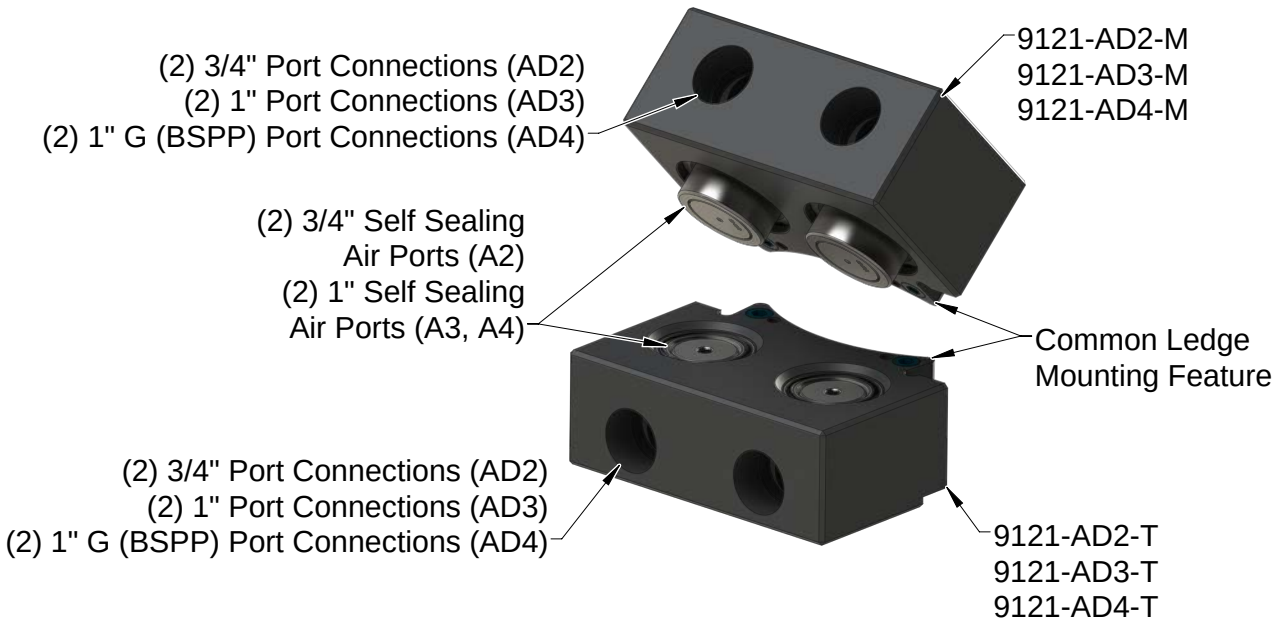
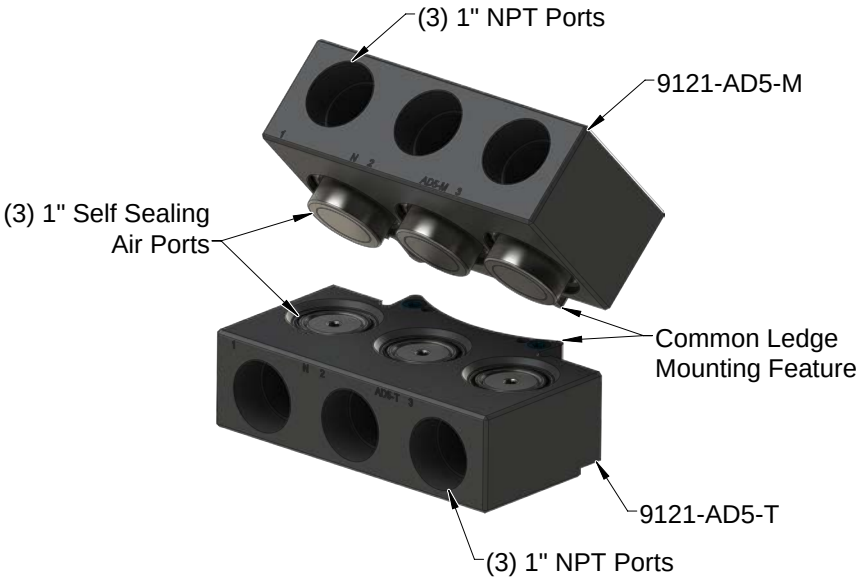


