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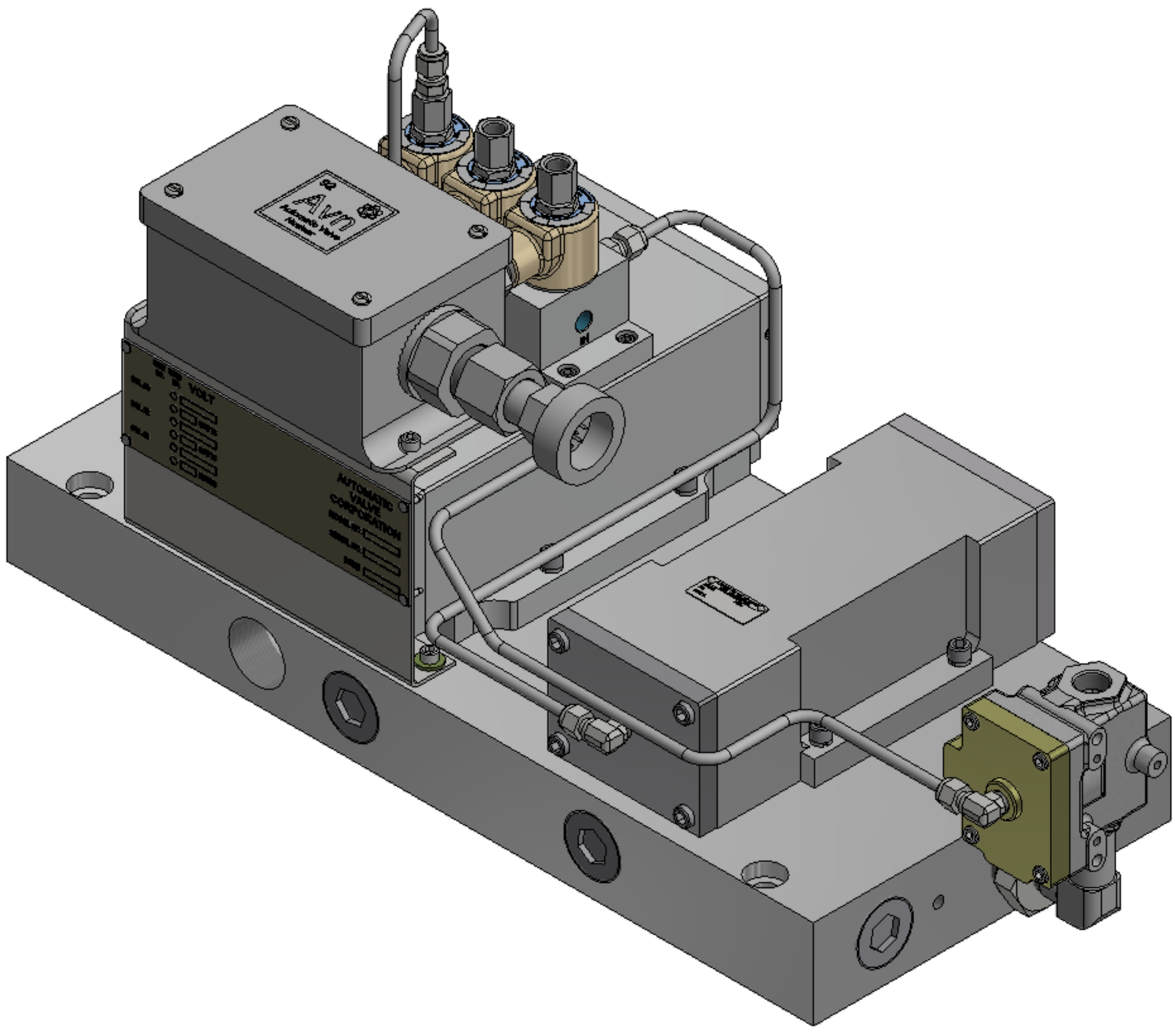
AIRPACK – INSTALLATION & MAINTENANCE



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PURPOSE AND SCOPE:

To provide installation and maintenance instructions for “Airpacks” in an accurate, consistent, and efficient manner.

REFERENCES AND DEFINITIONS:

None

REQUIREMENTS:

1. Index:

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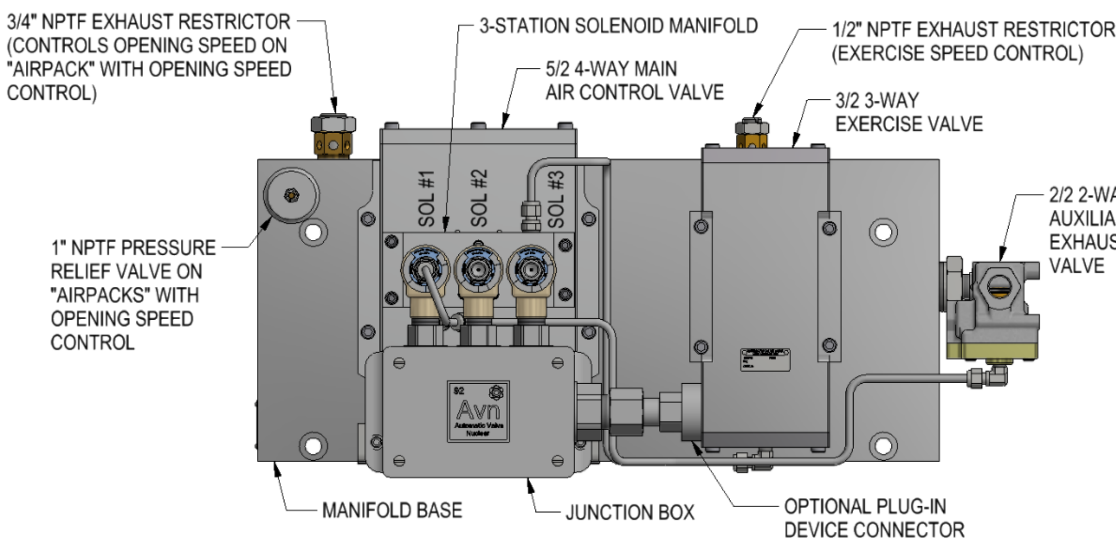
Note: Use Automatic Valve Corp. products only within the operating specifications stated for the product on the drawing. Catalog data is available from the website and drawings must be requested directly from the factory.

2. Description & Operation:

2.1. As shown in Figure 2.1, the “Airpack” is a manifolded system of pneumatic valves for mounting directly to the MSIV cylinder and is designed to control the position of the cylinder thereby opening and closing the MSIV. It includes:

- A 1 ¼”, 5/2 (five ported two position, four-way) pilot operated valve, the main air control valve which controls the position of the MSIV cylinder and thus the opening and closing of the MSIV.
- A ½” NPTF 2/2 (two ported two position) normally open pilot operated valve, the auxiliary exhaust valve, which provides an auxiliary means of exhausting the rod end of the MSIV cylinder.
- A 1 ¼”, 3/2 (three ported two position) normally open three way pilot operated valve that, in combination with a ½” NPTF exhaust restrictor, provides a means of slowly closing, or exercising, the MSIV without operating either the 5/2 or the 2/2 valves.
- A three station solenoid manifold containing three (3) direct acting three-way normally closed solenoid valves for controlling the pilot operated valves. Solenoids #1 and #2 are connected in parallel and used for controlling the positions of the 5/2 and 2/2 pilot operated valves. Solenoid #3 is used to control the position of the 3/2 pilot operated exercise valve.
- A NEMA IV junction box with terminal strip for making field to “Airpack” electrical connections. (Also available with an optional plug-in device receptacle.)
- On “Airpacks” with opening speed control a 1” NPTF pressure relief valve that, in combination with a ¾” NPTF exhaust restrictor, provide adjustment for controlling the opening speed of the MSIV. K

Figure 2.1 – “Airpack”



2.2. Air Supply Inlets:

2.2.1 A 1 ½” NPTF inlet provides air to the 1 ¼”, 5/2 4-way main air control valve which, depending on its position, applies air to either the top or bottom of the MSIV cylinder while alternately exhausting the opposite end of the cylinder.

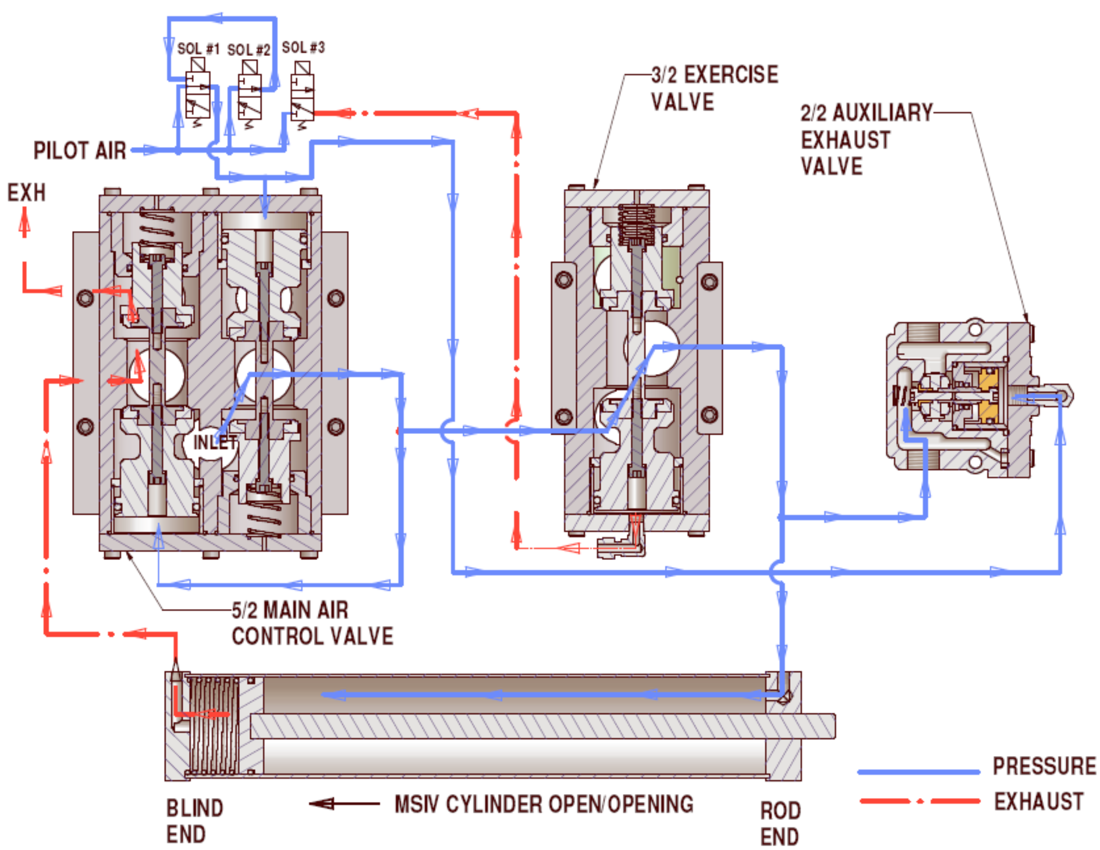
2.2.2 A ¼” NPTF inlet to the three station solenoid manifold. The position of the 5/2 main air control valve as well as the 2/2 auxiliary exhaust valve in turn is controlled by two (2) three way normally closed solenoid operated valves, solenoid valves #1 and #2. Solenoid #3 controls the position of the 3/2 exercise valve.

2.3. Figure 2.2 illustrates the opening of the MSIV, (the MSIV cylinder retracts). Either or both solenoid valves #1 and #2 are energized which feeds pilot air to the pistons of the 5/2 main air control valve and the 2/2 auxiliary exhaust valves causing both valves to shift to their energized positions. The auxiliary exhaust valve closes. The main air control valve shifts to supply air to the rod end of the MSIV cylinder and, simultaneously, exhausts air from the blind end of the cylinder to open the MSIV. On “Airpacks” with opening speed control, the opening speed is adjustable by means of an optional ¾” NPTF metering valve installed in the exhaust port of the main air control valve.

Should either solenoid #1 or #2 be de-energized while the other is energized, pilot pressure is maintained to the pistons of both the 5/2 main air control valve and the 2/2 auxiliary exhaust valve causing both valves to maintain their position. This causes the MSIV to remain open.

