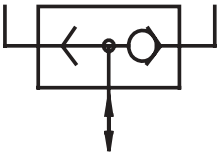
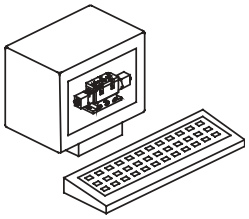
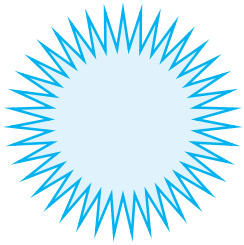
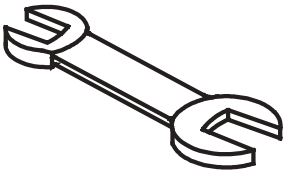
ISO 9001 AUTOMATIC VALVE



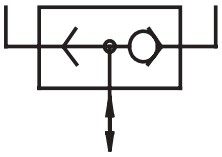


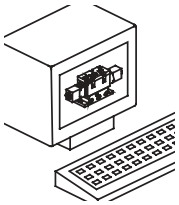


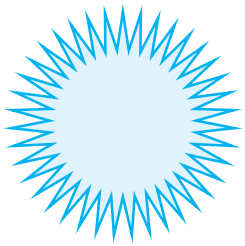


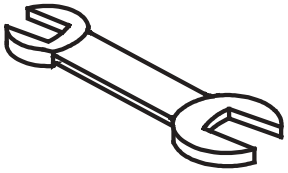
$$Cv = \frac{Q}{22.67} \times \sqrt{\frac{2 \times G \times T}{(P_1^2 - P_2^2)}}$$

PRECAUTIONS, ENGINEERING AND MAINTENANCE









$$Cv = \frac{Q}{22.67} \times \sqrt{\frac{2 \times G \times T}{(P_1^2 - P_2^2)}}$$