Figure 1.2—AD5 Module

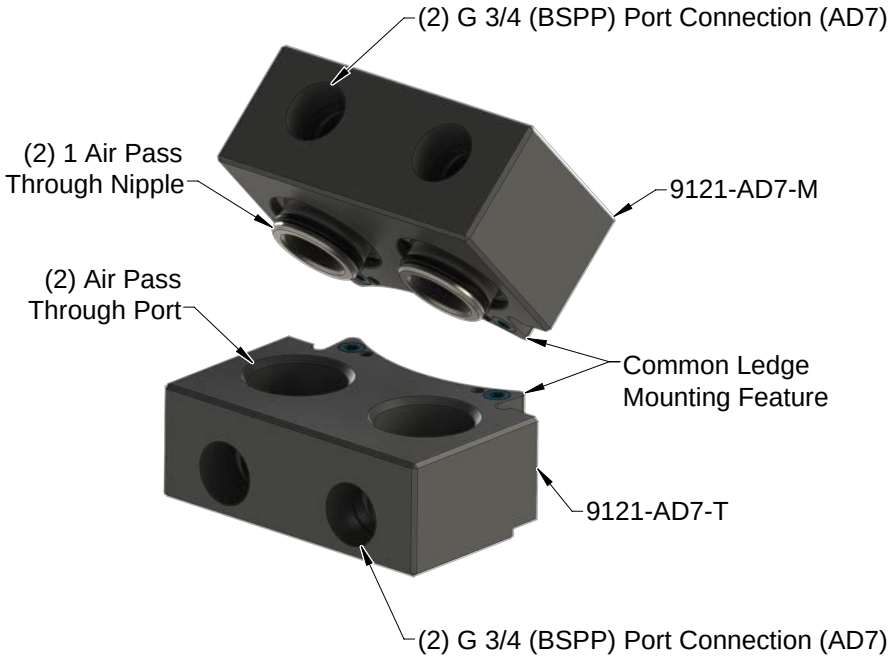


1.2 ADx Modules With Pass Through Air Ports: AD7

Refer to the following table and figure for a description of the different pass through air port modules. Refer to *Section 7—Specifications* and *Section 8—Drawings* for more information.

Table 1.2—ADx Pass Through Air Modules	
Module	**Description**
AD7	(2) G 3/4 BSPP pass through ports (Master and Tool side)
Note: 1. Do not attempt to couple modules of different types to each other.	

Figure 1.3—AD7 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

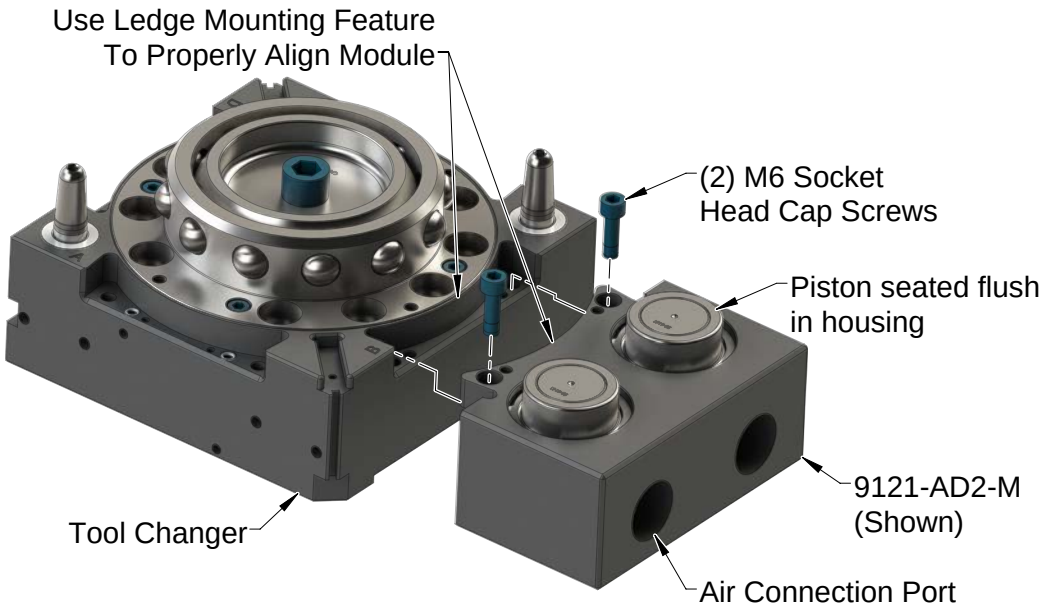
NOTICE: On the AD2, verify that the Master side valve pistons are seated flush with the valve stem; otherwise, the pistons can swivel inside the housing on the AD2. Refer to *Figure 2.1*.