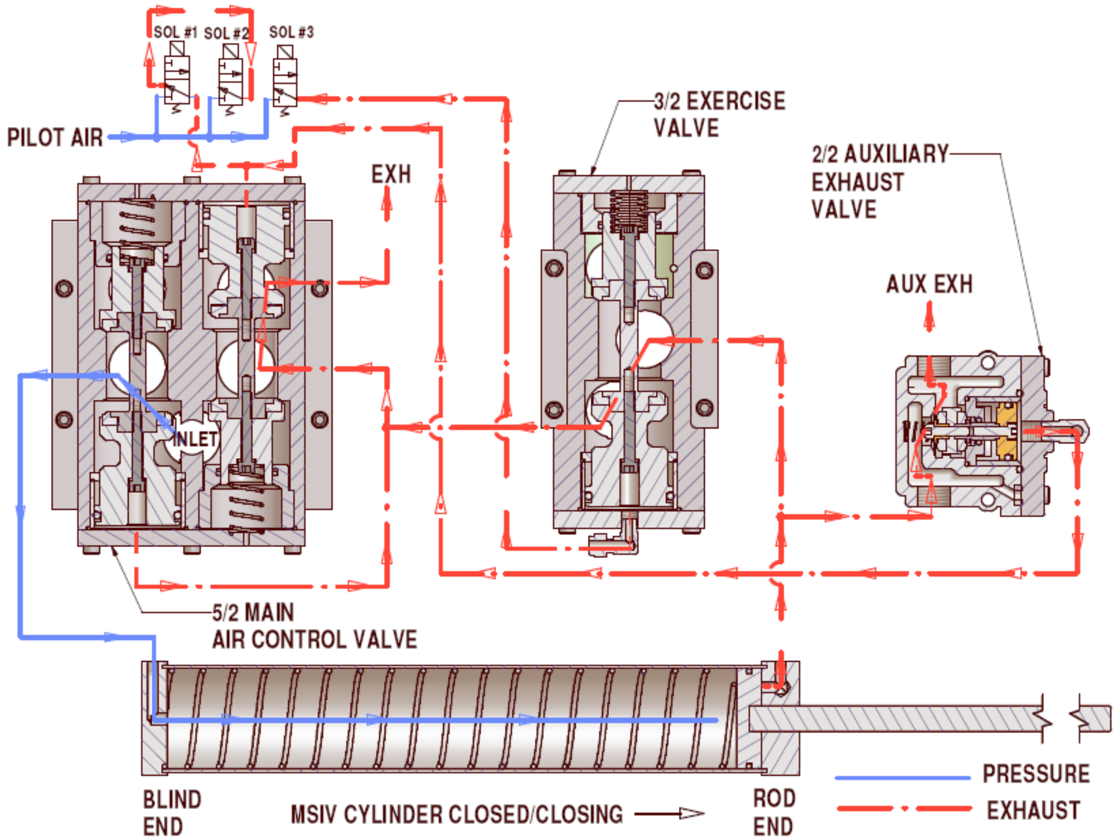
In the event that the system air supply is lost, the pilot pressure in the pistons of both the 5/2 main air control valve and the 2/2 auxiliary exhaust valve would exhaust out through the solenoid valves to atmosphere. The 5/2 main air control valve and the 2/2 auxiliary exhaust valve would shift to their de-energized positions and exhaust the air pressure from the rod end of the cylinder. The force generated by the closing springs will close the MSIV. (Any air pressure contained in the air storage tank, shown in Figure 5.2, will assist the springs in closing the MSIV.)

Figure 2.2 - MSIV Open/Opening



2.4. Figure 2.3 illustrates closing of the MSIV (the MSIV cylinder extends). Both solenoid valves #1 and #2 are de-energized which exhausts the pilot air from the pistons of both the 5/2 main air control valve and the 2/2 auxiliary exhaust valve causing them to shift to their de-energized position. The 5/2 main control valve then supplies air pressure to the blind end of the MSIV cylinder and, simultaneously, both the 5/2 main control valve and the 2/2 auxiliary exhaust valve exhausts air from the rod end of the cylinder causing the MSIV to close. It should be noted that in the event no air pressure is available for closing, the closing springs will supply the force necessary to close the MSIV. The closing speed is adjustable by means of the ¾" flow control valves contained in the MSIV hydraulic piping system. The hydraulic system is not part of the "Airpack".

Figure 2.3 - MSIV Closed/Closing



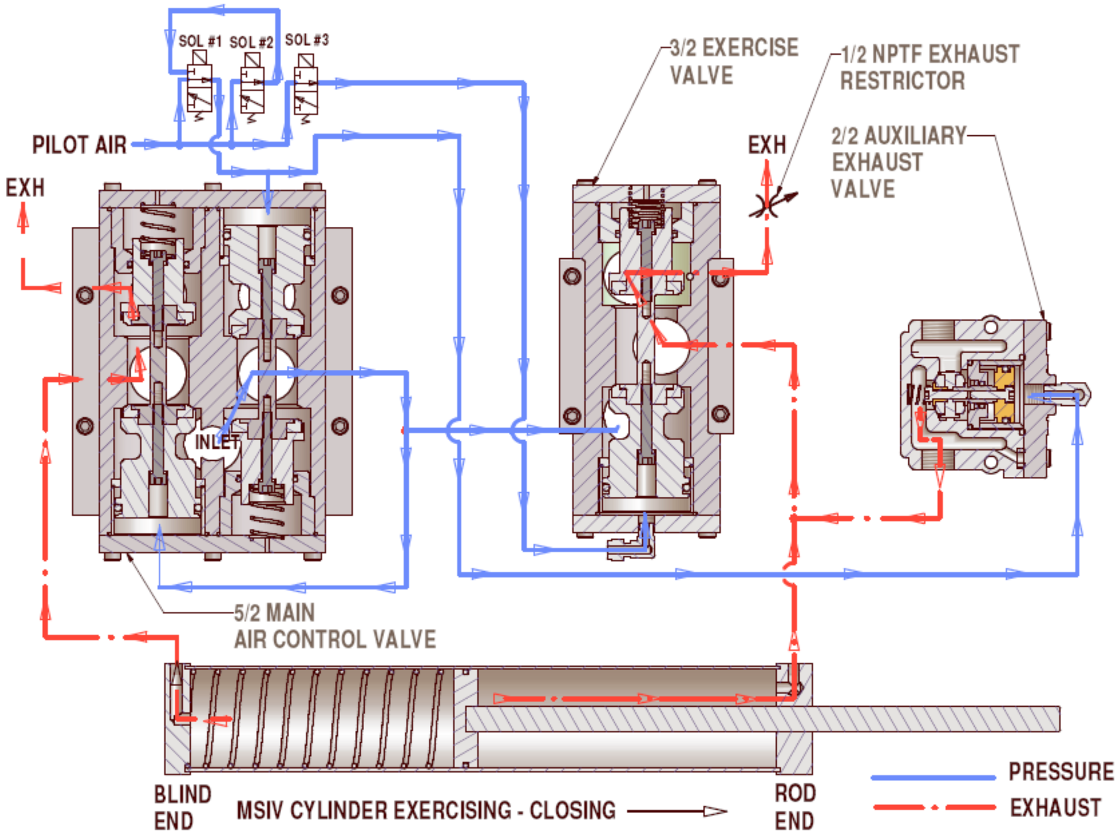
2.5. Figure 2.4 illustrates exercising of the MSIV. The slow speed exercising system is designed so that it can be operated without disturbing the normal main solenoid control valve system. A normally open three-way pilot operated valve, the 3/2 exercise valve, is installed in the air line between the rod end of the MSIV cylinder and the main air control valve in order to accomplish the exercise function. The exercise valve is controlled by a three-way normally closed solenoid valve, solenoid valve #3.

Solenoid valve #3 is energized to feed pilot air to the piston of the 3/2 exercise control valve. This causes it to shift to its energized position. The air supply being fed from the main control valve to the rod end of the cylinder is blocked and the air in the rod end of the cylinder is exhausted to atmosphere through the ½" NPTF exhaust restrictor. (The exhaust restrictor can be adjusted to control the rate of exercise closure speed.) When the pressure in the rod end of the MSIV cylinder decays to the point where the force exerted on the piston can no longer overcome the force generated by the closing springs, the MSIV will start to close.

Note: The MSIV is equipped with a position switch to indicate when the 90 percent open position has been reached. If the exercise control valve is left in the energized position the MSIV will go to the fully closed position.

When solenoid valve #3 is de-energized, it exhausts the pilot air from the piston of the 3/2 exercise valve causing it to shift back to its de-energized position. The exhaust port is now blocked and air from the main air control valve is fed to the rod end of the cylinder causing the MSIV to return to its full open position.

Figure 2.4 - MSIV Exercise Function



3. Specifications:

3.1. Design

3.1.1. The “Airpacks” manifold construction:
- Eliminates excess plumbing. Reduces or eliminates points of leakage. Reduces panel size, weight, and installation time.
- Includes port inserts on the bottom of the manifold. Inserts are replaceable if damaged.
- Includes valves that are mounted to the manifold base and can be removed for maintenance or replacement with a minimum of effort.

3.1.2. Poppet valve construction features:
- Large flow area with minimum stroke.
- Less harmful shock loads when the valves shift.
- Large diameter poppet seals absorb shock and compensate for wear.
- Faster response time.
- Only two resilient rubber to metal dynamic wear points, the piston and poppet seals.
- All seals are fluorocarbon.

3.1.3. Solenoid pilot valve construction features:
- Solenoid coil and housing potted together to form an integral unit which meets or exceeds NEMA IV specifications.
- Class “H” solenoid coils are rated for continuous duty at an ambient temperature of 150^0F.

3.1.4. Junction box construction features:
- Solenoid manifold mounted on top of the 4-way valve and a junction box mounted directly to the solenoids localizing the location of electrical connections.
- Provides either a common conduit connection or an optional 9-pin device receptacle into a NEMA IV junction box with terminal strip thus simplifying and reducing field installation and servicing time.

3.2. Media	Air or inert gases		
3.3. Temperature (ambient)	32^0F to 150^0F (0^0C to 66^0C)		
3.4. Pressure	Normal: 25 to 150 psig (3.4 to 10.3 bar)		
3.5. Solenoids			
3.5.1. Voltages	120/60	125 VDC	250 VDC
3.5.2. Resistance (Ohms)	149	1632	6063
3.5.3. Consumption (Watts)	9	9	9
3.5.4. Tolerance	Refer to the “Airpack” assembly drawing		
3.5.5. Temperature Rise	185^0F (85^0C)		
3.6. Flow	20 Cv		
3.7. Response Time (Open/Exercise)	9 to 20/45 to 60 Seconds – Factory preset but adjustable		
3.8. Leakage (Maximum Allowed)	0.01 SCFH @ 100 PSIG		
3.9. Filtration	50 Micron or better		
3.10. Lubrication	None required. Factory pre-lubed with Parker “Super-O-Lube”		
3.11. Design (Internal)	Poppet construction		
3.12. Weight	Approximately 100 pounds. (45.5 Kg)		
3.13. Materials	Aluminum, brass, stainless steel, fluorocarbon		

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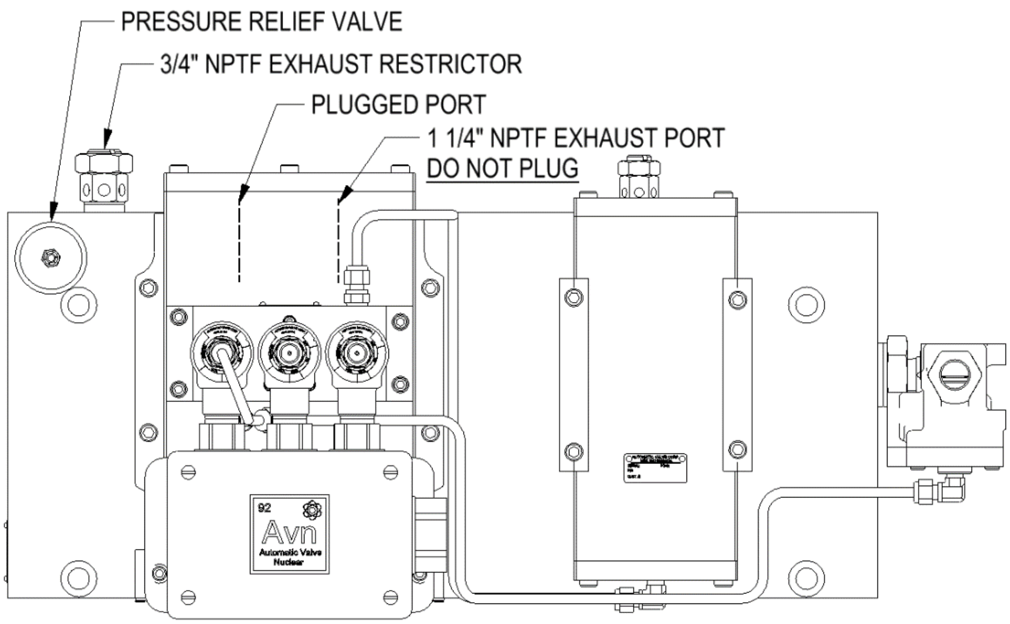
4. Model Configurations:

4.1. Figure 4.1 illustrates an “Airpack” with opening speed control. These models have a ¾” NPTF exhaust restrictor and a pressure relief valve located in the upper left portion of the manifold.

