Table of Contents

D. Air Modules

AP2—Air Module

1. Product Overview

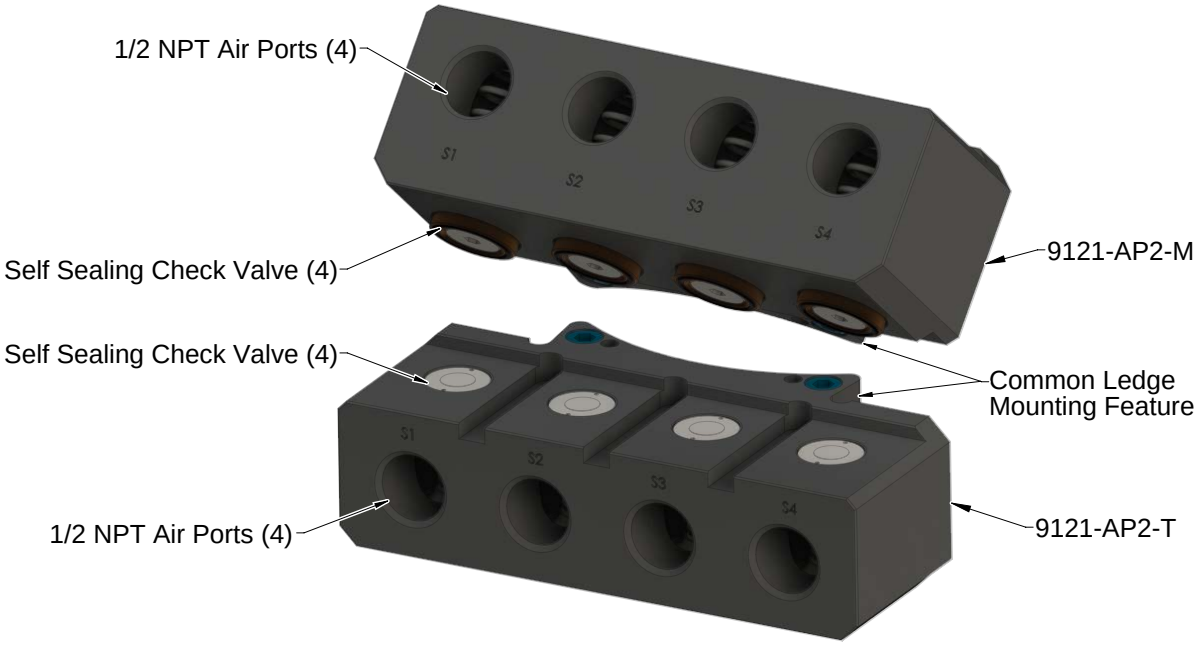
Air modules provide air utility and are attached to the Master and Tool plates. When the Tool Changer is coupled, the Master module passes the air supply to the Tool module for use by the customer tooling. Significant forces are encountered when using these modules. Assistance from the robot may be required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

Module	Air Ports	Valves
AP2-M	(4) 1/2 NPT	(4) self-sealing air
AP2-T		
AP8-T		(4) pass-through air

Figure 1.1—AP2 Air Modules



1.1 Pass-Through Ports and Self-Sealing Valves

Depending on the model, the Master and Tool modules contain pass-through ports and self-sealing valves. Pass-through ports release the air or vacuum when the Tool Changer is uncoupled. Before uncoupling the Tool Changer, turn-off the air pressure or vacuum supply for the pass-through ports. Unlike pass-through ports,self-sealing valves prevent the air circuits from discharging, which eliminates the need to close those circuits upstream.

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 (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.