INDEX

SYMBOLS

VALVES

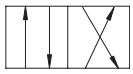
2/2 TWO WAY VALVES

NORMALLY CLOSED NORMALLY OPEN

3/2 THREE WAY VALVES

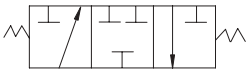
NORMALLY CLOSED NORMALLY OPEN

4/2 FOUR WAY VALVES - 4 PORTS

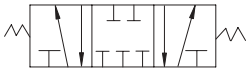


5/2 FOUR WAY VALVES - 5 PORTS

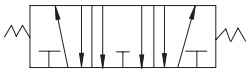
3/3 THREE WAY VALVES - 3 POSITIONS



5/3 FOUR WAY VALVES - 3 POSITIONS



CLOSED CENTER



EXHAUST CENTER - INLET BLOCKED

PRESSURE CENTER - EXHAUST BLOCKED

VALVE OPERATORS

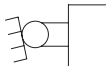
SPRING

MANUAL

PUSH BUTTON

LEVER

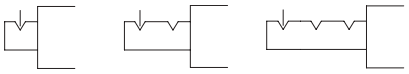
PEDAL OR TREADLE



MECHANICAL

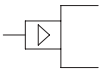
VALVE OPERATORS

DETENTS



(1) POSITION (2) POSITION (3) POSITION

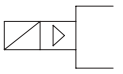
SOLENOID



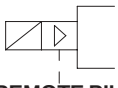
PILOT PRESSURE REMOTE SUPPLY

PILOT PRESSURE INTERNAL SUPPLY

SOLENOID AND PILOT



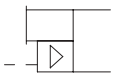
INTERNAL PILOT



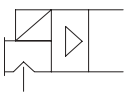
REMOTE PILOT

COMPOSITE VALVE OPERATORS

BASIC - ONE OPERATOR OPERATES VALVE

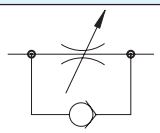


EITHER SIGNAL OPERATES VALVE



SOLENOID AND PILOT OR MANUAL OVERRIDE AND PILOT OPERATE VALVE

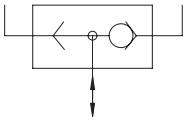
ACCESSORIES



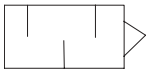
FLOW CONTROL VALVE ADJUSTABLE

CHECK VALVE

EXHAUST RESTRICTOR

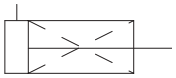


SHUTTLE VALVE



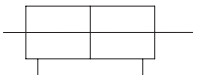
MUFFLER

CYLINDERS



SINGLE ACTING

DOUBLE ACTING



DOUBLE ROD END

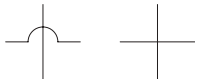
CONDUCTOR

WORKING LINE

PILOT LINE

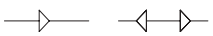
EXHAUST LINE

MISCELLANEOUS

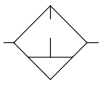


LINES CROSSING

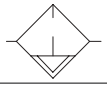
LINES JOINING



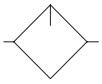
DIRECTION OF AIR FLOW



FILTER SEPARATOR MANUAL DRAIN



FILTER SEPARATOR AUTOMATIC DRAIN



LUBRICATOR

AIRLINE PRESSURE REG. ADJUSTABLE, RELIEVING

FILTER, REGULATOR AND LUBRICATOR

PRESSURE GAGE

FIXED DISPLACEMENT COMPRESSOR

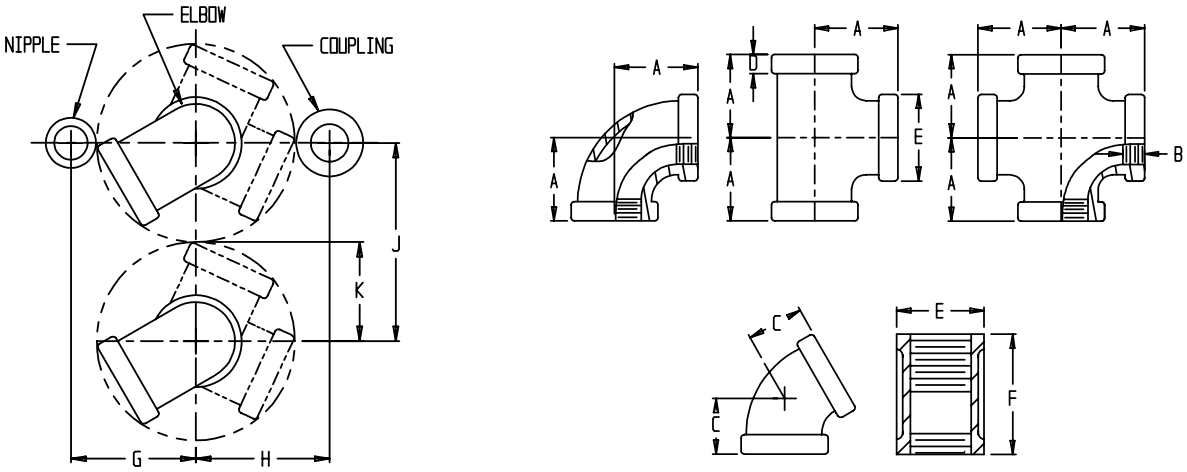
VARIABLE DISPLACE-MENT COMPRESSOR

PRESSURE SWITCH

PIPE AND FITTINGS

DIMENSIONS

DIMENSIONS & CENTERLINE DISTANCE OF AMERICAL STANDARD 150 LB. STANDARD MALLEABLE IRON SCREW FITTINGS										
PIPE SIZE	A	B (min)	C	D (min)	E	F	G	H	J	K
1/8	0.69	0.25	-	0.200	0.693	0.96	0.99	1.13	1.56	0.78
1/4	0.81	0.32	0.73	0.215	0.844	1.06	1.19	1.35	1.84	0.92
3/8	0.95	0.36	0.80	0.230	1.015	1.16	1.42	1.59	2.16	1.08
1/2	1.12	0.43	0.88	0.249	1.197	1.34	1.70	1.88	2.56	1.28
3/4	1.31	0.50	0.98	0.273	1.458	1.52	2.03	2.23	3.00	1.50
1	1.50	0.58	1.12	0.302	1.771	1.67	2.41	2.64	3.50	1.75
1 1/4	1.75	0.67	1.29	0.341	2.153	1.93	2.89	3.14	4.12	2.06
1 1/2	1.94	0.70	1.43	0.368	2.427	2.15	3.24	3.51	4.58	2.29
2	2.25	0.75	1.68	0.422	2.963	2.53	3.89	4.19	5.40	2.70



PIPE DATA - AMERICAN STANDARD TAPER PIPE THREAD - N.P.T. SCHEDULE 40								
NOMINAL SIZE	THREAD PER INCH	TAP DRILL SIZE	PIPE O.D.	PIPE I.D.	INTERNAL AREA SQ. IN.	THREAD ENGAGEMENT		NOMINAL SIZE
						HAND TIGHT	TIGHT	
1/8	27	11/32	.405	.269	.057	.16	.25	1/8
1/4	18	7/16	.540	.364	.104	.23	.38	1/4
3/8	18	37/64	.675	.493	.191	.24	.38	3/8
1/2	14	23/32	.840	.622	.304	.32	.50	1/2
3/4	14	59/64	1.050	.824	.533	.34	.56	3/4
1	11 1/2	1 5/32	1.315	1.049	.864	.40	.69	1
1 1/4	11 1/2	1 1/2	1.660	1.380	1.495	.42	.69	1 1/4
1 1/2	11 1/2	1 47/64	1.990	1.610	2.036	.42	.69	1 1/2
2	11 1/2	2 7/32	2.375	2.067	3.356	.44	.75	2

DESIGN

PRECAUTIONS

Automatic Valve products are general purpose industrial pneumatic and vacuum devices. They are not themselves inherently harmful. However, the control systems in which they operate must have necessary safeguards to prevent injury or damage should failure of system components occur.

Use Automatic Valve products only with the operating specifications stated for the product in each catalog section.

Read and be familiar with the precautions listed under the 'Design", "Installation", "Maintenance" and "Troubleshooting" portions of this section of the catalog. Provide adequate warnings and information on system components and in system operating manuals.