Figure 4.1 – “Airpack” with Opening Speed Control



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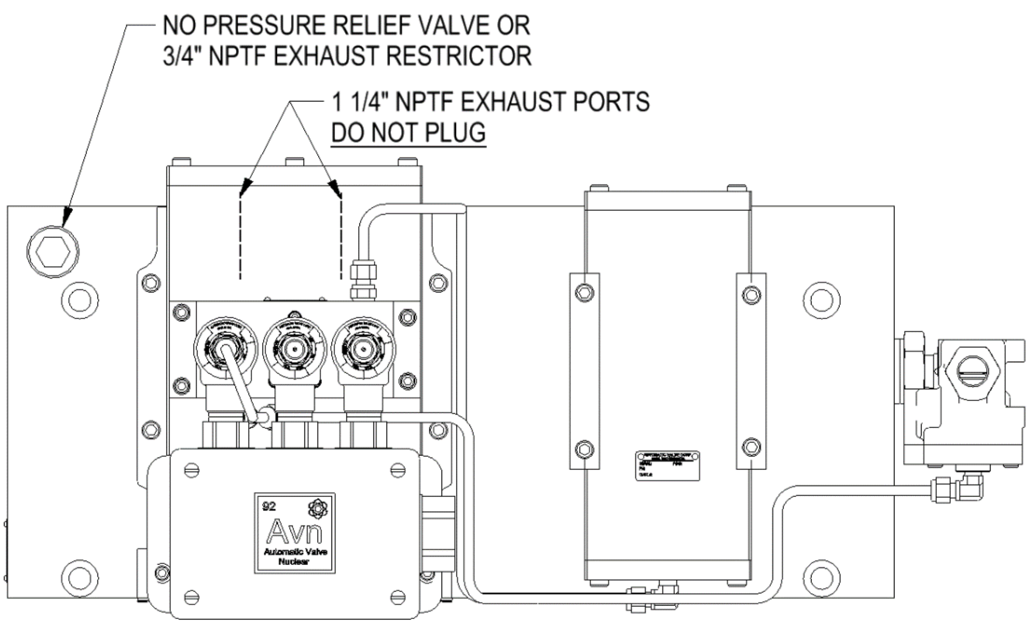
4.2. Figure 4.2 illustrates an “Airpack” without opening speed control. These models do not have either an exhaust restrictor or a pressure relief valve in the upper left portion of the manifold. Ports for these items are either non-existent or are plugged.

Figure 4.2 – “Airpack” without Opening Speed Control



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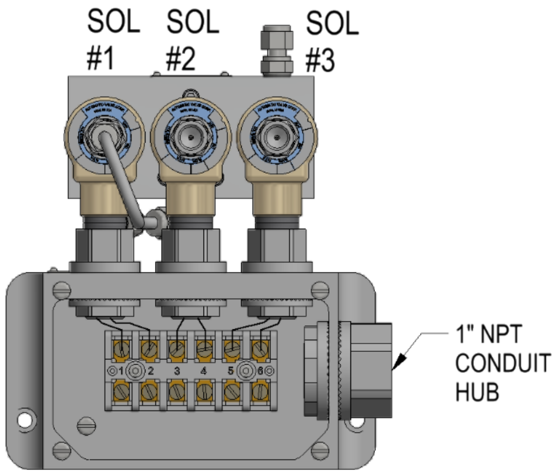
4.3. Figure 4.3 shows the solenoid junction box with a 1" NPT conduit connection.

Figure 4.3 – Junction Box with 1" NPT Conduit Connection



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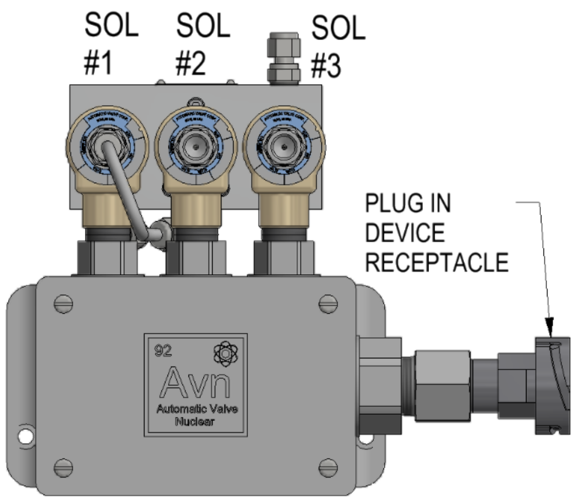
4.4. Figure 4.4 shows the solenoid junction box with a plug in device receptacle.

Figure 4.4 - Junction Box with A Plug In Device Receptacle



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5. Installation:

5.1. Inspect all packing crates for signs of damage. Open crates and inspect panels for damages or shortages. The crate containing the packing list will be marked "Packing List Enclosed".

5.1.1. Notify Automatic Valve Corp. immediately and save the packing crate in the event of any damages or shortages.

5.2. Return the "Airpack" and all other components to the packing crates for protection until their installation on the MSIV.

5.3. At the time of installation, **verify that all air pressure and electrical power is off**.

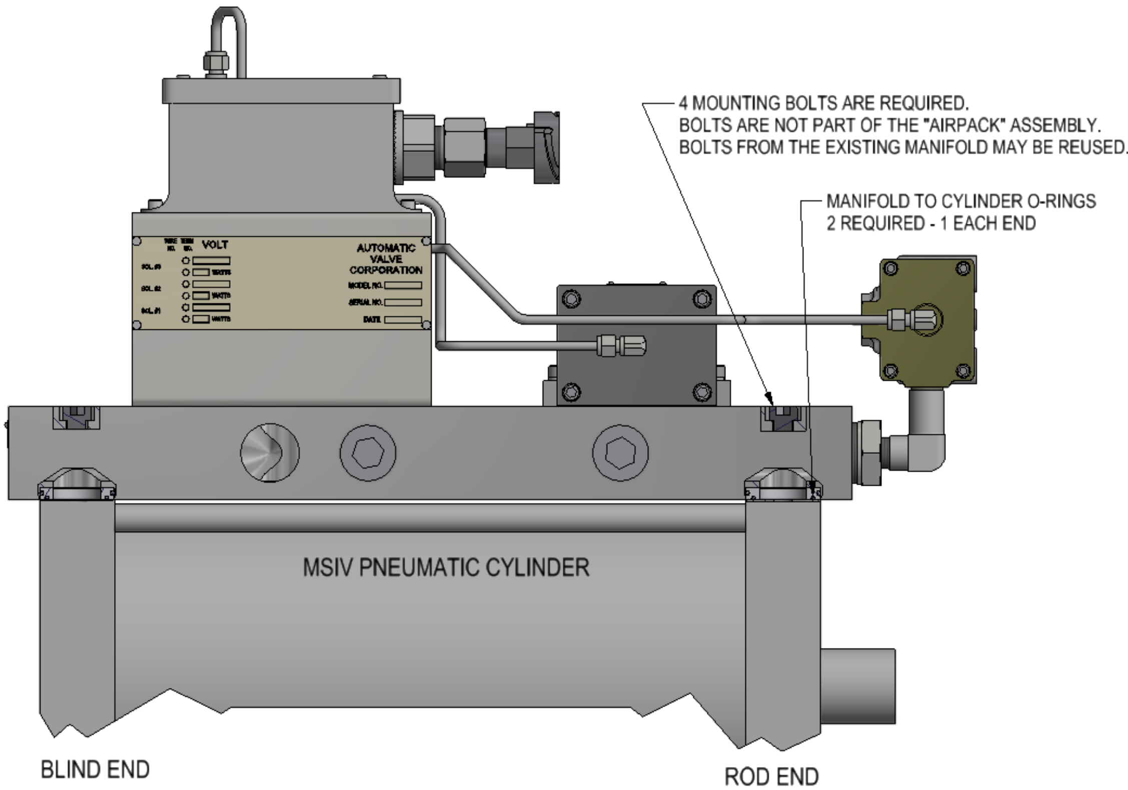
5.4. Disconnect all air and electrical connections to any existing manifold.

5.5. Remove any existing manifold assembly from the pneumatic cylinder on the MSIV. Retain the mounting bolts for mounting the new "Airpack".

5.6. Conduct an MSIV cylinder seal leak test to verify the integrity of the MSIV cylinder seals per the "Troubleshooting" section. If the test shows defective cylinder seals, they must be replaced before installing a new manifold assembly.

5.7. Mount the new "Airpack" assembly in place on the MSIV pneumatic cylinder per the instructions below, Figure 5.1, and refer to the manifold assembly drawing.

Figure 5.1 - "Airpack" Mounted on MSIV Pneumatic Cylinder



5.7.1. Verify that the "Airpack" is correctly positioned with respect to the MSIV cylinder – the 2-way valve should be toward the rod end of the cylinder – and mount the "Airpack" assembly to the MSIV pneumatic cylinder. K

5.7.2. Tighten the four (4) MSIV cylinder mounting bolts per plant technical specifications. (Note: The mounting bolts are not furnished as part of the "Airpack" manifold assembly. Bolts from the existing manifold may be reused.)

5.8. Before making any air line connections to the "Airpack", the following procedures must be followed:

5.8.1. Take all steps necessary to ensure that the quality of the air supplied to the manifold meets the following criteria:

5.8.1.1 Air must be filtered to a level of 50 microns or better.

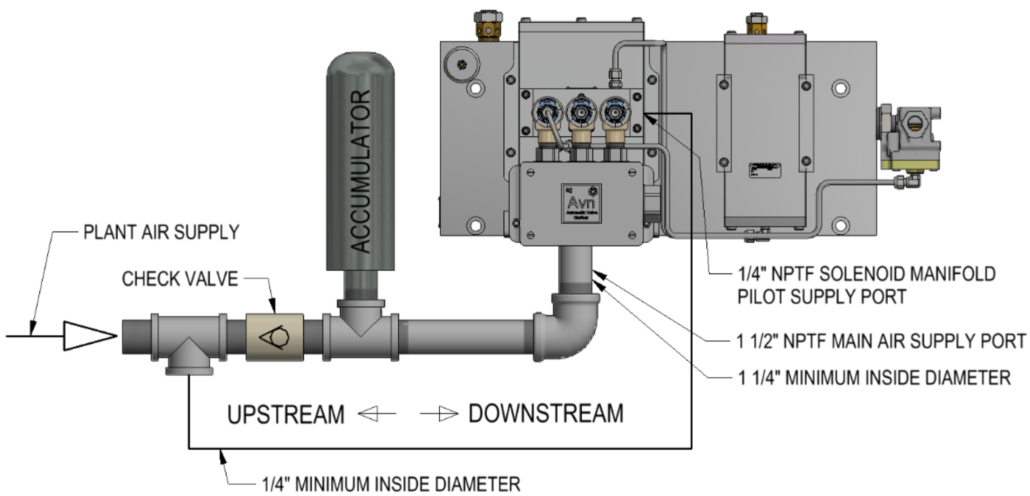
5.8.1.2 Air must be oil free.

5.8.1.3 Air pressure must be per the "Airpack" assembly drawing.

5.8.1.4 Air must be dried to a dew point of -40^{0}F at the operating pressure of the "Airpack".

5.8.2. Verify that the plumbing system conforms to Figure 5.2. Particular attention must be given to assure that the ¼" NPTF connection for the solenoid manifold pilot supply is located upstream of the check valve. This is a safety feature designed to close the MSIV in the event of a loss of main line air pressure. K

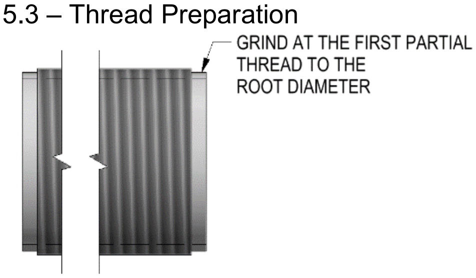
Figure 5.2 – "Airpack" and Plumbing System



5.8.3. Prior to making any piping connections, including those to the "Airpack" and those made during any modifications to the air supply system, prepare and install male pipe threads per the paragraphs below and Figures 5.3, 5.4, and 5.5:

5.8.3.1 Grind the first partial male thread down to the root diameter as shown in Figure 5.3. This is necessary to reduce the possibility of chips being generated when the pipe connections are made.