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 Module Installation

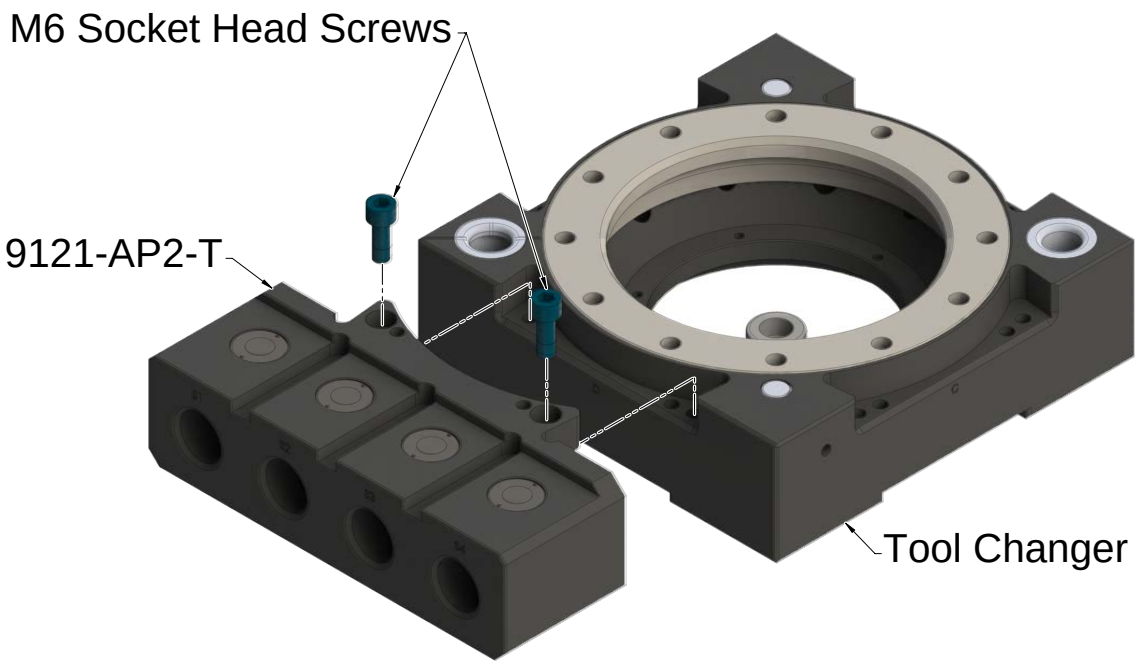
See *Figure 2.1*.

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 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—Installation and Removal of the AP2 module



2.2 Module Removal

Tools required: *5 mm hex key*

Supplies required: *Clean rag*

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

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 (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.

4.1 Preventive Maintenance

A visual inspection and preventive maintenance schedule is provided in *Table 4.1*.

Table 4.1—Preventive Maintenance Schedule

Inspection Schedule	Action Required
Weekly	Clean and inspect
6 months or 500,000 cycles	Seal replacement
Checklist	
Weekly Maintenance:	
☐ Clean mating surfaces.	
☐ Inspect modules for air leaks. Replace components as necessary.	
6 months or 500,000 cycle Maintenance:	
☐ Remove and replace self sealing valve O-ring seals in both the Master and Tool Module. During O-ring and seal replacement inspect valve stem and dowel pin for straightness. During O-ring and seal replacement re-lubricate bores. Refer to *Section 5.2.1—Master Side Self Sealing Valve* and *Section 5.2.2—Tool Side Self Sealing Valve*.	
☐ Inspect the mounting fasteners for tightness, tighten if loose 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 (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

Refer to the following table for trouble shooting information.

Table 5.1—Troubleshooting

Symptom	Possible Cause	Correction
Air Leakage	Damaged/Worn seals	Replace seals. Refer to *Section 5.2.1—Master Side Self Sealing Valve* and *Section 5.2.2—Tool Side Self Sealing Valve.*
	Debris blocking valve seal	Clean in and around valve components. Ensure air stream is free of large particulates, filter as necessary.
	Bent stem	Replace stem. Check module attachment to Tool Changer. Check robot program and ensure parallel approach trajectory during Tool Changer coupling. Refer to *Section 5.2.1—Master Side Self Sealing Valve* and *Section 5.2.2—Tool Side Self Sealing Valve.*
	Corrosion	Consult ATI for assistance.
Poor Flow	Air hose supply/return lines or connections damaged or blocked	Inspect supply/return hoses and connections for damage or blockage, clean/repair/replace as necessary.
	Valve blockage	Inspect valve components and clean/repair as necessary. Refer to *Section 5.2.1—Master Side Self Sealing Valve* and *Section 5.2.2—Tool Side Self Sealing Valve.*
Modules Won't Couple	Debris between Tool Change Master and Tool plates or modules.	Clean debris from between Master and Tool Plates and modules.
	Bent stem, dowel pin	Replace stem, dowel pins as necessary. Check module attachment to Tool Changer. Check robot program and ensure parallel approach trajectory during Tool Changer coupling. Refer to *Section 5.2.1—Master Side Self Sealing Valve* and *Section 5.2.2—Tool Side Self Sealing Valve.*