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: *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).
4. Use a paint marker to indicate where the module is to be re-installed.
5. Disconnect air plumbing to the module.
6. Remove the (2) M6 socket head cap screws using a 5 mm hex key.
7. Remove the module.

3. Operation

For pass through air modules, air must be turned off during coupling and uncoupling because they are not self-sealing.

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.
☐ Inspect modules for air leaks. Replace components as necessary.
6 months or 500,000 cycle Maintenance:
☐ On ADx 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—Service Procedures*.
☐ On ADx modules with pass through ports, remove and replace the O-ring in the groove of the air pass through nipple. Refer to *Section 5.2.5—AD7 O-rings and Air Nipple Replacement*.
☐ 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.

CAUTION: Do not use fasteners with pre-applied adhesive more than once. Fasteners might become loose and cause equipment damage. Always apply new thread locker when reusing fasteners.

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 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 or stem (for self-sealing valves)	Replace stem. Refer to *Section 5.2—Service Procedures*. Check module attachment to Tool Changer. Refer to *Section 2.1—Module Installation.* Check robot program and ensure parallel approach trajectory during Tool Changer coupling.
	Corrosion	Consult ATI Applications Engineering for assistance.
Poor 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 Won't Couple	Bent valve piston and/or stem (for self-sealing valves)	Replace stem. Refer to *Section 5.2—Service Procedures*. Check module attachment to Tool Changer. Refer to *Section 2.1—Module Installation.* 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 AD2 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