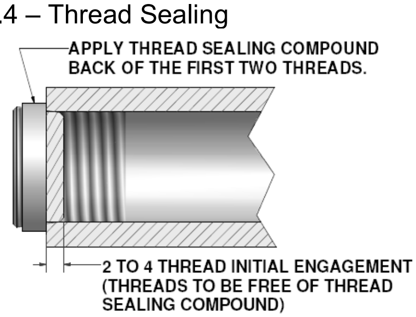
Figure 5.3 – Thread Preparation



5.8.3.2 Clean the fitting in solvent, rinse, and dry immediately prior to use.

5.8.3.3 Start the first two (2) to four (4) male threads into a clean tapped port per Figure 5.4.

Figure 5.4 – Thread Sealing



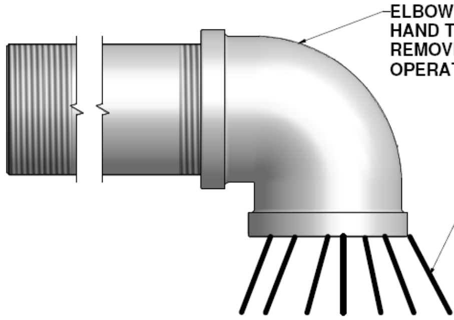
5.8.3.4 Apply thread sealing compound. **Do not use "Teflon®" tape or equivalent**.

5.8.3.5 Tighten the fitting to affect a bubble tight seal.

5.8.4. Prior to making any piping connections from the air supply system to the “Airpack”, but after all necessary air line modifications have been made, the air line system must be purged per paragraphs and figures below:

5.8.4.1 Direct all open pipes, including the “Airpack” inlet and the solenoid manifold pilot supply inlet, in a direction where the discharge will not harm personnel or equipment. A pipe elbow may be placed on the end of the pipes to act as a diverter per Figure 5.5.

Figure 5.5 – Flow Diversion



Caution: All personnel in the area during the purging operation must have suitable ear protection to avoid hearing damage due to the exhausting of air at sonic velocity and must wear goggles to prevent eye damage!

5.8.4.2 Turn the air supply ON for a period of approximately one (1) minute and then OFF for a period of approximately one (1) minute.

5.8.4.3 Repeat step 5.8.4.2 a minimum of three (3) times. Continue to repeat as many times as necessary to purge the air line system of all sediment.

5.8.4.4 Turn the air supply OFF and remove any elbows installed as diverters.

Note: Failure to purge air lines per the above paragraphs will void any warranty given for the “Airpacks” by Automatic Valve Corp.

5.8.5. After purging the air supply system, inspect all air line filters and clean as required.

5.8.6. **Do not remove any steel pipe plugs!** All steel pipe plugs are a permanent part of both types of “Airpack” assemblies.

5.8.7. Connect the 1 ½” NPTF main air supply to the manifold per paragraphs under 5.8.3 and Figures 5.2, 5.3, and 5.4.

5.8.7.1 The minimum inside diameter of the tubing or pipe supplying the 1 ½” NPTF main air supply port is 1 ¼”.

5.8.8. Connect the ¼” NPTF pilot supply line to the solenoid manifold per paragraphs under 5.8.3 and Figures 5.2, 5.3, and 5.4.

5.8.8.1 The minimum inside diameter of the tubing or pipe supplying the ¼” NPTF solenoid manifold supply port is ¼”.

Note: Do not use copper fittings to make air line connections either to the manifold base or the solenoid manifold. Stainless steel is recommended. Using copper fittings in aluminum could set up an electrolytic action causing corrosion.

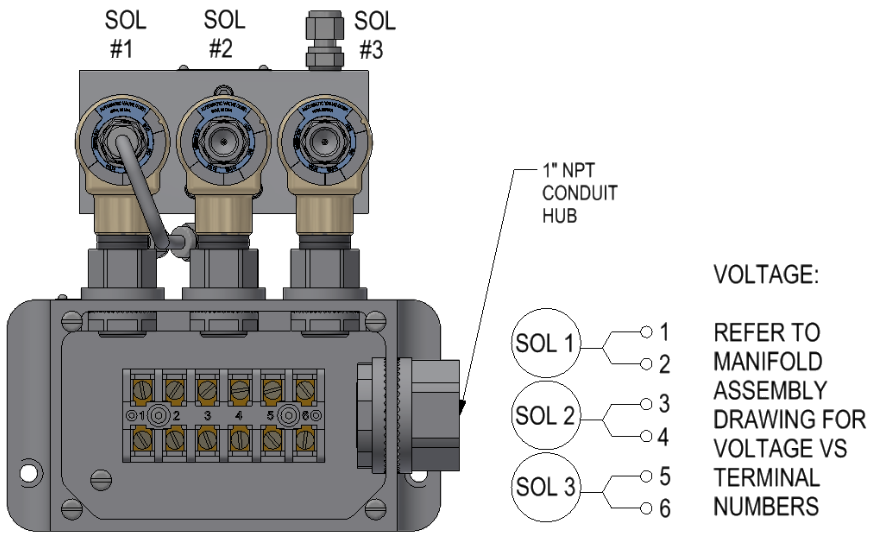
5.9. Connect electrical power to the solenoid manifold.

5.9.1. If the “Airpack” being installed has a 1” NPT conduit hub **without** a plug-in device receptacle refer to Figure 5.6 and the following paragraphs: K

5.9.1.1 Remove the junction box cover and attach electrical power leads to the numbered terminal strip in the junction box.

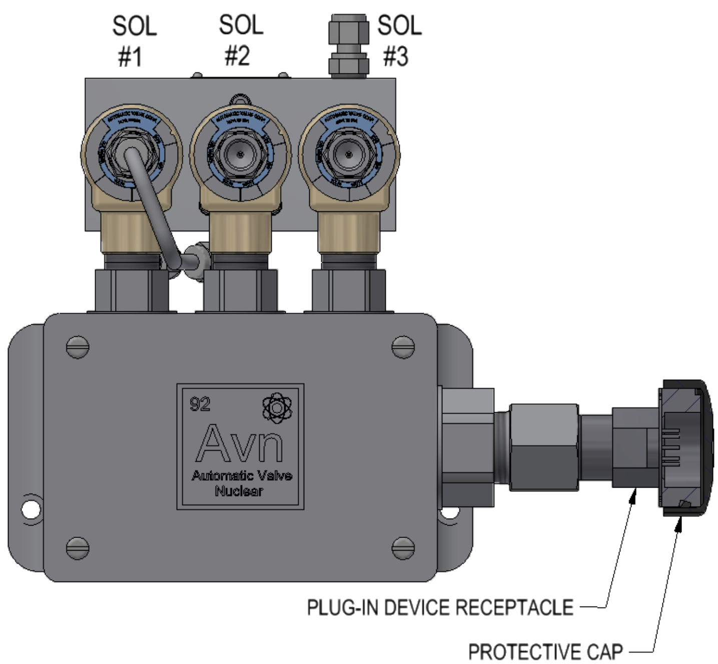
5.9.1.2 Replace the junction box cover.

Figure 5.6 – Junction Box & Solenoid Manifold K



5.9.2. If the “Airpack” being installed has a 1” NPT conduit hub **with** a plug-in receptacle as shown in Figure 5.7, remove the protective cap from the receptacle, and attach the connector per the manufacturer’s instructions. K

Figure 5.7 – Junction Box w/ Plug-In Receptacle & Solenoid Manifold K



5.10. Restore air and electrical power.

Caution: Before proceeding to the functional testing of the "Airpack", which involves operation of the MSIV, the steam line must be thoroughly flushed.

Caution: All personnel in the area during operation of the "Airpack" must have suitable ear protection to avoid hearing damage due to the exhausting of air at sonic velocity and must wear goggles to prevent eye damage.

5.11. With air to the "Airpack" ON, use a liquid leak detector to verify that there are no air leaks at any of the connections in the air supply system.

5.12. Test the "Airpack" for proper operation as follows:
- 5.12.1. Energize solenoid #1. The MSIV cylinder should retract (the MSIV opens). Verify that there are no leaks between the manifold to cylinder interfaces.
- 5.12.2. De-energize solenoid #1. The MSIV cylinder should extend (the MSIV closes). Verify that there are no leaks between the manifold to cylinder interfaces.
- 5.12.3. Energize solenoid #2. MSIV cylinder should retract (the MSIV opens).
- 5.12.4. De-energize solenoid #2. The MSIV cylinder should extend (the MSIV closes).
- 5.12.5. Energize solenoids #1 and #2 simultaneously. The MSIV cylinder should retract (the MSIV opens).
- 5.12.6. With solenoids #1 and #2 energized, energize solenoid #3. The MSIV cylinder should extend (the MSIV closes).
- 5.12.7. With solenoids #1 and #2 energized, de-energize solenoid #3. The MSIV cylinder should retract (the MSIV opens).
- 5.12.8. De-energize solenoids #1 and #2. The MSIV cylinder should extend (the MSIV closes).

5.13. Refer to Figure 2.1 and set the closure rate of the MSIV during the exercise cycle as follows:
- 5.13.1. Loosen the locknut on the ½" NPTF exhaust restrictor.
- 5.13.2. Turn the exhaust restrictor adjusting screw clockwise until it is fully closed.
- 5.13.3. Turn the exhaust restrictor adjusting screw counterclockwise two (2) turns.
- 5.13.4. Energize either solenoid #1, solenoid #2, or both to open the MSIV.
- 5.13.5. When the MSIV is fully open, energize solenoid #3 which controls the 3/2 3-way exercise valve. This valve exhausts air from the rod end of the cylinder allowing the springs alone to close the MSIV. The exhaust restrictor setting controls the speed of closure. Note the time to fully close the MSIV.
  - 5.13.5.1 The time to close the MSIV must be set per plant technical specifications.
  - 5.13.5.2 If the time is shorter, turn the exhaust restrictor adjusting screw one half (1/2) turn clockwise.
  - 5.13.5.3 If the time is longer, turn the exhaust restrictor adjusting screw one half (1/2) turn counterclockwise.
  - 5.13.5.4 Repeat steps 5.13.5.1 through 5.13.5.4 until the correct closure time is achieved.
- 5.13.6. Tighten the exhaust restrictor locknut.
- 5.13.7. This completes the installation of "Airpacks" which do not have pneumatic opening speed control. On "Airpacks" which have opening speed controls, follow the instructions under paragraph 5.14.

5.14. On "Airpacks" with opening speed controls, set the opening speed of the MSIV's per the paragraphs below and Figure 2.1.
- 5.14.1. Loosen the locknut on the ¾" NPTF exhaust restrictor.
- 5.14.2. Turn the exhaust restrictor adjusting screw clockwise until it is fully closed.
- 5.14.3. Turn the exhaust restrictor adjusting screw counterclockwise one (1) turn.
- 5.14.4. De-energize both solenoids #1 and #2 to close the MSIV.

5.14.5. Energize either solenoid #1, solenoid #2 or both to open the MSIV. Note the time to fully open the MSIV.
5.14.5.1 During this step, the pressure relief valve will open permitting pressure in the top of the MSIV cylinder to decay to approximately 20 PSIG.
5.14.5.2 The time to open the MSIV must be set per plant technical specifications.
5.14.5.3 If the time is shorter, turn the exhaust restrictor adjusting screw one half (1/2) turn clockwise.
5.14.5.4 If the time is greater, turn the exhaust restrictor adjusting screw one half (1/2) turn counterclockwise.
5.14.5.5 Repeat steps 5.14.5.1 through 5.14.5.5 until the correct opening time is achieved.
5.14.6. Tighten the exhaust restrictor locknut to complete the installation.

6. Service:

6.1. The most important aspect of a maintenance program is preventative maintenance. Therefore, it is imperative that the installation instructions of this form be followed thoroughly.

6.2. The following paragraphs in the installation instructions are of critical importance in ensuring that dirt, chips, pipe sealing compound, and other contaminants will not cause system malfunction:
6.2.1. Paragraphs 5.8.1 Quality of air supply.
6.2.2. Paragraphs 5.8.3 Preparation of fittings.
6.2.3. Paragraphs 5.8.5 Cleaning of air line filters following purging.

6.3. During normal plant operation, inspection and cleaning of air line filters should be done on a weekly basis or more often if experience so dictates. The use of air line filters with drains is recommended.

6.4. Manufacturers’ recommendations regarding the maintenance of compressors, air line dryers, pressure regulators, filters, etc., must be followed to maintain specified air quality.