Power Presses: Do not use Automatic Valve for power presses. Automatic Valve does not manufacture the special purpose dual safety clutch and brake valves required by OSHA Regulation 1910.217, dated November 1, 1975, and ANSI Standard B11.1, Revision 1982, and EN 13736: 1999.

Two Position Valves: Two position 2 and 3-way valves will have a flow path from the valve's inlet port to one of the valve's outlet ports in either one or both of the two positions. 4-way valves will always have a flow path from the inlet to one of the outlet ports regardless of its position. If retaining pressurized air in the system presents a hazard during system operation or servicing, a separate method must be used to exhaust the trapped air.

Three Position Valves: Solenoid operated and air piloted three position 3-way and 4-way valves will move to the center position if one of the operators is not actuated. Manually operated three position valves may or may not return to the center position, depending on the centering operator. When one of the operators is actuated, a flow path will exist as it does in two position valves. When the valve is in the center position, the flow path described below exists.

Closed Center: All ports, including inlet and exhaust posts, are blocked when the valve is in the center position. If trapping air in either or both of the valve outlet cylinder ports presents a hazard during system operation or servicing, a separate method must be used to exhaust the trapped air or the valve should not be used.

Caution: *Valves with closed centers should be used with discretion because there is no makeup air. Any leaks in the valve, cylinder, or system lines and fittings can cause drifting (movement) of the cylinder.*

Open Center: When the valve is in the center position, the inlet port is closed and the cylinder ports are open to exhaust ports. If this condition is hazardous in either operation or during servicing, the valve should not be used.

Solenoid Manual Overrides: Some Automatic Valve air piloted and solenoid operated valves incorporate manual overrides which, when actuated, shift the valve as if the solenoid or air pilot were actuated. If accidental or intentional operation of the manual override could cause a dangerous problem, the valve should be ordered without a manual override.

DESIGN

VALVE SIZING CALCULATIONS

Find the appropriate valve size for an application by calculating the required C_v (flow coefficient) as shown below and then choose a valve with a Cv equal to or greater than the calculated valve. The equation is:

$$Cv = \frac{Q}{22.67} \times \sqrt{\frac{2 \times G \times T}{(P_1^2 - P_2^2)}}$$

Where:
- **Q** = Standard cubic feet of free air (scfm)
- **G** = Gas constant
  - = 1.00 for air
- **T** = Absolute temperature
  - = Number of F^0 + 460
- P_1 = Valve inlet pressure
  - = psia (pounds per square inch absolute)
  - = psig (pounds per square inch gage) + 14.7
- P_2 = Valve outlet pressure
  - = psia (pounds per square inch absolute)
  - = psig (pounds per square inch gage) + 14.7

Step 1: Determine the cylinder operating speed, **S** in ft/min. The equation is:

$$S = \frac{(60 \times L)}{12 \times t} \quad \text{or} \quad \frac{(5 \times L)}{t}$$

Where:
- **L** = Length of cylinder stroke in inches
- **t** = Time to extend or retract in seconds

Step 2: Determine the volume of free air, **Q**. The equation is:

$$Q = \frac{(\pi \times D^2)}{576} \times S \times \frac{P_1}{14.7}$$

Where:
- π = 3.14
- **D** = Cylinder diameter in inches
- **S** = Cylinder operating speed
- P_1 = Valve inlet pressure, psia

Step 3: Apply Step 1 and 2 results to the Cv formula.

Example: A 2" bore x 2" stroke cylinder is to extend in .500 seconds at 80 psig inlet pressure with a 10 psi drop through the valve (70 psig outlet pressure). Assume an operating temperature of 70°F.

Step 1:

$$S = \frac{(5 \times L)}{t}$$

$$= \frac{(5 \times 2)}{.500}$$

$$= 20 \text{ ft/min}$$

Step 2:

$$Q = \frac{(\pi \times D^2)}{576} \times S \times \frac{P_1}{14.7}$$

$$= \frac{(3.14 \times 2^2)}{576} \times 20 \times \frac{(80 + 14.7)}{14.7}$$

$$= 2.8 \text{ scfm}$$

Step 3:

$$Cv = \frac{Q}{22.67} \times \sqrt{\frac{2 \times G \times T}{(P_1^2 - P_2^2)}}$$

$$= \frac{2.8}{22.67} \times \sqrt{\frac{2 \times 1 \times (70 + 460)}{(80 + 14.7)^2 - (70 + 14.7)^2}}$$

$$= \mathbf{.094}$$

DESIGN

VALVE SIZING CHART

The chart below may be used instead of mathematical calculations for close approximations or required valve Cv. The Valve Sizing Chart assumes the following:

- Valve inlet pressure is 80 psig.
- Pressure drop through the valve is 10% inlet pressure or 8 psi.
- There are no line restrictions between the valve and cylinder.
- Distance between the valve and cylinder is 6 feet or less.

Step 1: Calculate the required cylinder speed in inches per second: $S = \frac{L}{t}$

Where: **S** = Cylinder speed in inches/second
L = Length of cylinder stroke in inches
t = Time to extend or retract in seconds

Step 2: Choose the applicable cylinder bore size column.

Step 3: Move vertically down the column to select a speed (inches per second) equal to or greater than the calculated speed and read the required Cv in the left hand column.