5.2 Service Procedures

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

5.2.1 AP2 Master Side Self Sealing Valve

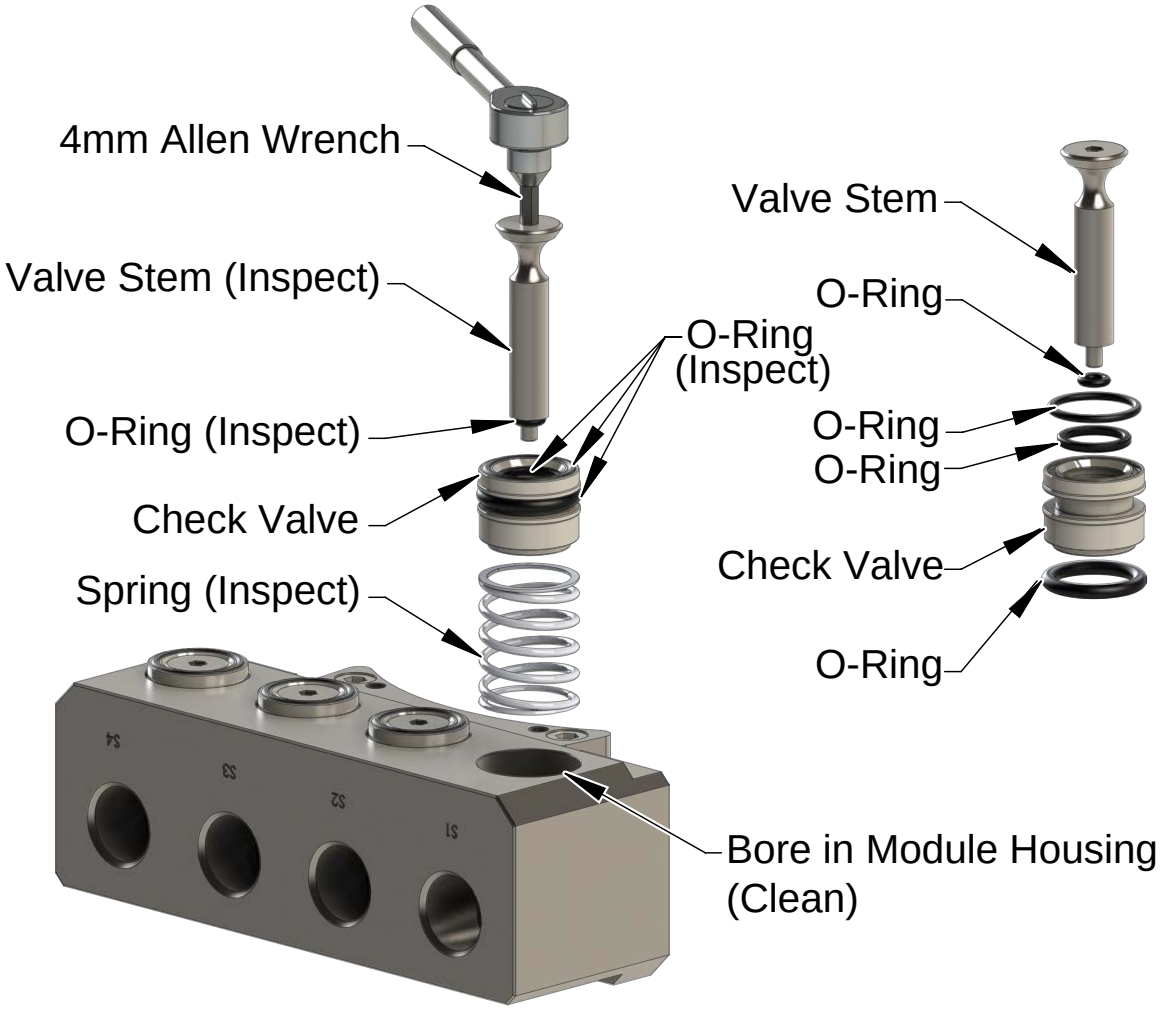
Parts required: *Refer to Section 8—Drawings*

Tools required: *4 mm hex key, torque wrench*

Supplies required: *Loctite 222, Magnalube G lubricant*

1. Place the Tool in a secure location. Leave the locking mechanism unlocked.
2. Turn off and de-energize all energized circuits (e.g. electrical, air, water, etc.)
3. Remove the self sealing valve assembly (stem, check valve, spring and seals) using a 4 mm hex key. Be careful not to strip the hex on the valve stem during removal. Refer to *Figure 5.1*.
4. Clean any lubrication from the check valve, valve stem, and bore in the module housing using a clean rag.
5. Inspect all seals and replaced as required.
6. Inspect the spring in the assembly and replaced as required.
7. Inspect the valve stem for straightness and replaced, if bent.