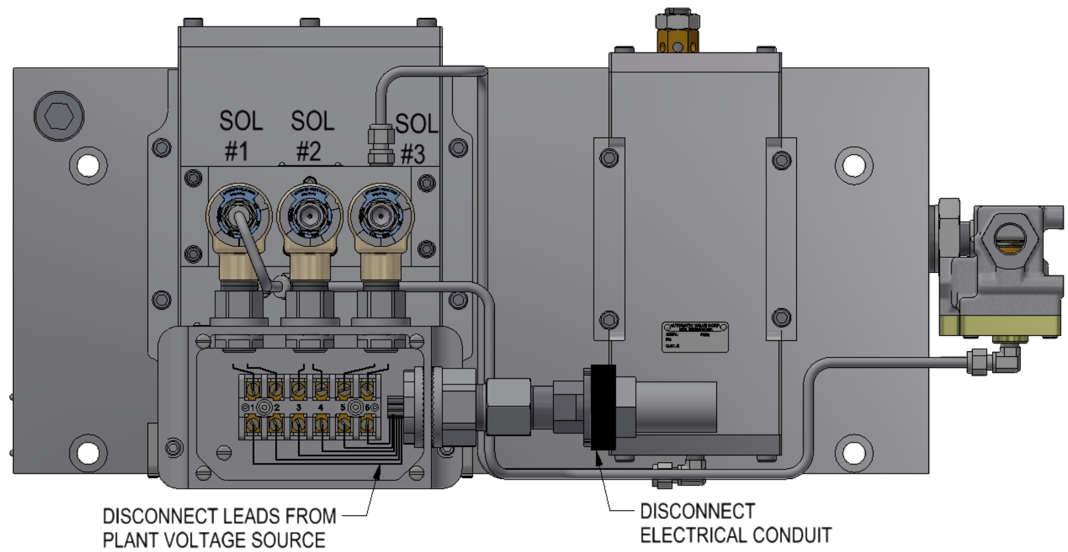
6.5. During each scheduled shutdown for plant maintenance, at 12 to 18 month intervals, the “Airpacks” should be inspected for wear and loss of seal resiliency and have major components replaced at regular intervals per plant requirements. K
6.5.1. While it is possible to inspect and maintain the “Airpack” while it is mounted on the MSIV pneumatic cylinder, plant experience has shown that it is more efficient to remove the panel and to bench test the rebuilt “Airpack” prior to reinstalling it on the MSIV.

7. Maintenance:

7.1. Prior to doing any maintenance work on the “Airpack”, **air and electrical power must be OFF**.

7.2. Remove the “Airpack” per the paragraphs below:
7.2.1. Disconnect the “Airpack” from the plant voltage source.
7.2.1.1 If the “Airpack” has a junction box with a plug-in device receptacle, disconnect the power supply by unscrewing the field connector.
7.2.1.2 If the “Airpack” has a junction box without a plug-in device connector, remove the junction box cover and, referring to Figure 7.1, disconnect the leads from the plant voltage source at the terminal strip.
7.2.1.2.1 Disconnect the electrical conduit leading to the junction box.

Figure 7.1 - Electrical Connections



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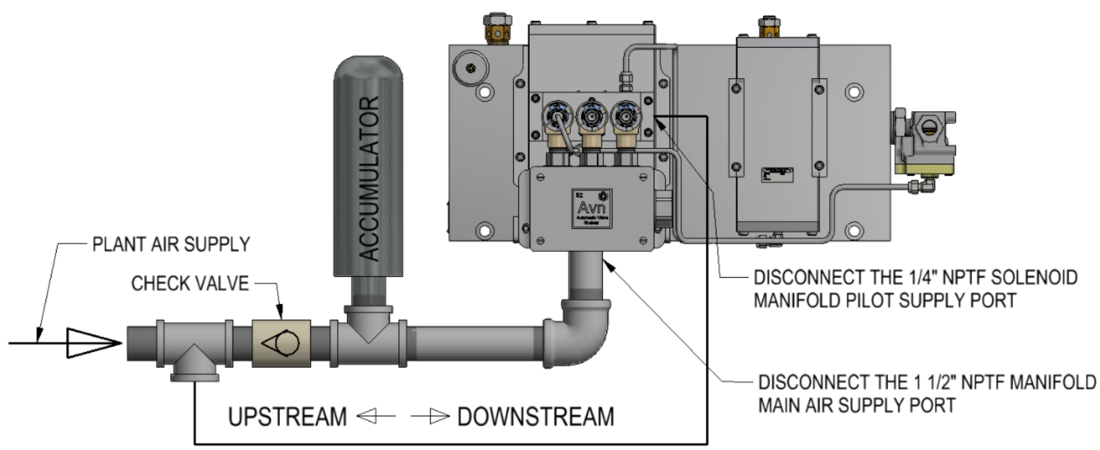
7.2.2. Refer to Figure 7.2 and disconnect both the 1 ½" NPTF air supply to the manifold block and the ¼" NPTF supply to the solenoid manifold pilot supply port.

Figure 7.2 – "Airpack" and Plumbing System



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7.2.3. After all air and electrical power have been disconnected, loosen the four (4) manifold to cylinder mounting screws and remove the "Airpack".

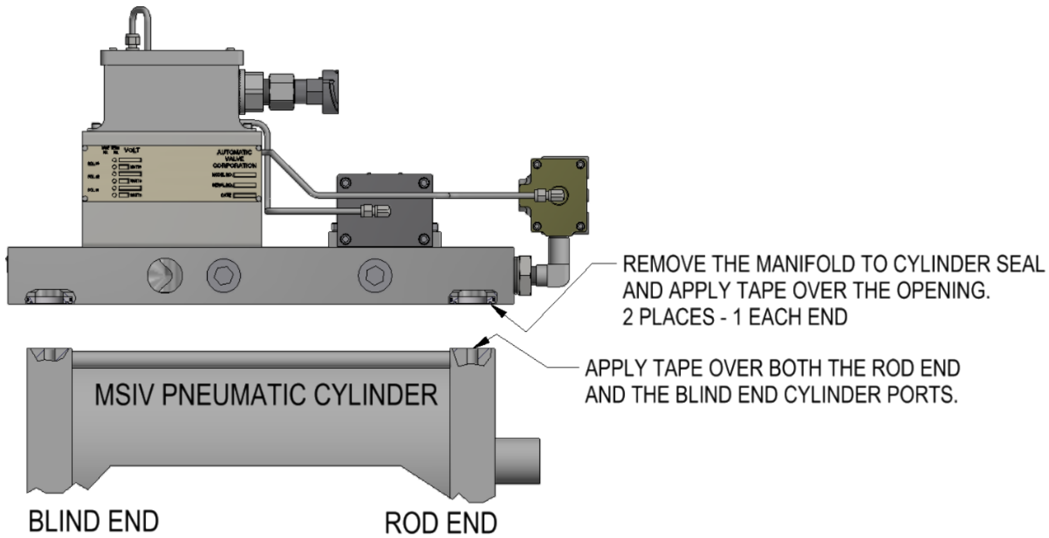
Caution: "Airpacks" weigh approximately 100 pounds. Use care when removing to avoid injury.

7.2.3.1 Save the mounting bolts for reuse. It is recommended that they be hand tightened into the cylinder mounting holes to prevent them from being misplaced.

7.3. After the “Airpack” has been removed, remove and discard the two (2) manifold to cylinder “O” rings.

7.3.1. Place protective tape over both the “Airpack” cylinder ports and the MSIV cylinder ports per Figure 7.3 to prevent the entry of contaminants while the “Airpack” is removed for service.

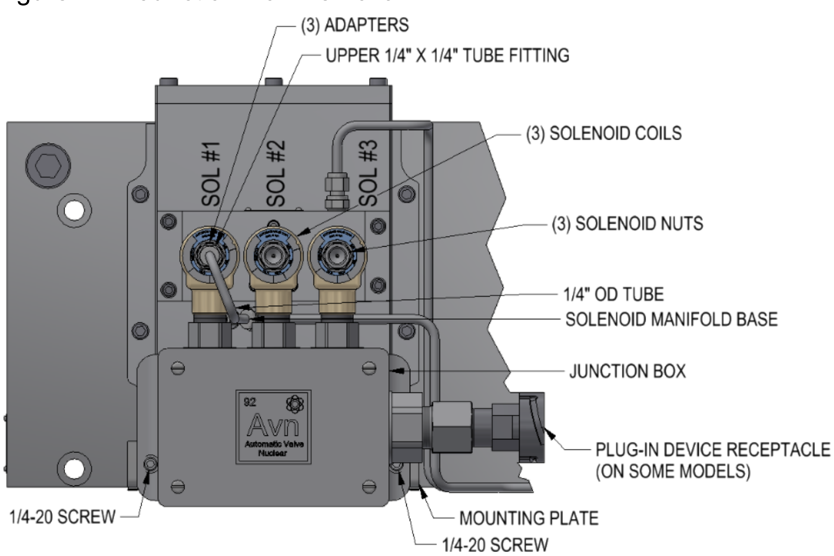
Figure 7.3 – Protective Tape Locations



7.4. Removing the junction box:

7.4.1. Remove the junction box per paragraphs below, the solenoid manifold assembly drawing, and Figure 7.4.

Figure 7.4 - Junction Box Removal



7.4.2. Loosen the upper tube fitting nut located at the top of solenoid #1 and the lower tube fitting nut located at the bottom of the solenoid manifold between the manifold and the junction box. The bottom fitting can be loosened using a 9/16” open end wrench.

7.4.3. Remove the tubing.

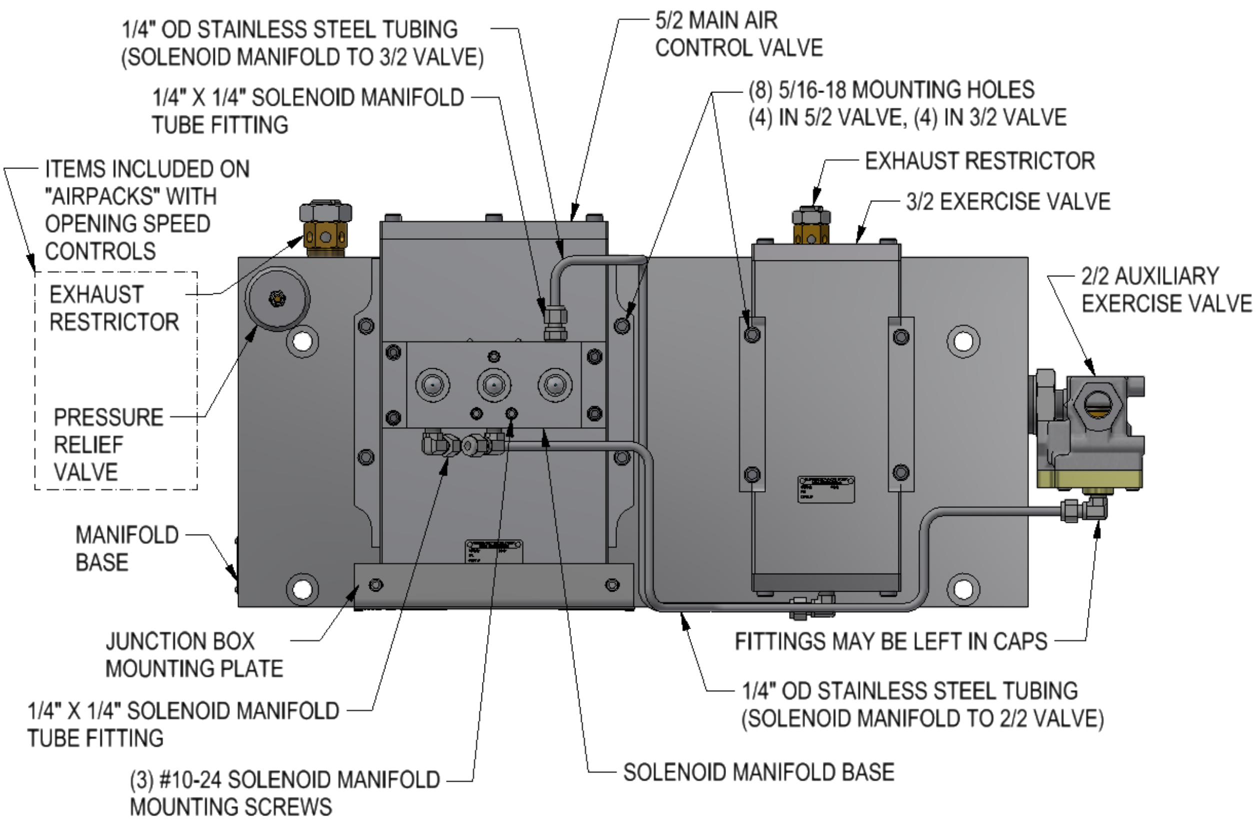
7.4.4. Remove the (2) solenoid nuts at solenoids #2 and #3 and the adapter with the tube fitting at solenoid #1.

7.4.5. Remove the two (2) ¼-20 screws attaching the junction box to the mounting plate.

7.4.6. Lift off and save the junction box assembly with the solenoid coils attached.

7.5. Remove the following items from the manifold per Figure 7.5 and the "Airpack" assembly drawing:

Figure 7.5 – "Airpack" manifold



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7.5.1. Loosen the nuts on the four (4) ¼" x ¼" tube fittings connecting the solenoid manifold to the 2/2 and 3/2 valves and remove the tubes.

7.5.1.1. The fittings may be left in both the solenoid manifold and the caps on the 2/2 and 3/2 valves.

7.5.2. Remove the three (3) #10-24 socket head cap screws mounting the solenoid manifold and remove the solenoid manifold.

7.5.3. Remove the four (4) 5/16-18 5/2 valve mounting screws and the four (4) 5/16-18 3/2 valve mounting screws and remove the 5/2 and 3/2 valves.