	CYLINDER BORE SIZE (inches)															
Cv		.75	1.00	1.13	1.50	2.00	2.50	3.00	3.25	4.00	5.00	6.00	7.00	8.00	10.00	12.00
	.1	26.8	15.1	11.9	6.7	3.8	2.4	1.7	1.4	.94	.60	.42	.31	.24	.15	.10
	.2	53.7	30.2	23.9	13.4	7.5	4.8	3.4	2.9	1.9	1.2	.84	.62	.47	.30	.21
	.5	134	75.5	59.6	33.6	18.9	12.1	8.4	7.1	4.7	3.0	2.1	1.5	1.2	.75	.52
	1.0	268	151	119	67.1	37.7	24.2	16.8	14.3	9.4	6.0	4.2	3.1	2.4	1.5	1.0
	2.0	537	302	239	134	75.5	48.3	33.6	28.6	18.9	12.1	8.4	6.2	4.7	3.0	2.1
	4.0	-	604	477	268	151	96.6	67.1	57.2	37.7	24.2	16.8	12.3	9.4	6.0	4.2
	8.0	-	-	-	536	302	193	134	114	75.5	48.3	33.6	24.7	18.9	12.1	8.4
	16.0	-	-	-	-	604	387	268	229	151	96.6	67.1	49.3	37.7	24.2	16.8
	32.0	-	-	-	-	-	773	537	457	302	193	134	98.6	75.5	48.3	33.6

VALVE CONVERSION CHART

FOR
Single operator spring return valves with balanced spools

PORTS:
1 = SUPPLY = P
2 = OUTLET =A
3 = EXHAUST = EA
4 = OUTLET = B
5 = EXHAUST = EB

OPERATION	PLUG	SUPPLY*	OUTLET	EXHAUST
2 WAY NORMALLY CLOSED	2,3,5	1	4	-
2 WAY NORMALLY OPEN	4,3,5	1	2	-
3 WAY NORMALLY CLOSED	2,3	1	4	5
3 WAY NORMALLY OPEN	4,5	1	2	3
3 WAY DIVERTER	3,5	1	2,4	-
3 WAY SELECTOR	3,5	2,4	1	-
4 WAY		1	2,4	3,5

*Minimum operating pressure is 35 psi. Use external pilot when using a port other than 1 for supply or when using a fluid media besides air.

DESIGN

FLOW CHARACTERISTICS

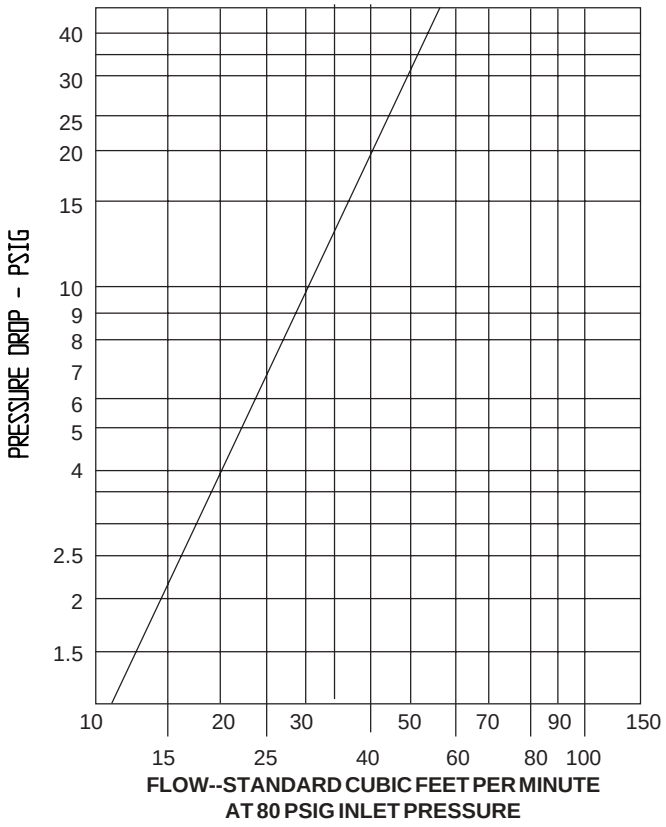
The chart at the right shows the flow (scfm) characteristics for a valve with a Cv of 1.0. Because there is a linear relationship between Cv and flow, a valve with a Cv of 3.0 will have three times the flow at the same pressure drop as does a valve with a Cv of 1.0. This linear relationship many be used to find the required Cv for any flow rate and pressure drop.

Example: Required - Flow of 200 scfm at 80 psig inlet with a 4 psi pressure drop.

Step 1: From the chart at right, a valve with a Cv of 1.0 and a pressure drop of 4 psi, has a flow of 20 scfm.

Step 2: Divide the required flow, 200 scfm, by 20 scfm to determine the required Cv:

$$\frac{200 \text{ scfm}}{20 \text{ scfm}} = \mathbf{10\ Cv}$$



The "SCFM to Cv Approximation" chart at the right is another method for determining Cv. This chart assumes conditions of 70°F with a 10% pressure drop. "Q" is the standard cubic feet of free air (scfm).