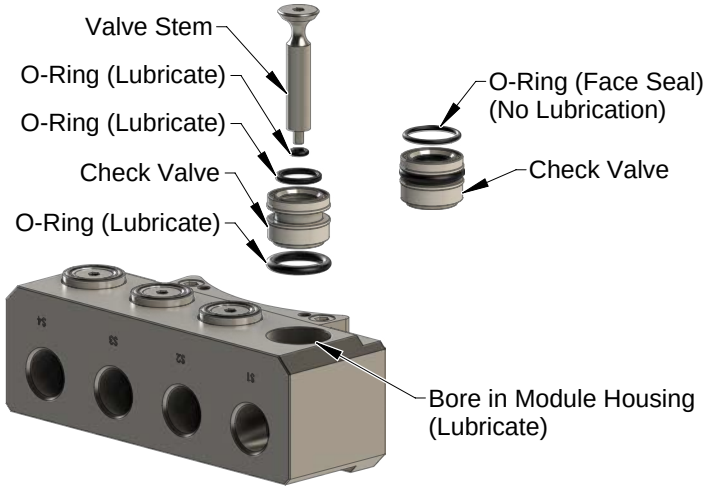
Figure 5.1—Disassemble Self Sealing Master Valve



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

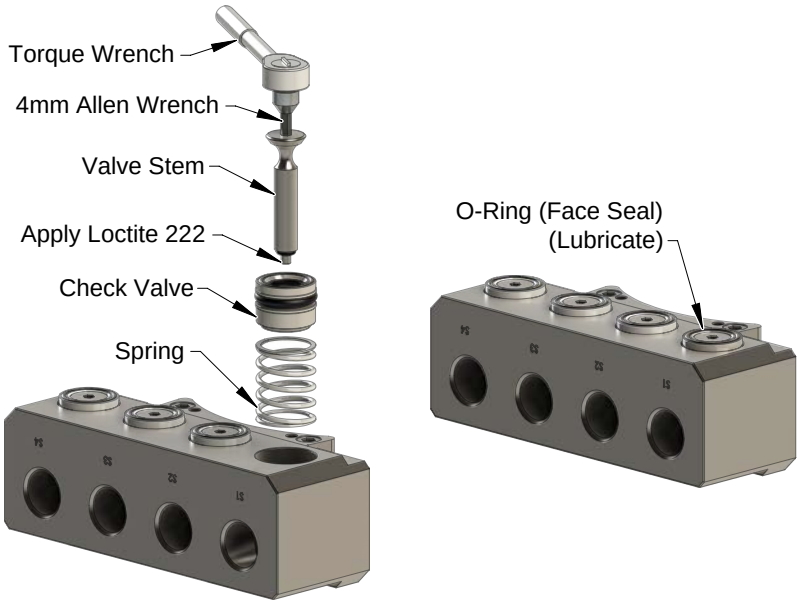
8. Lubricate bore in the module housing and the O-ring seals except the face seal as shown in *Figure 5.2* with Magnalube G (Teflon/Petroleum based grease).
9. Install the O-ring on the valve stem.
10. Install the internal O-ring and the outer O-ring on the check valve.
11. Install the non-lubricated O-ring (face seal) into the check valve.

Figure 5.2—Master Valve O-ring Installation and Lubrication



12. Re-install the valve assembly, all components should be arranged in order as removed. See *Figure 5.3*.
13. Apply Loctite 222 or similar thread locker to the threaded end of the stem, re-install and tighten to 10 in-lbs (1.1 Nm). The piston will have to be pushed down flush with the mating surface in order to get the stem thread started.
14. Lubricate the installed O-ring (face seal) as shown in *Figure 5.3* with Magnalube G (Teflon/Petroleum based grease)
15. Safely resume normal operation.