7.5.4. On "Airpacks" with opening speed controls, remove and discard the pressure relief valve.

7.5.5. **DO NOT** remove the 2/2 valve or the exhaust restrictor/s.

7.6. Consult factory for replacement components.

7.7. Clean and rebuild the "Airpack" manifold base.
Rebuild the manifold per the paragraphs below, Figure 7.6, and the "Airpack" assembly drawing. K

7.7.1 Thoroughly clean all grease, dirt, etc. from the manifold and the exhaust restrictor/s. Solvent, if used, must be compatible with fluorocarbon seals and aluminum.

7.7.1.1 If air is used to blow out the manifold, it must be oil free and filtered to a level of 50 microns or better.

7.7.1.2 Remove and replace the port insert and seals located on the bottom side at each end of the manifold.

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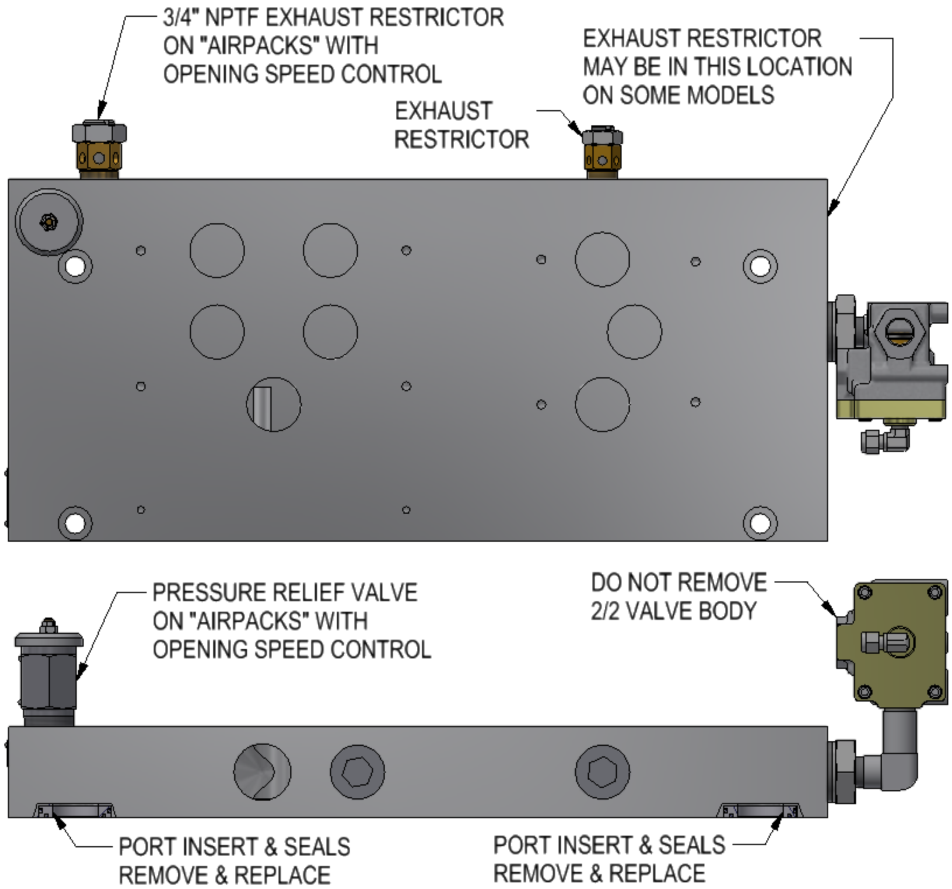
Figure 7.6 – “Airpack” Manifold



7.8. Reassemble the “Airpack”
- 7.8.1. 3/2 valve - mount the valve to the manifold.
- 7.8.2. 5/2 valve - mount the valve to the manifold.
- 7.8.3. Install the 3-station solenoid manifold, less the solenoid coils and junction box, on top of the four-way valve.
- 7.8.4. Refer to the “Airpack” assembly drawing and Figure 7.5 and install the following:
  - 7.8.4.1. The solenoid manifold to 3/2 valve tubing.
  - 7.8.4.2. The solenoid manifold to 2/2 valve tubing.
- 7.8.5. Install the junction box with the solenoid coils and conduit hubs on the solenoid manifold. K
  - 7.8.5.1. Refer to the solenoid manifold assembly drawing and install and tighten the three solenoid nuts at solenoids #1, #2, and #3.
  - 7.8.5.2. Refer to the solenoid manifold assembly drawing and install the tube fitting adapters at solenoids #1, #2, and #3.
  - 7.8.5.3. Install the tubing leading from the tube fitting at the top of solenoid #1 to the solenoid manifold and tighten the tube nuts.
  - 7.8.5.4. Refer to the “Airpack” assembly drawing and install the bracket.
  - 7.8.5.5. Tighten the two junction box to bracket mounting screws.
  - 7.8.5.6. Tighten the hub nuts on the three ½” NPT conduit hubs on the junction box assembly.

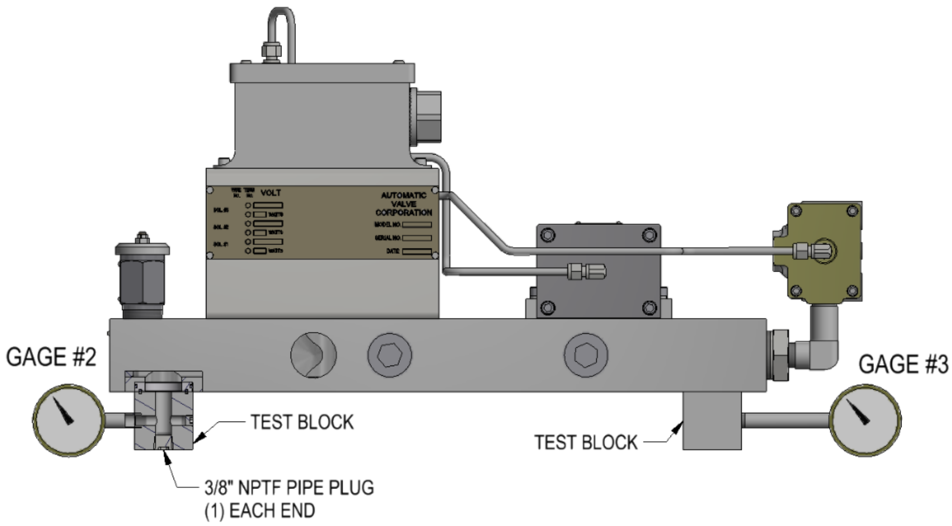
7.9. Bench test the “Airpack” per the “Testing” section of this document and the “Airpack” assembly drawing.

8. Testing:

Bench test the “Airpack” per the paragraphs below:

8.1. Bolt test blocks contained in the cylinder “Leak Test Kit” to the “Airpack” assembly per Figure 8.1.

Figure 8.1 – “Airpack” on Test Blocks



8.1.1 Refer to the “Troubleshooting” section for the “Leak Test Kit” number versus the “Airpack” model number.

8.1.2 Install pressure gages #2 and #3 in the gage ports and install pipe plugs in the 3/8” NPTF ports per paragraph 5.8.3 and the paragraphs below.

8.1.2.1. Clean the fittings in solvent, rinse, and dry immediately prior to use.

8.1.2.2. Start the fitting into a clean tapped hole two (2) to four (4) threads.

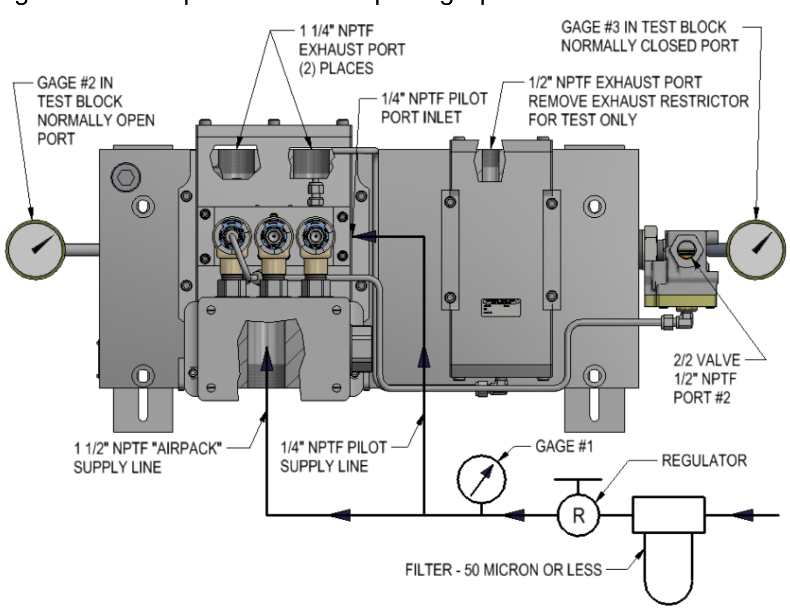
8.1.2.3. Apply thread sealing compound.

8.1.2.4. Tighten the fittings to affect a bubble tight seal.

8.2. Manifolds without opening speed control:

8.2.1 Refer to Figure 8.2 and remove the ½” NPTF exhaust restrictor. Do not change the setting on the exhaust restrictor adjusting screw.

Figure 8.2 – “Airpack” Without Opening Speed Control



8.2.2 Refer to Figure 8.2 and install test fittings per Figure 8.4 in the two (2) 1 ¼” NPTF exhaust ports, in the ½” NPTF port where the exhaust restrictor was removed, and in the ½” NPTF port ‘2’ of the 2/2 valve.

8.2.2.1 It is recommended that fittings with an ‘O’ ring seal, shown in Figure 8.4, be used to avoid the use of thread sealing compound which then must be cleaned from the ports at the conclusion of the test.

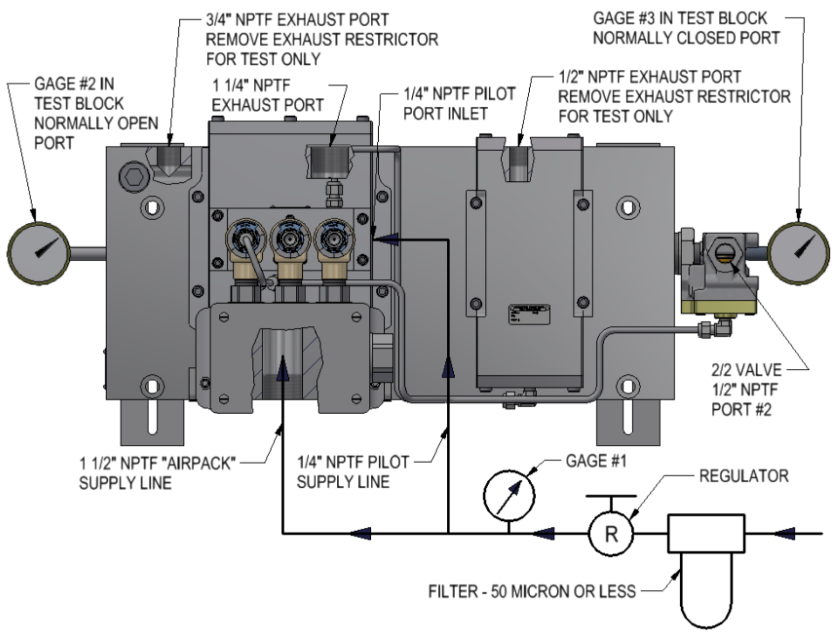
8.3. Manifolds with opening speed control:

8.3.1. Refer to Figure 8.3 and remove both the ½” NPTF and the ¾” NPTF exhaust restrictors and the 1” NPTF pressure relief valve. K

8.3.1.1. Do not change the setting on the exhaust restrictors adjusting screw.

8.3.1.2. Place a 1” NPTF pipe plug in the port used for the pressure relief valve.

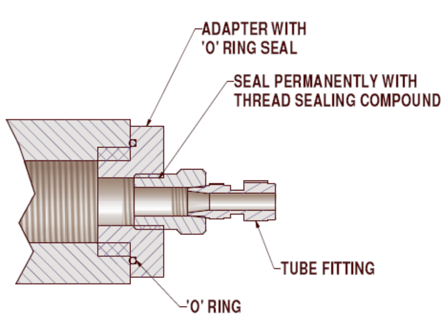
Figure 8.3 – “Airpack” with Opening Speed Control



8.3.2. Refer to Figure 8.3 and install tube fittings in the 1 ¼” NPTF exhaust port, in the ½” and ¾” NPTF ports where the exhaust restrictors were removed, and in port ‘2’ of the 2-way valve.

8.3.2.1. It is recommended that fittings with an ‘O’ ring seal, shown in Figure 8.4, be used to avoid the use of thread sealing compound which then must be cleaned from the ports at the conclusion of the test.

Figure 8.4 – Test Fitting



8.4. Connect air supply lines to the 1 ½" NPTF "Airpack" inlet port and to the ¼" NPTF solenoid pilot inlet port per Figure 8.2 for "Airpacks" without speed controls, per Figure 8.3 for "Airpacks" with speed controls, and the following paragraphs.