Example: Required - Flow of 200 scfm at 80 psig inlet with a 10% pressure drop and 70°F.

Step 1: From the chart at right, the formula for 80 inlet psig is:

Cv = .0376 x Q

Where: Q = 200 scfm

Step 2: **Cv = .0376 x 200 = 7.52**

An approximation of the Cv with a required flow of 200 scfm at 80 psig inlet with a 10% pressure drop could be obtained from the graph above by determining the numerical value of the 10% pressure drop (80 psig x .10) = 8 psig. This 8 psig pressure drop has a flow of about 26.5 scfm. 200 scfm divided by 26.5 = **7.47 Cv**.

SCFM TO C_v APPROXIMATION @ 70° WITH A 10% PRESSURE DROP	
INLET PRESSURE	**Cv**
30 psig	.089 x Q
40 psig	.070 x Q
50 psig	.0575 x Q
60 psig	.0489 x Q
70 psig	.0425 x Q
80 psig	.0376 x Q
90 psig	.0338 x Q
100 psig	.0306 x Q
110 psig	.0280 x Q
120 psig	.0258 x Q

INSTALLATION

PRECAUTIONS

Automatic Valve products should only be installed by trained and qualified personnel who have knowledge of how specific pneumatic products are to be piped and electrically connected.

Install Automatic Valve products only in systems which contain adequate safeguards to prevent injury or damage in the event of product failure.

Insure that the system has provisions for turning air and electrical power off and for exhausting all air trapped within the system.

OPERATING MEDIA

Automatic Valve products are designed primarily for use with air or other inert gases. For use with other media, contact your Automatic Valve distributor.

When solenoid piloted valves are used for vacuum service, an external pilot supply must be used.

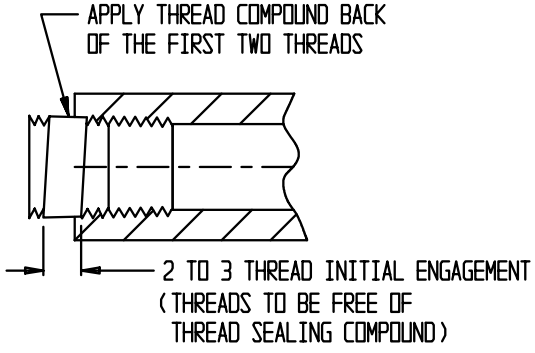
AIR LINES

Before installing any pneumatic product, air lines must be blown clean to remove all contamination. Clean air line filters after purging is completed.

Caution: *Compressed air streams are dangerous. Divert the stream away from personnel and equipment. Personnel in the area must wear suitable eye and ear protection.*

PIPE AND FITTING PREPARATION

Pipe sealant or tape should be applied behind the first two or three threads to prevent the sealant from entering and contaminating the system.



MOUNTING

Spool valves must be mounted with the spool in a horizontal position. Other valves, cylinders, and accessories maybe mounted in any position.

Where practical, mount valves so that they are accessible for service and so that solenoid manual overrides can be used.

INSTALLATION

VALVE INLET LINES

Valve inlet lines should have an inside diameter equal to or greater than the valves' inlet port size as shown in the following chart:

INLET TAP SIZE	SUPPLY ID (MIN.)
1/8 NPT	.25"
1/4 NPT	.38"
3/8 NPT	.50"
1/2 NPT	.63"

INLET TAP SIZE	SUPPLY ID (MIN.)
3/4 NPT	.75"
1 NPT	1.00"
1 1/4 NPT	1.25"
1 1/2 NPT	1.50"

Restricted inlet lines will reduce the system operating speed and can cause valve malfunction. Eliminate or minimize sharp bends and install regulators as close as possible to the valve inlet port.

VALVE OUTLET LINES

For optimum system performance, locate valves as close as possible to the device they are operating. Minimize all sharp bends and other restrictions.

VALVE EXHAUST PORTS

Spool valve exhaust ports may be restricted to provide speed control for cylinders or other devices.

Poppet valve exhaust ports must not be restricted. Such restriction can cause valve malfunction.

All open valve exhaust ports should have mufflers installed to reduce noise levels and to prevent the entry of atmospheric contaminations.

FILTRATION

Filters with 50 micron elements are adequate for all Automatic Valve products. However, where devices not made by Automatic Valve are used in the system, the manufacturer should be consulted regarding their filtration requirements.

Install filters within 20 feet of the valve or per the manufacturer's instructions.

OPERATING PRESSURES AND TEMPERATURES

Minimum and maximum operating pressures and temperatures for Automatic Valve products are specified in each catalog section. While products may function at lower or higher limits, such operation is unsafe and must be avoided.

Contact your Automatic Valve distributor if your application requires products that exceed the operating limits shown in this catalog.

PILOT PRESSURE

For proper operation, pilot pressure must be within the minimum and maximum operating pressures shown in each catalog section.

If solenoid piloted valves are to operate at lower or higher operating pressures than the specified pilot pressure limits, an external pilot supply within the proper pressure range must be used. Valves may either be ordered with an external pilot supply, option "B", or may be field converted as shown in each catalog section.