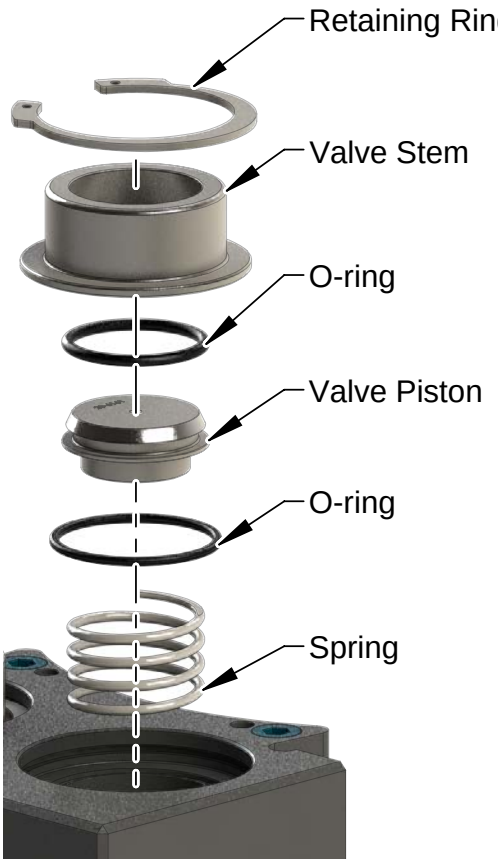
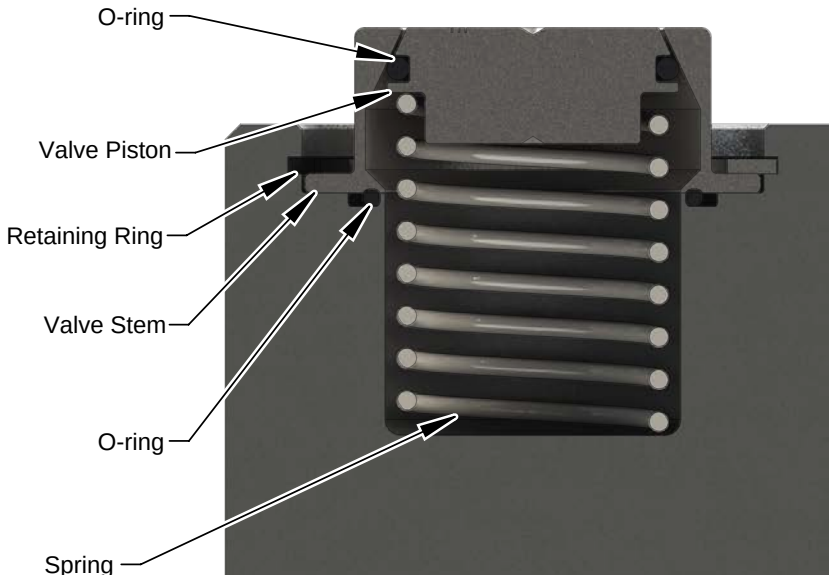


Figure 5.2—Master Self-Sealing Valve Cross Sectional View



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 AD2 Tool Side Self-Sealing Valve

Parts required: *Refer to Section 6.1—AD2, AD3, AD4, and AD5 Tool Valves.*

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

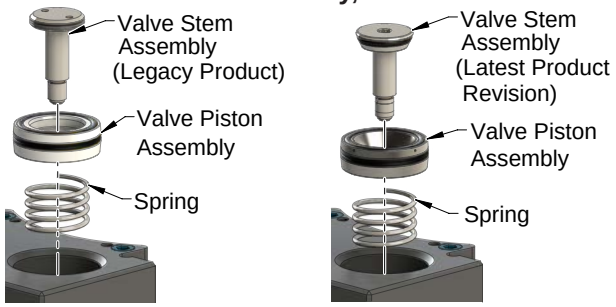
Supplies required: *Clean rag, Magnalube G lubricant, Loctite 242*

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, air, and water.

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

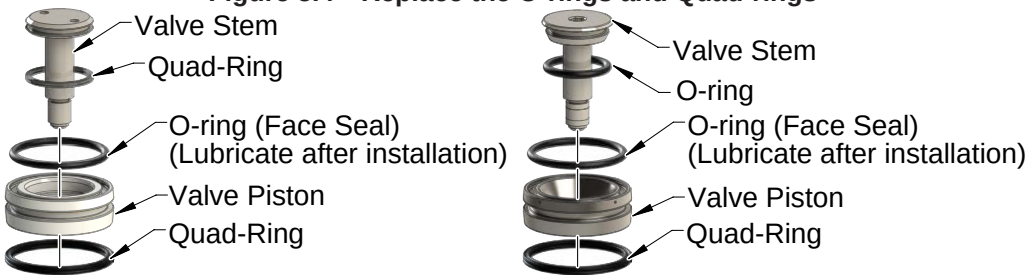
4. Purge and disconnect all customer plumbing connections to the module.
   a. Turn the supply lines off.
   b. Cover the valves with a rag for safety.
   c. Manually actuate the module's self-sealing valves to purge the line pressure.
5. Use a spanner wrench or 5 mm hex key to remove the valve stem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

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



6. Inspect the valve stem, valve piston, and the spring for wear or damage; replace all worn or damaged components.
7. 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.