Figure 5.3—Assemble Self Sealing Master Valve



5.2.2 AP2 Tool Side Self Sealing Valve

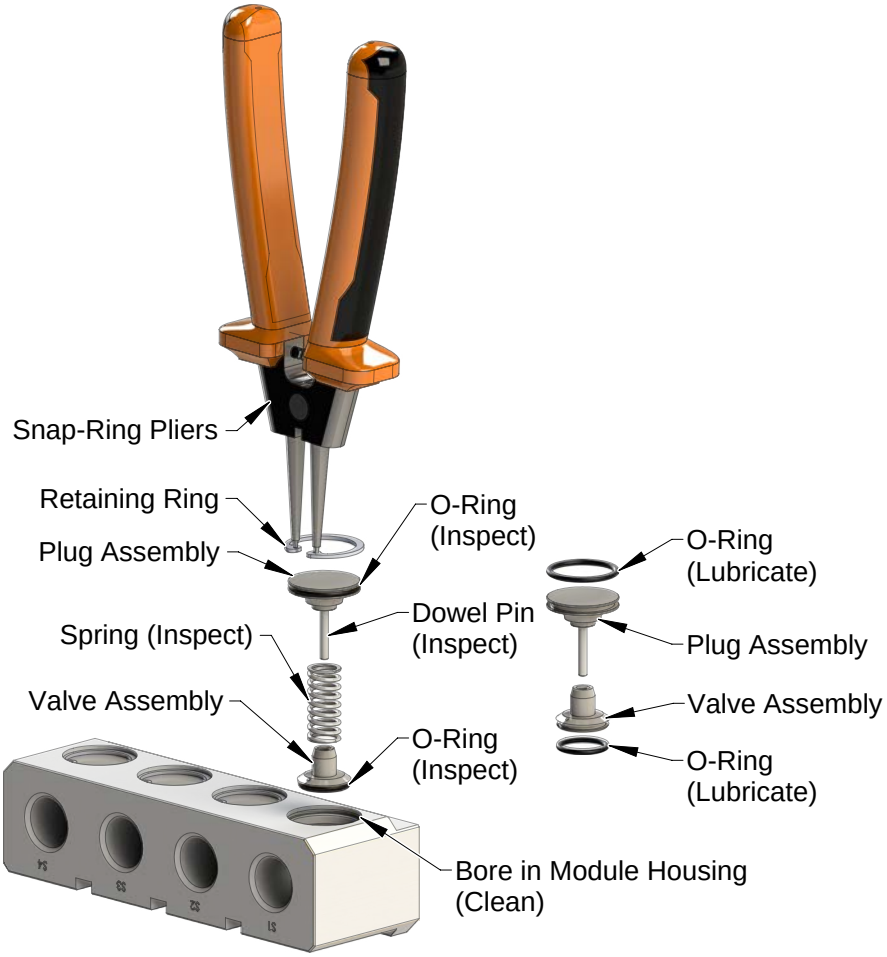
Parts required: *Refer to Section 8—Drawings*

Tools required: *snap-ring pliers*

Supplies required: *Magnalube G lubricant*

1. Place the Tool in a secure location. Leave the locking mechanism unlocked.
2. Turn off and de-energize all energized circuits (e.g. electrical, air, water, etc.)
3. Remove the retaining ring from the bottom of the tool side module using snap-ring pliers. Remove the self sealing valve assembly (plug, spring, valve, and seals). It may be necessary to remove the tool side module to have access to the plug. Refer to the*Section 2.2—Module Removal* for instructions for module removal.
4. Once the retaining ring is removed, the seals on the plug assembly and valve assembly can be inspected and replaced as required.
5. The spring in the assembly should be inspected and replaced as required.
6. The plug assembly contains a dowel pin. The dowel pin should be inspected for straightness, replace the plug assembly if the dowel pin is bent.
7. Clean any excess lubrication from the valve assembly, plug assembly, and bores in the module housing using a clean rag.
8. Lubricate O-ring seals and bores in the module housing with Magnalube G (Teflon/ Petroleum-based grease).