INSTALLATION

LUBRICATION

Lubrication of Automatic Valve products is not required but is recommended to maximize service life. Where devices not made by Automatic Valve are used in the system, the manufacturer should be consulted regarding their lubrication requirements.

Lubricators should be installed downstream of regulators, per the manufacturer's instructions.

Oils used in air line lubricators should be compatible with seals used in the system. Generally, Automatic Valve products use Buna "N" seals. Fluoroelastomer seals are available as option "A". Oils should be parafinic, petroleum based with oxidation inhibitors, an ISO 32 or lighter viscosity, and an aniline point between 82°C (180°F) and 99°C (210°F).

In general, lubricators should not be synthetic or reconstituted, and should not have alcohol content or detergent additives.

MAINTENANCE

PRECAUTIONS

Automatic Valve products should be serviced only by qualified and knowledgeable personnel who understand the function and operation of the product.

Before servicing any pneumatic system, verify that the air and electrical power are **off** and that all air within the system has been exhausted.

Take all necessary precautions to prevent degradation of products caused by stepping on them, dropping them or hitting them with a hammer or other object.

Return products damaged as a result of improper handling to Automatic Valve for inspection.

PREVENTATIVE MAINTENANCE

Install all pneumatic systems as described in the “Installation” portion of this catalog. Improper installation can cause sluggish system performance and, if contaminates are not purged, premature wear of components.

Drain, clean, and service air line filters on a periodic basis or as recommended by the manufacturer.

Adjust air line lubricators per the manufacturer’s recommendations (generally, one drop per minute) and fill the reservoir at scheduled intervals. When filling the reservoir, use lubricating oils as prescribed under “Installation”.

To avoid possible solenoid malfunction, keep all electrical switches and relay contacts in good condition.

Inspect mechanical actuators, such as cams and rollers, for signs of wear and replace when necessary.

Automatic Valve products are designed to operate in normal air system environments with a minimum of maintenance. In extreme conditions, as evidenced by sluggish performance or sticking problems, a periodic program for cleaning internal product components should be established.

To clean products, use a water soluble detergent. To avoid component damage, do not use abrasive compounds or scrape metal parts.

SERVICING

When servicing Automatic Valve products, use only those components furnished in Automatic Valve service kits. Items contained in these kits are designated in the service portion of each catalog section or on the drawing.

After a product has been disassembled, discard all items designated as service kit items.

Clean remaining metallic components, except for solenoid coils and housings, with a non-abrasive, water soluble detergent.

When reassembling the product, refer to the appropriate service section or the drawing and lightly lubricate items, designated to be lubricated, to the drawing instructions.

Test the product according to the drawing instructions.

TROUBLESHOOTING

PRECAUTIONS

Read and follow the precautions listed in the “Maintenance” section of this catalog. Stay clear of all moving parts that must be actuated when troubleshooting.

GENERAL COMMENTS

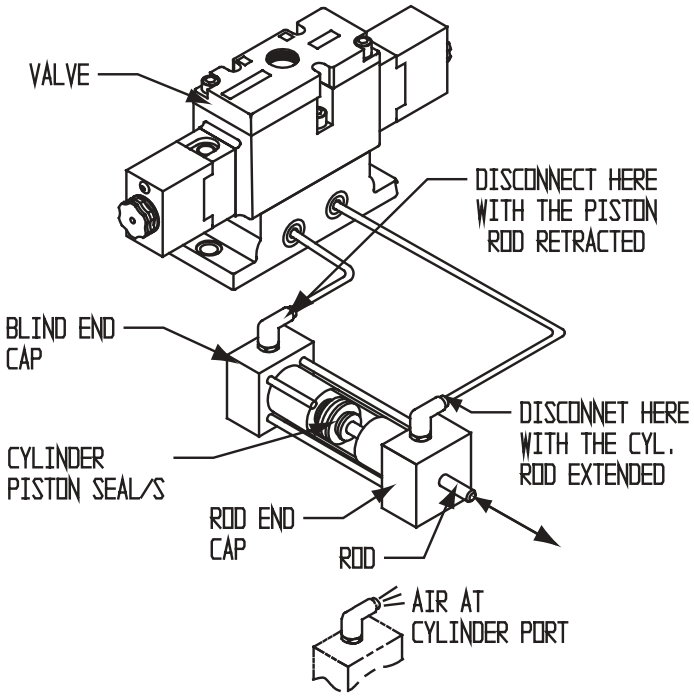
Of all the components in an electrical/mechanical/pneumatic system, it is most often the control valve that will be faulted for system malfunction. In many cases, the valve is only the symptom of the problem. Leaking cylinder seals, poor electrical connectors, clogged air line filters, and broken or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