8. Lubricate the replacement valve Piston Quad-ring and the valve stem Quad-ring or O-ring.
9. Install the O-ring face seal into the top groove in the valve piston. Then lubricate the O-ring.
10. Clean the check port with a clean dry rag. Assemble the components in the order shown.
11. 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.
12. Safely resume normal operation.

5.2.3 AD3, AD4, AD5 Master Side Self-Sealing Valve

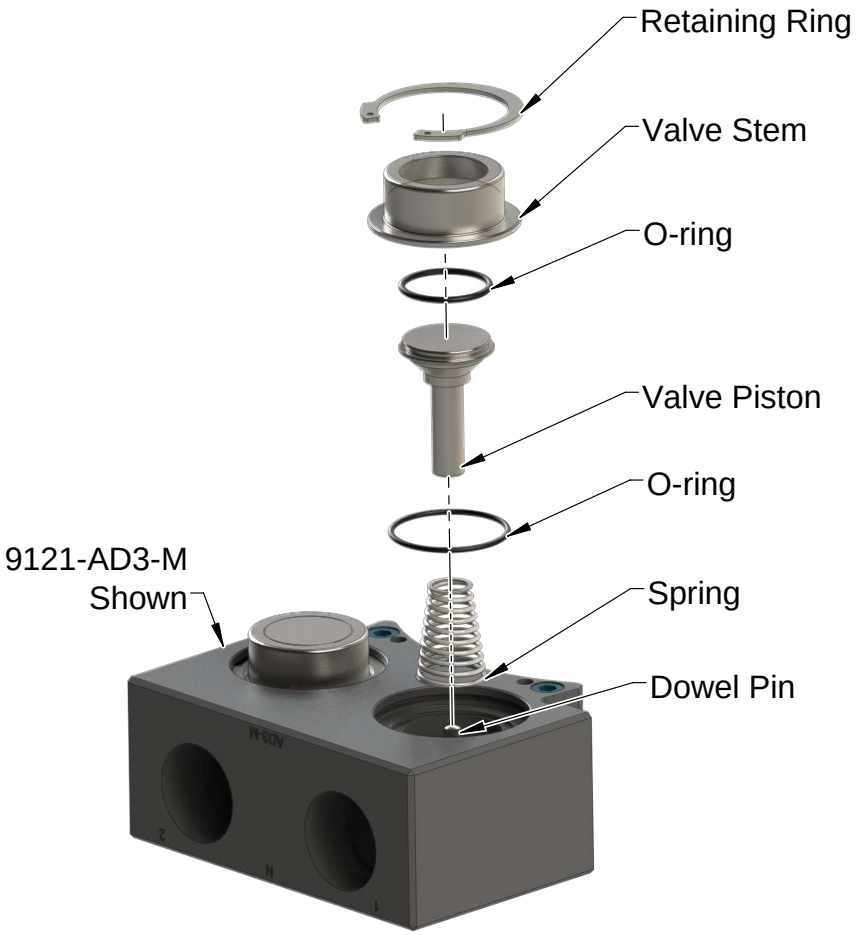
Parts Required: *Refer to Section 8—Drawings.*

Tools Required: *Snap ring pliers*

Supplies Required: *Clean rag, Magnalube*

1. For a Tool Changer, if the Tool Changer is installed place the Tool safely in the tool stand. Uncouple the Tool Changer or Utility Coupler to allow clear access to the Master and Tool plates.
2. Turn off and de-energize all energized circuits (e.g. electrical, air, water, etc.).
3. Purge and disconnect all customer plumbing connections to the module. Once the supply lines have been turned off, manually actuate the module's self-sealing valves to purge the line pressure. Cover the valves with a rag prior to purging in order to keep the air from impinging upon any person. Depending upon the service or repair being done connections up to the module may or may not need to be disconnected.
4. Using the snap ring pliers, remove the retaining ring and self-sealing valve assembly (valve stem, valve piston, spring, and O-rings). Refer to *Figure 5.5*.
5. Inspect the O-rings, valve stem, and spring for wear. Replace as necessary.
6. Inspect the valve piston for straightness and wear. Replace as necessary.
7. Clean the valve bore and internal components (dowel pin) with a clean dry rag.
8. Lubricate the dowel pin and bore with Magnalube.