8.4.1. Inlet air must be oil free and filtered to a 50 micron level or less. Filters must be cleaned per the manufacturer's instructions.

8.4.2. Inlet lines do not require thread sealing compound. Leakage at the inlet ports is permissible during bench testing.

8.5. Set the Inlet pressure, Gage #1, to Max psig and functionally sequence the "Airpack" per Figure 8.5. Perform leak tests per paragraph 8.7.

8.5.1 For the proper solenoid voltages, refer to the "Airpack" assembly drawing and/or the solenoid manifold assembly drawing.

8.5.1.1 On "Airpacks" with junction boxes with plug-in device receptacles, use a compatible field connector.

Figure 8.5

Step Number	Gage #1 Status *	Solenoid #1 Status	Solenoid #2 Status	Solenoid #3 Status	Gage #2 Status	Gage #3 Status
1	Max/Min	De-energized	De-energized	De-energized	Max/Min	0/0
2	Max/Min	Energized	De-energized	De-energized	0/0	Max/Min
3	Max/Min	Energized	De-energized	Energized	0/0	0/0
4	Max/Min	De-energized	Energized	De-energized	0/0	Max/Min
5	Max/Min	De-energized	Energized	Energized	0/0	0/0
6	Max/Min	Energized	Energized	De-energized	0/0	Max/Min
7	Max/Min	Energized	Energized	Energized	0/0	0/0

Note: All tolerances for pressure readings are Max +5/-0 psig for Min -5/+0 psig.
* For Max/Min operating pressure refer to print.

8.5.2 Each step shall be held for a minimum of three (3) minutes.

8.6. Set the inlet pressure, gage #1, to Min. psig and functionally sequence the "Airpack" per Figure 8.5

8.6.1 Perform leak tests per paragraph 8.7.

8.6.2 Repeat 8.6. at Max psig.

8.7. Leak test procedure

8.7.1 During steps #1 through #7 of the Max psig test, test the following for leaks:

8.7.1.1 The 5/2 four-way valve to manifold base interface.

8.7.1.2 The solenoid manifold to 5/2 four-way valve interface.

8.7.1.3 The 3/2 three-way valve to manifold base interface.

8.7.1.4 All stainless steel tubing connections.

8.7.1.5 All piping connections.

8.7.1.6 All manifold base pipe plugs.

8.7.1.7 All valve component interfaces.

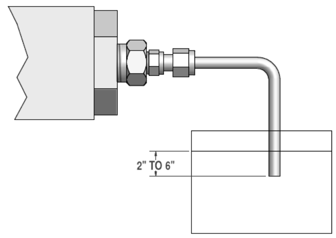
8.7.1.8 "Airpack" manifold base to exhaust port test fixture interfaces.

8.7.1.9 The 1" NPTF plug in the pressure relief valve port on "Airpacks" with opening speed controls.

8.7.2 During steps #1 through #7 of the Max and Min psig pressure tests, the manifold exhaust ports and the 2/2 two-way valve cylinder port #2 must be leak tested by one of the following methods.

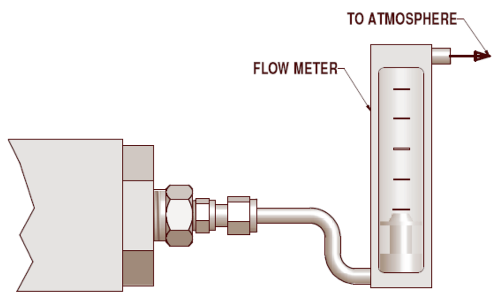
8.7.2.1 Connect a ¼" OD tube from the ports and submerge it two (2) to six (6) inches deep under water per Figure 8.6 noting all bubbles escaping.

Figure 8.6 – Leak Detection with Water



8.7.2.2 Connect a tube from the exhaust ports to a flow meter per Figure 8.7 and note any leakage that exceeds 0.01 SCFH.

Figure 8.7 – Leak Detection with Flow Meter



8.7.3 Reject “Airpacks” with bubbles escaping if tested per paragraph 8.7.2.1 or with leakage exceeding 0.01 SCFH if tested per paragraph 8.7.2.2.

8.8. Accessory Reinstallation and Testing:

“Airpacks” without opening speed controls:

8.8.1 Remove the test tubing and fittings from the ½” NPTF exhaust port and install the ½” NPTF exhaust restrictor per paragraphs 8.1.2.1 through 8.1.2.4 and Figures 7.6 and 8.2. K

“Airpacks” with opening speed controls:

8.8.2 Remove the test tubing and fittings from the ½” NPTF and ¾” NPTF exhaust ports and remove the 1” NPTF plug at the pressure relief valve port.

8.8.2.1 Refer to Figures 7.6 and 8.3 and install the two (2) exhaust restrictors and the 1” NPTF pressure relief valve per paragraphs 8.1.2.1 through 8.1.2.4.

“Airpacks” with and without opening speed controls:

8.8.3 Set the inlet pressure, gage #1, to 65 ± 5 PSIG and repeat steps #1 through #3 of the functional test per Figure 8.5 to ensure proper operation of the “Airpack” with the exhaust restrictor/s installed. There is no hold time requirement during this step and no leak tests need to be conducted

8.8.4 Repeat step 8.8.3 with inlet pressure set to lowest pressure specified on the “Airpack” assembly print. (+0,-5 psi tolerance on the setting)

8.8.5 Repeat step 8.8.4 with inlet pressure set to highest pressure specified on the “Airpack” assembly print. (-0,+5 psi tolerance on the setting)

8.8.6 Remove all remaining test fixtures, including the test blocks, the two (2) inlet lines, and the tubing and fittings at the 1 ¼” NPTF exhaust port.

8.9. Visual Inspection:

8.9.1 A final visual inspection is required noting the following:

8.9.1.1 Any chips, burrs, or foreign matter in any port opening. Remove any that are found.

8.9.1.2 Any deviations from the applicable assembly drawings to ensure proper location of all components. Correct any deviations that are found.

8.10. Wipe the entire "Airpack" clean.

8.11. Reinstall the "Airpack" by following the procedures given in the "Installation" section.

9. Troubleshooting:

9.1. **Precautions:** Compressed air is powerful and may be dangerous. Before attempting to remove a component from an air line or air line system, always disconnect the supply air and thoroughly exhaust the line or system. Never attempt to construct, operate, or service anything using compressed air unless you have been properly trained to do so**. Failure to heed this warning could result in serious, even fatal, personal injury**.

9.2. General Comments:
Of all the components in an electrical/mechanical/pneumatic system it is most often the control valve that will be faulted for system malfunction. In many cases, the valve is only the symptom of the problem. Leaking cylinder seals, poor electrical connectors, clogged air line filters, and broken or jammed mechanical components are just a few of the problems that can initially be blamed on a valve.

Before disassembling any system component, use the following troubleshooting guide to try to pinpoint the exact cause of the problem.

Problem	Possible Cause	Solution
Valve leaks to exhaust when not actuated	-Defective cylinder or valve seals	Paragraph 9.3
Valve leaks to exhaust when actuated	-Defective cylinder or valve seals -Inadequate air supply -Inadequate pilot supply -Contamination	Paragraph 9.3 Paragraph 9.4 Paragraph 9.5 Paragraphs 9.6 & 9.7
Solenoid pilot leakage	-Dirt on seats or seal wear	Paragraph 9.8
Solenoid buzzes or Solenoid burnout	-Incorrect voltage -Faulty or dirty solenoid	Paragraph 9.9 Paragraph 9.10
Solenoid valve fails to shift electrically	-Inadequate air supply -Inadequate pilot supply -Contamination -Incorrect voltage -Defective coil or wiring -Mechanical binding	Paragraph 9.4 Paragraph 9.5 Paragraphs 9.6 & 9.7 Paragraph 9.9 Paragraph 9.11 Paragraph 9.13
Valve shifts but fails to return	-Broken spring -Mechanical binding	Paragraph 9.12 Paragraph 9.13

9.3. Defective Cylinder or Valve Seals:

9.3.1. Verify if the leakage is caused by the cylinder or valve as follows: (**Use extreme caution as the MSIV cylinder will be actuated during this procedure.**)

9.3.2. The cylinder leak test kit contains the test blocks, valves, and gages required for the test. The customer is to supply mounting bolts, air hoses or tube fittings, and regulated and filtered air. Mounting bolts from the "Airpack" panel may be used to mount the test fixtures.

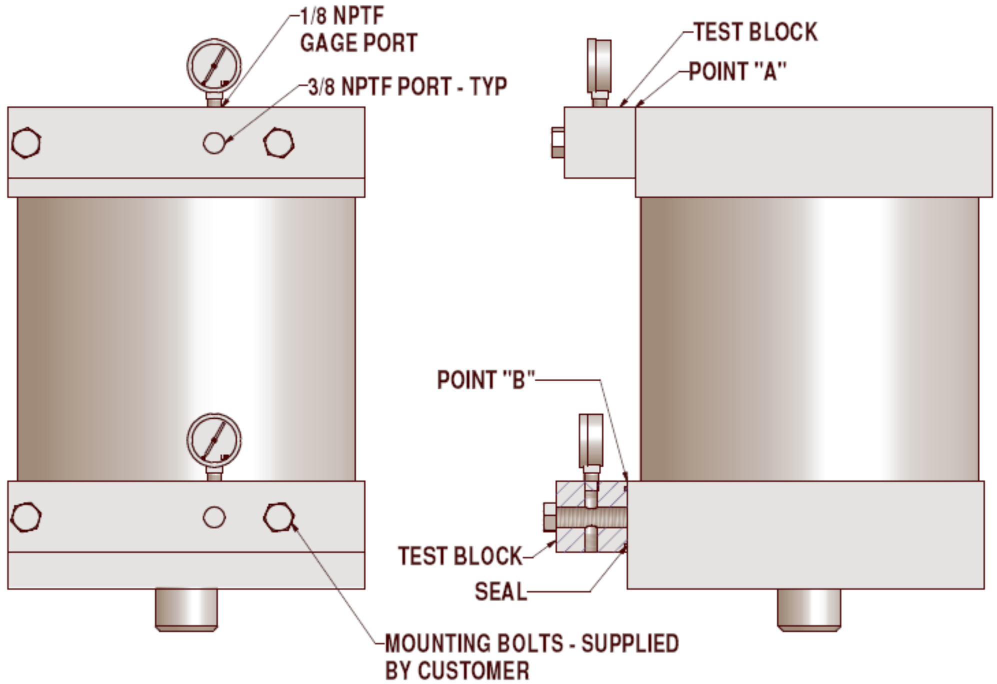
9.3.3. Use test kit B5458-002 for all "Airpacks" with a mounting bolt spread of 7.094".

9.3.4. Do not perform the cylinder leak test until the main steam line is completely flushed with clean water. The cylinder leak test shall be run not more than eight (8) hours after this cleaning. The air supply used for the test must be filtered to a 50 micron level or better.

9.3.5. While performing the cylinder leak test, eye and ear protection must be worn.

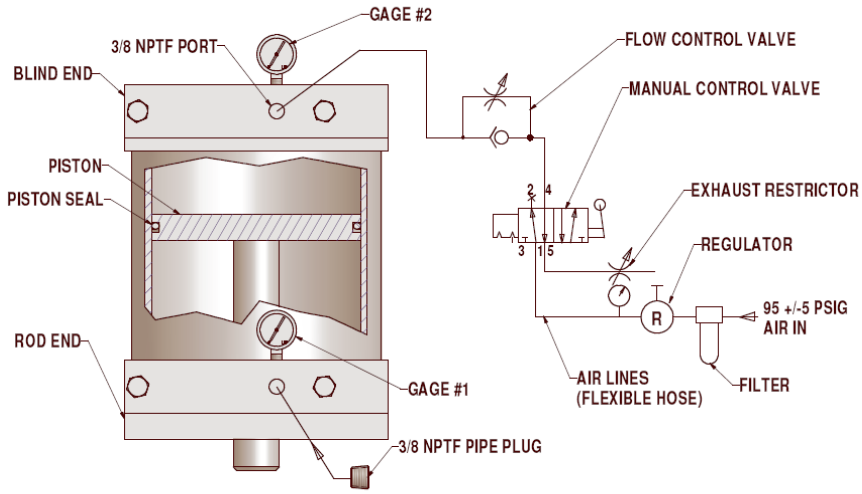
9.3.6. With the "Airpack" removed from the cylinder, refer to Figure 9.1 and attach the test blocks to the rod and blind end caps.

Figure 9.1 – Location of Test Blocks on MSIV Cylinder



9.3.7. With the MSIV cylinder in the normally extended position, connect air supply lines and valves to the blind end cap of the cylinder per the following and Figure 9.2.