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 Not actuated	Defective cylinder or valve seals Maintenance	Paragrpah 1 Paragraph 17
Valve leaks to exhaust Acutated	Defective cylinder or valve seals Inadequate air supply Inadequate pilot supply Contamination Maintenance	Paragrpah 1 Paragraph 2 Paragraph 3 Paragraphs 4 & 5 Paragraph 17
Solenoid pilot leakage	Dirt on seats or seal wear Maintenance	Paragraph 6 Paragraph 17
Operator vent leaks	Worn piston seal Damaged cap seal Maintenance	Paragraph 7 Paragraph 7 Paragraph 17
Sluggish operation	Contamination Inadequate air supply Inadequate pilot supply Improper or clogged muffler Inadequate or improper lubrication Mechanical binding Maintenance	Paragraphs 4 & 5 Paragraph 2 Paragraph 3 Paragraph 8 Paragraph 9 Paragraph 15 Paragraph 17
Poppet valve chatter	Inadequate air or pilot supply Contamination Improper or clogged muffler Inadequate or improper lubrication Maintenance	Paragraphs 2 & 3 Paragraphs 4 & 5 Paragraph 8 Paragraph 9 Paragraph 17
Solenoid buzzes or solenoid burnout	Incorrect voltage Faulty or dirty solenoid Maintenance	Paragraph 10 Paragraph 11 Paragraph 17
Solenoid valve fails to shift electrically but shifts with manual override	Incorrect voltage Override left activated Defective coil or wiring Maintenance	Paragraph 10 Paragraph 12 Paragraph 13 Paragraph 17
Solenoid valve fails to shift electrically or with manual override	Inadequate air supply Inadequate pilot supply Contamination Inadequate or improper lubrication Mechanical binding Maintenance	Paragraph 2 Paragraph 3 Paragraphs 4 & 5 Paragraph 9 Paragraph 15 Paragraph 17
Valve shifts but fails to return	Broken spring Mechanical binding Maintenance	Paragraph 14 Paragraph 15 Paragraph 17
Cam operated valve fails to operate	Cam or roller adjustment Maintenance	Paragraph 16 Paragraph 17

TROUBLESHOOTING

GENERAL COMMENTS - PARAGRAPH 1 - VALVE EXHAUST PORT LEAKAGE



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

1. With the piston rod retracted, disconnect the line at the cylinder blind end cap. If air comes out of the cylinder port fitting, as shown above, the cylinder piston seals are defective amd must be replaced. If there is no leakage, reconnect the line.

2. With the cylinder rod extended, disconnect the line at the cylinder rod end cap. If there is leakage at the cylinder port fitting, the cylinder piston seals must be replaced.

3. If there is no leakage at the fitting, the leakage is caused by defective valve seals or gaskets. Reconnect the line and install new seals and gaskets that are included in the valve body service kit.

GENERAL COMMENTS - PARAGRAPH 2 - INADEQUATE AIR SUPPLY

An inadequate air supply can cause the pilot supply pressure to drop during valve actuation. This can result in valve chatter or oscillation, particularly in poppet valves, or may keep the valve in a partially shifted condition where it continually blows to exhaust. If the pressure gage falls by more than 10% during valve actuation, there is probably a deficiency in the air supply system.

1. Airline filters should be cleaned and pressure regulators checked for proper operation. The line sizing recommendations in the “Installation” section of this catalog should be reviewed and modifications made if restrictions or undersize inlet lines are found.

2. Verify that the air compressor has sufficient capacity to meet all systems requirements.

TROUBLESHOOTING

GENERAL COMMENTS - PARAGRAPH 3 - PILOT SUPPLY

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

1. 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.

2. Comments in Paragraph 2 also apply to pilot supplies.

GENERAL COMMENTS - PARAGRAPH 4 - LIQUID CONTAMINATION

Accumulation of oil and water at low points in the system, including valves, can cause erratic or sluggish performance and exhaust leaks.

1. If heavy concentrations of water or oil are found when a device is disassembled, it should be thoroughly cleaned, re-lubricated and reassembled.

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

3. If there are concentrations of moisture at below freezing temperatures, ice can form and cause erratic operations, or completely bind system components. In such situations, steps must be taken to dry the air to a dew point of at least 10°F below the minimum system operating temperature. Also, filters should be equipped with automatic drains.

GENERAL COMMENTS - PARAGRAPH 5 - SOLID CONTAMINANTS

Solid contaminants, such as broken pieces of pipe threads, pipe sealant or tape, or rust scale, can cause valve seal damage, scratches on spools and sealing surfaces, or system binding and possible exhaust leaks. Such problems are most often encountered in new installations that have not been properly purged or where there are heavy concentrations of atmospheric contaminants.

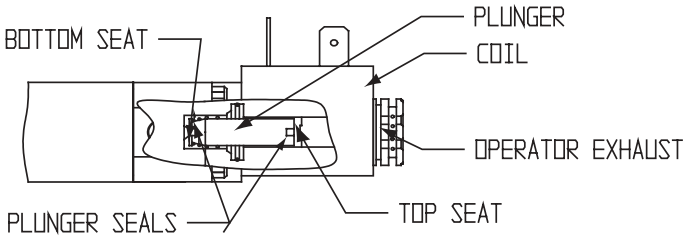
1. In may cases, cycling the valve several times will flush the particles away. If not, the item must be disassembled, the parts thoroughly examined for signs of damage and replaced as necessary.

2. Before reinstalling the product, the air line should be purged, as stated in the “Installation” section of this catalog. Air line filters should be cleaned and checked for proper operation. Properly sized mufflers should be installed in valve exhaust ports.