Figure 5.4—Disassemble Self Sealing Tool Valve

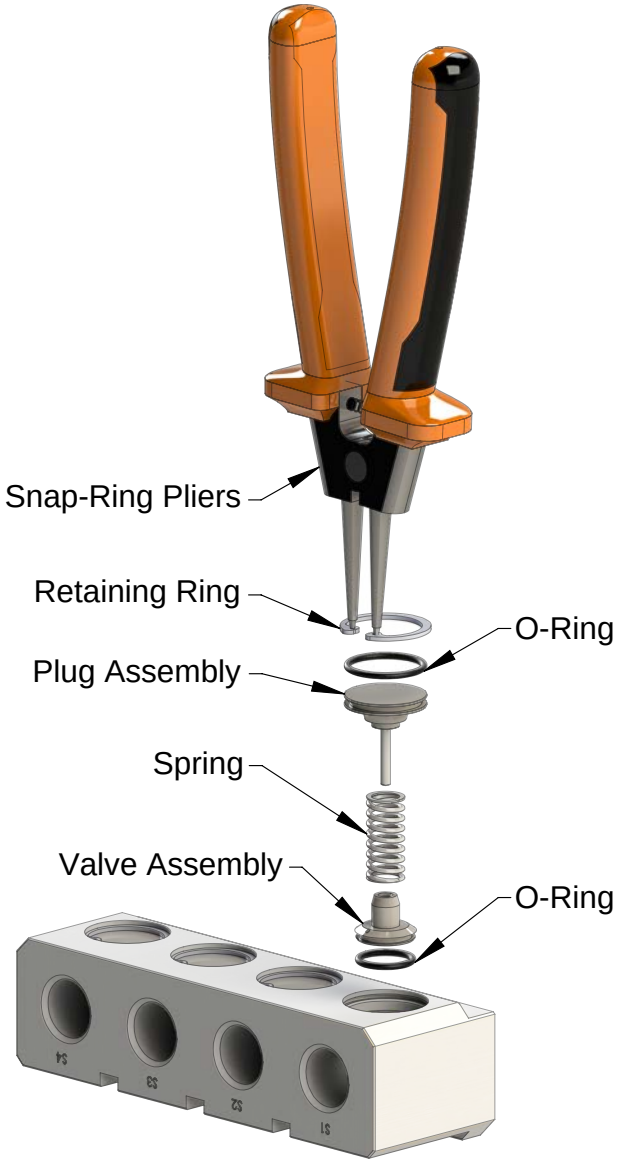


9. Install the O-rings on the plug assembly and the valve assembly.
10. Re-install the valve assembly, all components should be arranged in order as removed. Refer to *Figure 5.5*.

NOTICE: Care should be taken not to damage the O-ring around the plug base during installation.

11. Safely resume normal operation.

Figure 5.5—Assemble Self Sealing Master Valve



6. Serviceable Parts

See drawings in *Section 8—Drawings* of this manual.