Figure 9.2 – Rod End Leak Test



9.3.7.1. Attach an air line from port 4 of the manual control valve to the inlet port of the flow control valve and from the outlet port of the flow control valve to the blind end test block.

Note: Make sure that the “Free Flow” arrow on the flow control valve, indicating the direction of free flow, points toward port 4 of the manual control valve.

9.3.7.2. Attach the exhaust restrictor into port 5 of the manual control valve.
9.3.7.3. Attach gage #1 in the 1/8” NPTF gage port in the rod end test block and gage #2 in the 1/8” NPTF gage port in the blind end test block as follows and per Figure 9.2.
9.3.7.3.1. Start pipe threads into clean tapped two (2) to four (4) threads.
9.3.7.3.2. Apply thread sealing compound.
9.3.7.3.3. Tighten the gage to affect a bubble tight seal.
9.3.8. Ensure that the lever on the manual control valve is forward and attach a filtered and regulated air supply to port 1 of the control valve.
9.3.9. Set the inlet pressure to the manual control valve at 90 psig.

(Note: The blind end of the cylinder can be pressurized and exhausted without causing movement of the main steam valve.)

9.3.10. To avoid the main steam valve opening or closing at too fast a rate, the speed control valve and exhaust restrictor must be adjusted as follows:
9.3.10.1. Turn the flow control valve and the exhaust restrictor adjusting screws clockwise all the way in.
9.3.10.2. Turn the flow control valve adjusting screw counterclockwise four (4) turns.
9.3.10.3. Turn the exhaust restrictor adjusting screw counterclockwise two (2) turns.
9.3.10.4. Pull back the manual control valve hand lever to open the control valve and pressurize the top of the MSIV pneumatic cylinder.
9.3.10.5. Refer to the plant’s technical specifications for the minimum time to pressurize the top of the cylinder, gage #2, to 90 psig.
9.3.10.5.1. If the time is shorter, turn the flow control valve adjusting screw one half (1/2) turn clockwise.
9.3.10.5.2. If the time is longer than twenty (20) seconds, turn the flow control valve adjusting screw one half (1/2) turn counterclockwise.
9.3.10.6. Push the hand lever on the manual control forward to exhaust the top of the cylinder.

9.3.10.7. Refer to the plant's technical specifications for the minimum time to exhaust the top of the cylinder, gage #2 reading 0 psig.

9.3.10.7.1. If the time is shorter, turn the exhaust restrictor adjusting screw one half (1/2) turn clockwise.

9.3.10.7.2. If the time is longer than sixty (60) seconds, turn the exhaust restrictor adjusting screw one half (1/2) turn counterclockwise.

9.3.10.8. Repeat steps 9.3.10.4 through 9.3.10.7.2 until:

9.3.10.8.1. The time it takes to pressurize the top of the cylinder, gage #2 reading 90 psig, is between 9 and 20 seconds.

9.3.10.8.2. The time it takes to exhaust the top of the cylinder, gage #2 reading 0 psig, is between 45 and 60 seconds.

9.3.11. Open the manual control valve, lever back, and pressurize the blind end of the cylinder. Gage #2 reading 90 psig.

9.3.12. Wait at least one (1) minute to ensure that the cylinder is fully extended and that all air is exhausted from the rod end of the cylinder.

9.3.13. Install a 3/8" NPTF pipe plug in the open port in the rod end test block per Figure 9.2 and paragraphs 9.3.7.3.1 through 9.3.7.3.3.

9.3.14. Apply liquid leak detector, such as "Snoop", between the face of the rod end test block and the cylinder rod end cap, point 'B' in Figure 9.1, and at the threads of the pipe plug and gage #1 to ensure that there are no air leaks.

9.3.15. Maintain pressure at the blind end of the cylinder per paragraph 9.3.11 for a period of five (5) minutes. There should be no pressure buildup registered by gage #1. If gage #1 indicates a pressure buildup, the piston seals are defective and should be replaced.

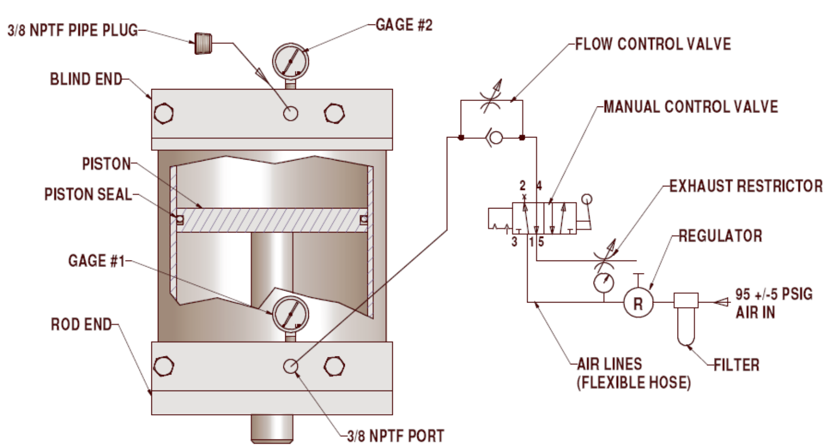
9.3.16. Close the manual control valve, lever forward, and allow the air in the blind end of the cylinder to exhaust to atmosphere.

9.3.17. When the blind end of the cylinder is completely exhausted, gage #2 reading 0 PSIG, remove the line from the flow control valve to the blind end test block and the 3/8" NPTF pipe plug from the rod end test block.

9.3.18. Install the line from the flow control valve to the 3/8" NPTF port in the rod end test block per Figure 9.3 and paragraphs 9.3.7.3.1 through 9.3.7.3.3.

9.3.18.1 **Do not** change the settings on the flow control valve or the exhaust restrictor.

Figure 9.3 – Blind End Leak Test



9.3.19. Open the manual control valve, lever back, and pressurize the rod end of the cylinder. Gage #1 reading 90 PSIG.

9.3.20. Wait at least one (1) minute to ensure that the cylinder is fully retracted and that all air is exhausted from the blind end.

9.3.21. Install a 3/8" NPTF pipe plug in the open port in the blind end test block per Figure 9.3 and paragraphs 9.3.7.3.1 through 9.3.7.3.3.

9.3.22. Apply liquid leak detector, such as “Snoop”, between the face of the blind end test block and the cylinder, point “A” in Figure 9.1 and at the threads of the pipe plug and gage #2 to ensure that there are no air leaks.

9.3.23. Maintain pressure at the rod end of the cylinder per paragraph 9.3.19 for a period of five (5) minutes. There should be no pressure buildup registered at gage #2. If gage #2 indicates a pressure buildup, the piston seals are defective and should be replaced.

9.3.24. Close the manual control valve, lever forward, and allow the air to exhaust to atmosphere.

9.3.25. When the rod end of the cylinder is completely exhausted, gage #1 reading 0 PSIG, remove the test blocks and all test equipment.

9.3.26. If there was no pressure buildup indicated during observations made per paragraphs 9.3.15 and 9.3.23, the integrity of the MSIV cylinder seals have been verified. If there is leakage at the valve exhaust port, the leakage is caused by defective valve seals. Install new seals according to instructions in the maintenance section.

9.4. Inadequate Air Supply:

9.4.1. An inadequate air supply can cause the pilot supply pressure to drop during valve actuation. This can result in valve chatter or oscillation or may keep the valve in a partially shifted condition where it continually blows to exhaust.

9.4.2. If the pressure gage falls by more than 10% during valve actuation, there is probably a deficiency in the air supply system. Air line filters should be cleaned and pressure regulators checked for proper operation.

The line sizing recommendations in the installation section of this manual should be reviewed and modifications made if restrictions or undersize inlet lines are found. Also, verify that the air compressor has sufficient capacity to meet all system requirements.

9.5. Inadequate Pilot Supply:

9.5.1. Remote air pilot signals or pilot supplies to externally piloted solenoid valves that are restricted or are below the minimum operating pressures given in the catalog or on “Airpack” or valve assembly drawings can cause valve oscillation or partial actuation resulting in exhaust port leakage.

9.5.2. Verify that the operating signal is at the proper pressure and that there are no restrictions caused by clogged filter elements or improperly sized pilot lines. The comments in paragraph 9.4 also apply to pilot supplies.

9.6. Liquid Contamination:

9.6.1. Accumulation of oil and water at low points in the system, including valves, can cause erratic or sluggish performance. If heavy concentrations of water and/or oil are found when a device is disassembled it should be thoroughly cleaned, re-lubricated, and reassembled.

9.6.2. Filters and lubricators should be cleaned and checked for proper operation. If necessary, air lines should be rerouted to eliminate low points.

9.6.3. If there are concentrations of moisture at below freezing temperatures, ice can form that can not only cause erratic operations, but can completely bind up system components. In such situations, steps must be taken to dry the air to a dew point of at least 10^0F below the minimum system operating temperature. Also, filters should be equipped with automatic drains.

9.7. Solid Contamination:

9.7.1. Solid contaminants such as broken pieces of pipe sealant or tape or rust scale can cause valve leakage, seal damage, scratches on metal spools and sealing surfaces, or system binding.

9.7.2. Such problems are most often encountered in new installations that have not been properly purged or where there are heavy concentrations of atmospheric contaminants. In many cases, cycling the valve several times will flush the particles away. If not, the item must be disassembled, the parts thoroughly examined for signs of damage and replaced when necessary.

9.7.3. Before reinstalling the product, the air line should be purged as stated in the installation section of this manual. Air line filters should be cleaned and checked for proper operation. If used, properly sized mufflers should be installed in exhaust ports.

9.8. Dirt on Seats or Seal Wear:

9.8.1. Continuous leakage from the operator exhaust port when the solenoid is de-energized can be caused by a foreign particle trapped between the bottom seat and plunger, by a damaged bottom seat, or by a worn or damaged bottom plunger seal.

9.8.2. Leakage at the exhaust port and/or solenoid buzzing when the solenoid is energized can result from a foreign particle lodged in the top seat area. Leakage in this area can also be caused by worn or damaged top seats or top plunger seals.

9.8.3. The solenoid should be disassembled, cleaned, and the parts examined for wear or damage. If damaged plunger seals or damaged top seats are found, the solenoid should be replaced. If bottom damaged seats are found, the solenoid manifold needs to be replaced.

9.8.4. Before installing any replacement parts, follow the recommendations in paragraph 9.7 regarding solid contaminants.

9.9. Incorrect Voltage:

9.9.1. Automatic Valve Corp. solenoids are designed to operate at between 90% and 110% of the rated voltage shown on the solenoid coil. A supply voltage that does not fall within the range shown can cause solenoid buzzing, failure of the valve to shift, or coil burnout.

9.9.2. To verify proper voltage, shut off and exhaust the air supply to the “Airpack”. Attach a voltmeter to the solenoid’s electrical supply, energize the solenoid, and note the voltage reading. If the reading is either too high or too low the electrical supply must be corrected.

9.10. Faulty or Dirty solenoid:

9.10.1. Improper voltage, broken or damaged shading rings, or dirt on the plunger or around the top seat can cause solenoid buzzing or even coil burnout.

9.10.2. Correct voltage should first be verified per paragraph 9.9.2. If the voltage is correct, the air and electrical supplies should be shut OFF and the pilot section disassembled for inspection.

9.10.2.1. If the copper shading ring around the top seat is damaged the solenoid should be replaced.

9.10.2.2. If dirt is found in the plunger guide and/or on the plunger or spring, they should be thoroughly cleaned and inspected for damage. If damaged, the solenoid should be replaced prior to reassembling.

9.11. Defective Coil or Wiring:

9.11.1. Verify the integrity of the coil by shutting electrical power off and use an ohmmeter to check continuity. If the coil is open, it is burned out and must be replaced.

9.11.2. Because coils used by Automatic Valve Corp. seldom burn out when operated within listed voltage limits, verify that the operating voltage is correct per paragraph 9.9.2. Also, verify that there is no dirt in the plunger guide or on the plunger per paragraph 9.10.

9.11.3. If there is coil continuity, the electrical system should be checked for loose or broken connections and for worn or defective switches and contacts. Also, check for worn or loose cams if cam operated switches are part of the electrical system.

9.12. Broken Spring:

9.12.1. Broken springs in spring return valves can cause a valve to remain in the actuated position or to only partially return and perhaps leak to exhaust.

9.12.2. Broken springs must be replaced. Contact the factory for replacement options. K

9.13. Mechanical Binding:

9.13.1. Mechanical binding of cylinders or other mechanical components can cause symptoms that can be improperly diagnosed as sluggish valve operation or even failure of a valve to shift.

9.13.2. If a valve appears stuck, note the flow from the valve exhaust ports as the valve is actuated or de-actuated. If there is a puff of air from each exhaust port yet the device fails to move, the probable cause is mechanical binding.

9.13.3. Turn air and electrical power **OFF**. Follow all safety precautions recommended by the manufacturer of the equipment and make mechanical inspections and adjustments as required.