Figure 5.5—Master Self-Sealing Valve



5.2.4 AD3, AD4, AD5 Tool Side Self-Sealing Valve

Parts Required: *Refer to Section 6.1—AD2, AD3, AD4, and AD5 Tool Valves.*

Tools Required: *Spanner wrench (legacy product), 2.5 and 5 mm (latest product) Allen wrench, Torque wrench*

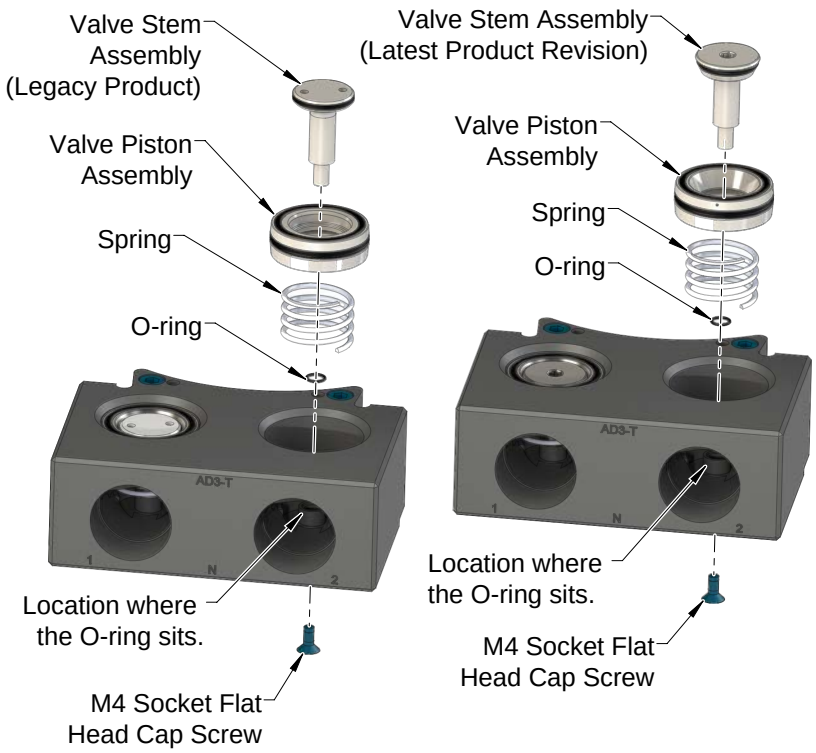
Supplies Required: *Clean rag, Magnalube*

1. Place the Tool in a secure location.
2. Uncouple the Master and Tool plates.
3. Turn off and de-energize all energized circuits (e.g. electrical, air, water, etc.).