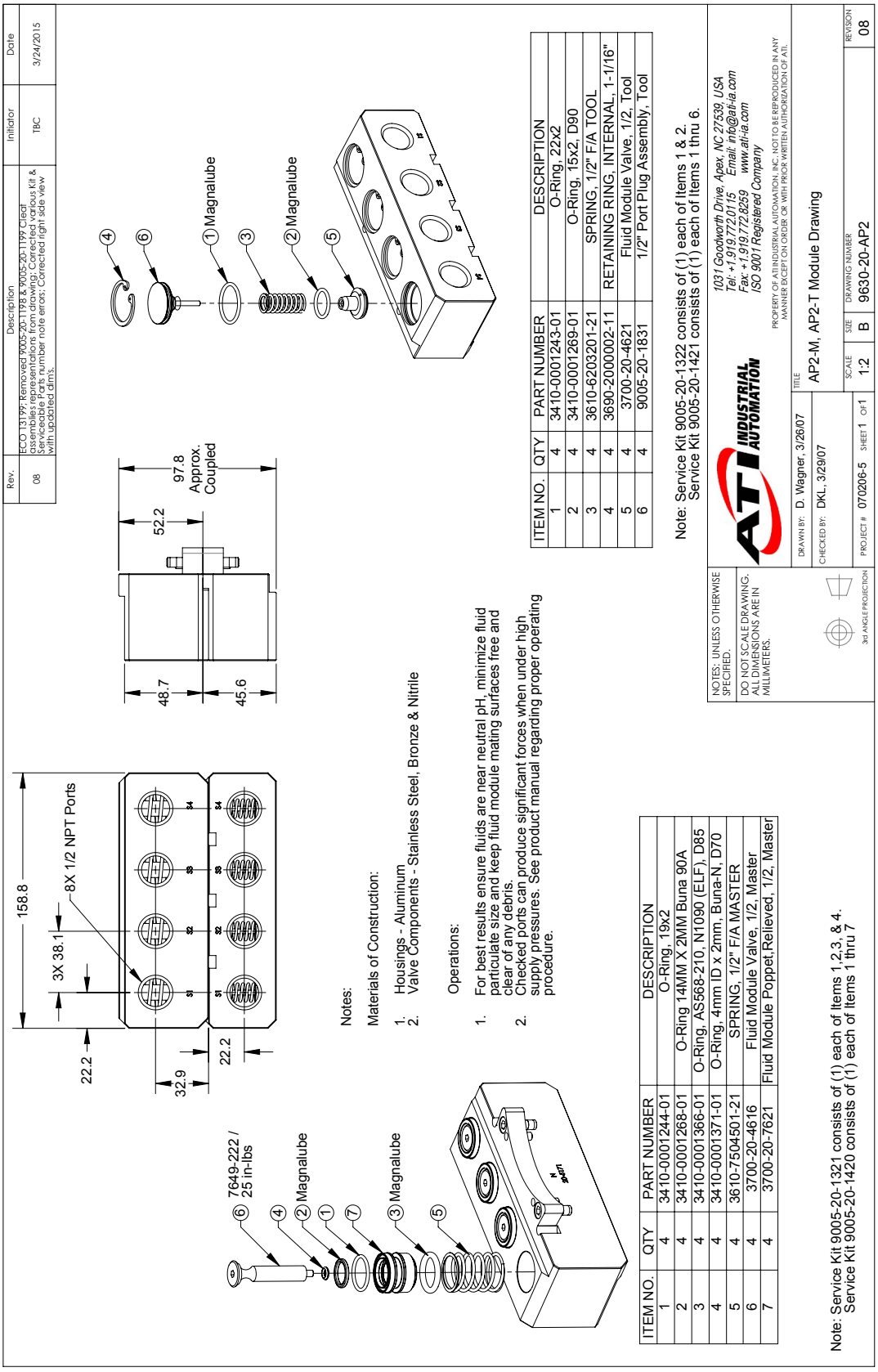
7. Specifications

Table 7.1—AP2 Module Specifications	
9121-AP2-M	Pneumatic module with (4) 1/2” NPT self-sealing ports - Master Side
9121-AP2-T	Pneumatic module with (4) ½” NPT self-sealing ports - Tool side
Materials of Construction	Various - Stainless Steel valve components, aluminum housing, Buna-N seals
Weight:	
Master Module	2.7 lbs (1.22 kg)
Tool Module	1.9 lbs (0.86 kg)
Self-Sealing Valves:	
Quantity	4
Air Pressure	Maximum pressure of 100psi (6.9bar)
Cv, Min	3.1
Customer Port Connection	1/2 NPT

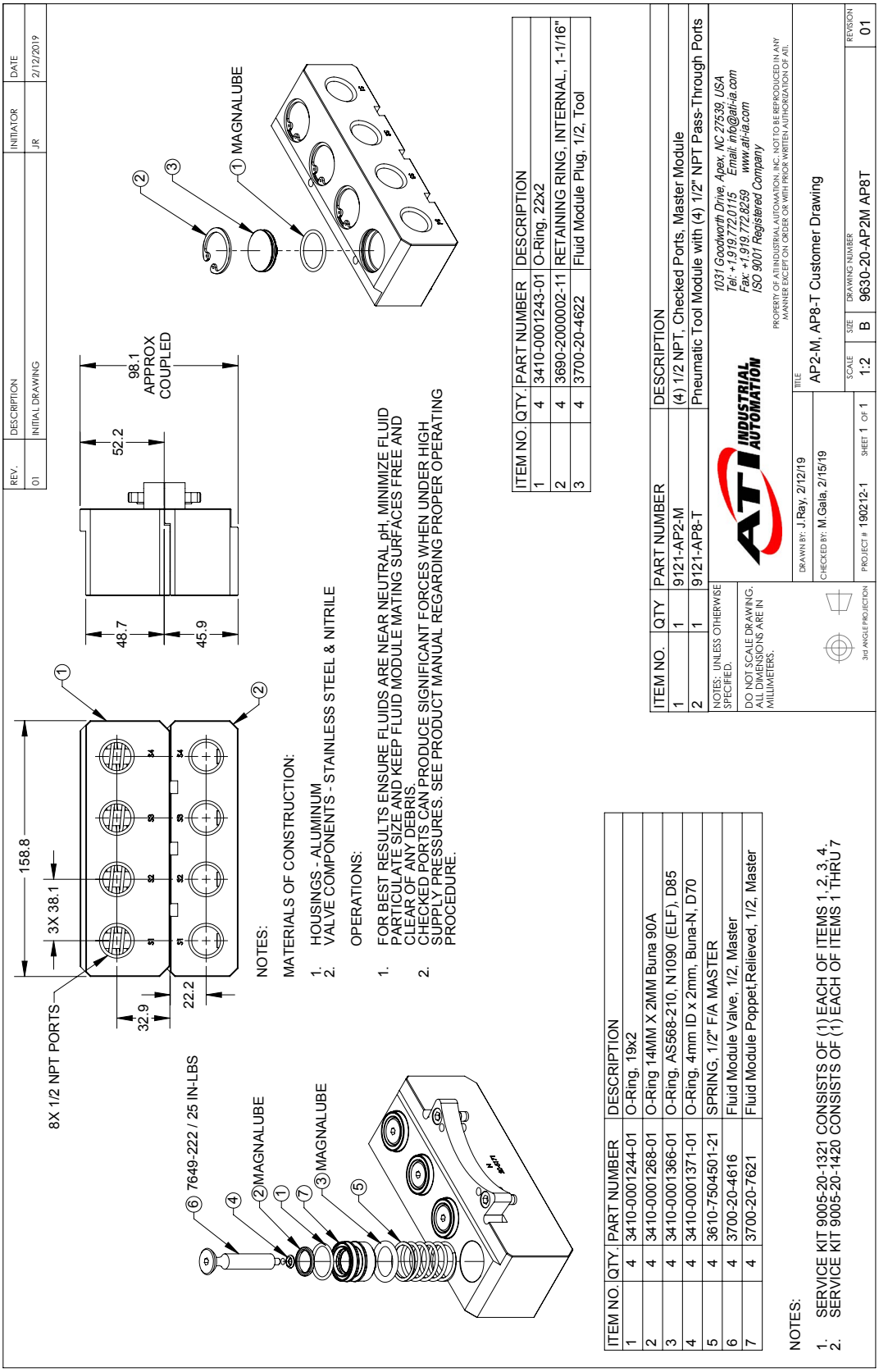
Table 7.2—AP8 Tool Module Specifications	
9121-AP8-T	Pneumatic module with (4) ½” NPT pass-through ports - Tool side
Materials of Construction	Various - Stainless Steel valve components, aluminum housing, Buna-N seals
Weight:	
Tool Module	1.8 lbs (0.82 kg)
Self-Sealing Valves:	
Quantity	4
Air Pressure	Maximum pressure of 100psi (6.9bar)
Cv, Min	3.1
Customer Port Connection	1/2 NPT