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

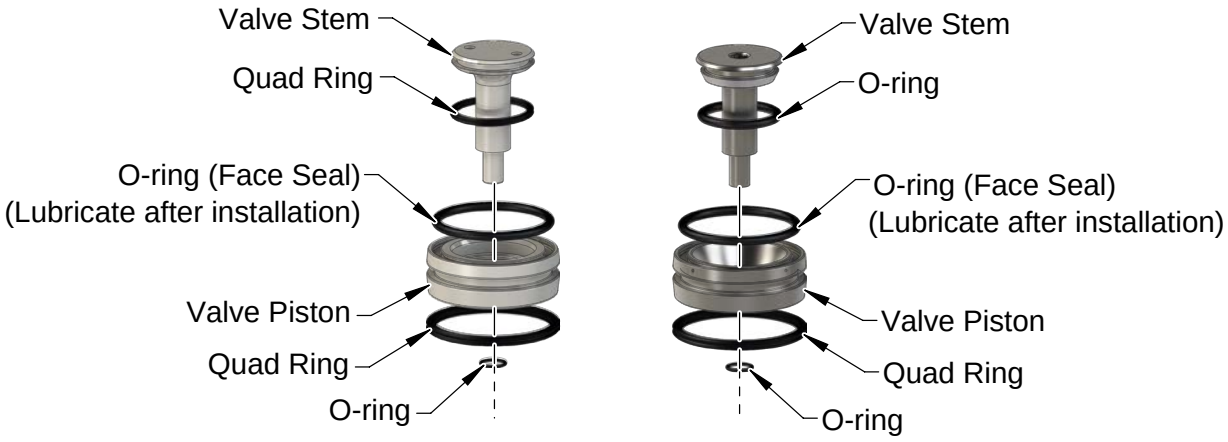
4. Purge and disconnect all customer plumbing connections to the module.
   a. Turn the supply lines off.
   b. Cover the valves with a rag for safety.
   c. Manually actuate the module's self-sealing valves to purge the line pressure.
5. Use a 2.5 mm Allen wrench to remove the M4 socket flat head cap screw from the bottom of the housing.
6. Use a spanner wrench or a 5 mm Allen wrench to remove the valve stem assembly, the valve piston assembly, and the spring from the housing.

Figure 5.6—Tool Self-sealing Valve



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

Figure 5.7—Tool Self-sealing Valve



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

9. Lubricate the replacement valve piston Quad-ring, the valve stem Quad-ring or O-ring, and the small O-ring.
10. Install the O-ring face seal into the top groove in the valve piston. Then lubricate the O-ring.
11. Clean the check port with a clean dry rag. Assemble the components in the order shown.
12. 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 a 5 mm Allen wrench.
13. Apply Loctite 222 to the threads of the M4 socket flat head cap screw.
14. Use a 2.5 mm Allen wrench to install the M4 socket flat head cap screw. Tighten to 14 in-lb (1.6 Nm).
15. After the procedure is complete, resume normal operation.

5.2.5 AD7 O-rings and Air Nipple Replacement

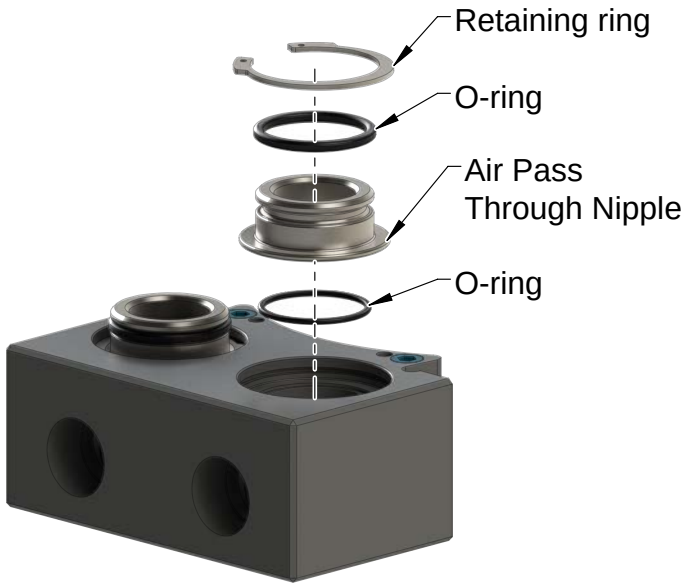
Parts Required: *Refer to Section 8—Drawings.*

Tools Required: *Snap ring pliers*

Supplies Required: *Clean rag, Magnalube*

1. For a Tool Changer, if the Tool Changer is installed place the Tool safely in the tool stand. Uncouple the Tool Changer or Utility Coupler to allow clear access to the Master and Tool plates.
2. Turn off and de-energize all energized circuits (e.g. electrical, air, water, etc.).
3. Depending upon the service or repair being done connections up to the module may or may not need to be disconnected. If required disconnect all customer plumbing connections to the module.
4. Inspect the O-ring in the top groove of the air pass nipple. Replace as necessary. Refer to *Figure 5.8*.
5. Using snap ring pliers, remove the retaining ring from the housing.
6. Inspect the O-ring and air pass through nipple for wear, and replace as necessary.
7. Clean the valve bore with a clean dry rag.