8. Drawings

8.1 AP2-M AP2-T



8.2 AP2-M AP8-T


REV. | DESCRIPTION | INITIATOR | DATE
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3X 38.1
8X 1/2 NPT PORTS
32.9
22.2
52.2
98.1 APPROX COUPLED
48.7
45.9
1 MAGNALUBE
2
3
6 7649-222 / 25 IN-LBS
4
2 MAGNALUBE
1
7
3 MAGNALUBE
5
NOTES:
MATERIALS OF CONSTRUCTION:
1. HOUSINGS - ALUMINUM
2. VALVE COMPONENTS - STAINLESS STEEL & NITRILE
OPERATIONS:
1. FOR BEST RESULTS ENSURE FLUIDS ARE NEAR NEUTRAL pH, MINIMIZE FLUID PARTICULATE SIZE AND KEEP FLUID MODULE MATING SURFACES FREE AND CLEAR OF ANY DEBRIS.
2. CHECKED PORTS CAN PRODUCE SIGNIFICANT FORCES WHEN UNDER HIGH SUPPLY PRESSURES. SEE PRODUCT MANUAL REGARDING PROPER OPERATING PROCEDURE.
ITEM NO. | QTY. | PART NUMBER | DESCRIPTION
1 | 4 | 3410-0001244-01 | O-Ring, 19x2
2 | 4 | 3410-0001268-01 | O-Ring 14MM X 2MM Buna 90A
3 | 4 | 3410-0001366-01 | O-Ring, AS568-210, N1090 (ELF), D85
4 | 4 | 3410-0001371-01 | O-Ring, 4mm ID x 2mm, Buna-N, D70
5 | 4 | 3610-7504501-21 | SPRING, 1/2" F/A MASTER
6 | 4 | 3700-20-4616 | Fluid Module Valve, 1/2, Master
7 | 4 | 3700-20-7621 | Fluid Module Poppet,Relieved, 1/2, Master
NOTES:
1. SERVICE KIT 9005-20-1321 CONSISTS OF (1) EACH OF ITEMS 1, 2, 3, 4.
2. SERVICE KIT 9005-20-1420 CONSISTS OF (1) EACH OF ITEMS 1 THRU 7
ITEM NO. | QTY. | PART NUMBER | DESCRIPTION
1 | 4 | 3410-0001243-01 | O-Ring, 22x2
2 | 4 | 3690-2000002-11 | RETAINING RING, INTERNAL, 1-1/16"
3 | 4 | 3700-20-4622 | Fluid Module Plug, 1/2, Tool
ITEM NO. | QTY | PART NUMBER | DESCRIPTION
1 | 1 | 9121-AP2-M | (4) 1/2 NPT, Checked Ports, Master Module
2 | 1 | 9121-AP8-T | Pneumatic Tool Module with (4) 1/2" NPT Pass-Through Ports
NOTES: UNLESS OTHERWISE SPECIFIED.
DO NOT SCALE DRAWING. ALL DIMENSIONS ARE IN MILLIMETERS.
INDUSTRIAL AUTOMATION
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DRAWN BY: J. Ray, 2/12/19
CHECKED BY: M Gala, 2/15/19
TITLE
AP2-M, AP8-T Customer Drawing
3rd ANGLE PROJECTION
PROJECT # 190212-1
SHEET 1 OF 1
SCALE 1:2
SIZE B
DRAWING NUMBER 9630-20-AP2M AP8T
REVISION 01