Figure 5.8—Master Self-Sealing Valve



8. Insert an O-ring into the bottom groove of the modular housing. Refer to *Figure 5.8*.
9. Insert the air pass through nipple so that it rests on the ledge of the valve bore.
10. Using snap ring pliers, reinstall the retaining ring in the groove of the modular housing.
11. After repair is complete, module(s) may be placed in normal operation.

6. Serviceable Parts

Refer to *Section 8—Drawings*.

6.1 AD2, AD3, AD4, and AD5 Tool Valves

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.

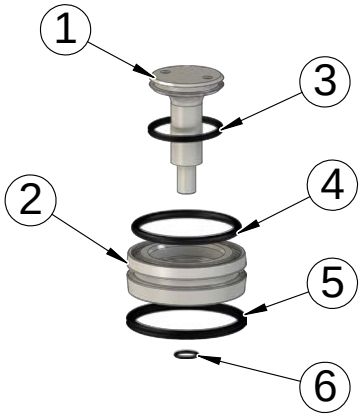


Table 6.1—AD2, AD3, AD4, and AD5 Tool Valve Piston, Valve Stem, and Seals (Legacy Version)

Item No.	Qty[1]	Part Number	Description
1	2	3700-20-9607	Tool Valve Stem for AD2
		3700-20-6442	Tool Valve Stem for AD3, AD4, AD5
2	2	3700-20-6807	Tool 3/4” Valve Piston
3	2	3410-0001096-01[2,3]	4 lobed, low friction seal, Buna N D70, 13/16” ID
4	2	3410-0001341-01[2,3]	O-Ring, 1-3/16 ID x 3/32 W, AS568-123 Buna-N, D90
5	2	3410-0001099-01[2,3]	4 lobed, low friction seal, Buna N D70, 1-5/16”ID
6	2	3410-0001316-01[3]	O-Ring, 6mm x 1mm, Buna-N, D70 (For AD3, AD4, and AD5)

Notes:

1. The AD5 has a quantity of (3) for each component in the table.
2. Seals for AD2 are supplied in a kit 9121-AD2-T-Seal.
3. Seals for AD3, AD4, and AD5 are supplied in a kit 9121-AD3-T-Seal.

7. Specifications

Table 7.1—Master Module Specifications				
Module	**Materials of Construction**	**Weight**	**Air Ports, (Qty) Size (Cv)**	**Pressure (Maximum)**
9121-AD2-M	Stainless steel valve components, aluminum housing, Buna-N seals	3.0 lbs (1.4 kg)	(2) 3/4 NPT (4.0)	100 psi (6.9 bar)
9121-AD3-M			(2) 1 NPT (8.0)	
9121-AD4-M			(2) G 1 (BSPP) (8.0)	
9121-AD5-M		3.47 lbs (1.57 kg)	(3) 1 NPT (8.0)	
9121-AD7-M		2.66 lbs (1.21 kg)	(2) G 3/4 (BSPP)	

Table 7.2—Tool Module Specifications				
Module	**Materials of Construction**	**Weight**	**Air Ports, (Qty) Size (Cv)**	**Pressure (Maximum)**
9121-AD2-T	Stainless steel valve components, aluminum housing, Buna-N seals	2.4 lbs (1.1 kg)	(2) 3/4 NPT (4.0)	100 psi (6.9 bar)
9121-AD3-T			(2) 1 NPT (8.0)	
9121-AD4-T			(2) G 1 (BSPP) (8.0)	
9121-AD5-T		2.83 lbs (1.28 kg)	(3) 1 NPT (8.0)	
9121-AD7-T		1.85 lbs (0.84 kg)	(2) G 3/4 (BSPP)	

8. Drawings

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