3. If there is heavy atmosphere contamination, valves with foundry option “D” should be installed.

TROUBLESHOOTING

GENERAL COMMENTS - PARAGRAPH 6 - SOLENOID PILOT LEAKAGE

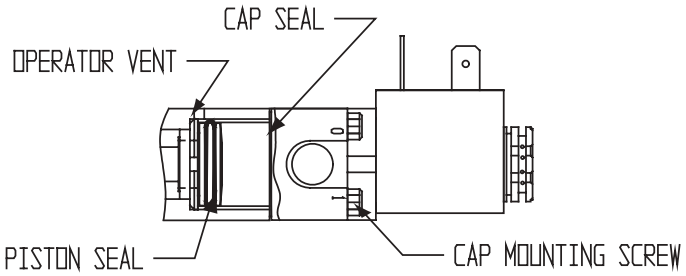


Continuous leakage from the operator exhaust port when the solenoid is de-energized can be caused by a foreign particle trapped between the bottom seat and the plunger, by a damaged bottom seat, or by a worn or damaged bottom plunger seal.

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.

1. The solenoid should be disassembled, cleaned, and the parts examined for wear or damage.
2. If damaged plunger seals are found, the plunger should be replaced.
3. A damaged bottom seat requires replacement of the operator.
4. A damaged top seat requires replacement of the solenoid.
5. Before reinstalling the product, follow the recommendations in Paragraph 5 regarding contaminants.

GENERAL COMMENTS - PARAGRAPH 7 - OPERATOR VENT LEAKS



Vent leakage when the solenoid is energized can be caused by either a faulty operator piston or cap seal, by an improperly placed cap seal, or by improperly tightened cap mounting screws.

Vent leakage when the solenoid is de-energized is often caused by an improperly placed cap seal or by improperly tightened cap mounting screws.

1. In either case, tighten the cap mounting screws before disassembling the operator to determine if this will stop the problem.
2. If tightening the screws does not work, disassemble the operator, clean it, replace worn or damaged seals, and reassemble taking care to properly position the cap seal.

TROUBLESHOOTING

GENERAL COMMENTS - PARAGRAPH 8 - MUFFLERS

Mufflers that are undersized for the application or that have become clogged can cause slow system response or, in the case of poppet valves, system malfunction or valve oscillation.

1. Remove the muffler and cycle the valve several times to see if it operates satisfactorily without the muffler.

2. If it does, the muffler should be cleaned or, if it is not dirty, replaced with a larger muffler with adequate exhaust flow capacity.

GENERAL COMMENTS - PARAGRAPH 9 - IMPROPER LUBRICATION

Air line lubricators that are not set at the proper flow rate or that contain lubricants not compatible with seals can cause sluggish system performance or malfunction.

1. If oil mist can be seen in the exhaust air, if films of oil are in evidence on surfaces around exhaust ports, or if pools of oil are found in valves or other devices, the lubricator is set at too high a flow rate. As a general rule, a flow rate of one drop per minute is adequate to provide a thin film of oil on moving surfaces.

2. If the flow rate is too low or the reservoir is empty, system elements that require lubrication can slow down or even bind. Lubricator reservoirs should be filled on a scheduled basis and the proper lubricator flow rate maintained.

3. Compatibility of the luburicating oil with system seals should also be verified, as stated in the “Installation” section. Incompatible lubricants can cause seals to swell which can result in sluggish performance or even binding of moving parts.

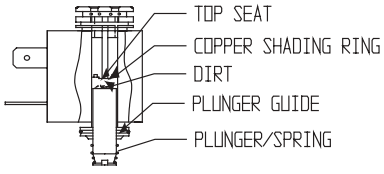
GENERAL COMMENTS - PARAGRAPH 10 - INCORRECT SOLENOID VOLTAGE

Automatic valve solenoids are designed to operate at between 90% to 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.

1. To verify proper voltage, shut off and exaust the air supply to the valve.

2. Attach a voltmeter to the solenoid’s electrical supply, energize the solenoid, and note the voltage reading. If the reading is too low, the electrical supply is inadequate and must be corrected.

GENERAL COMMENTS - PARAGRAPH 11 - INCORRECT SOLENOID VOLTAGE



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.

TROUBLESHOOTING

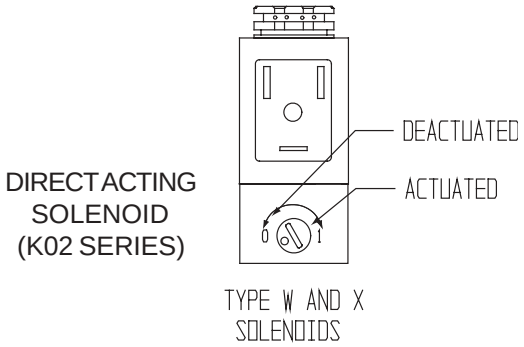
GENERAL COMMENTS - PARAGRAPH 11 - INCORRECT SOLENOID VOLTAGE CONT.

1. Correct voltage should first be verified per Paragraph 10. The electrical supply should be shut off and the pilot section disassembled for inspection.

2. If the copper shading ring around the top seat is cracked or damaged, the solenoid assembly should be replaced.

3. If dirt is found in the plunger guide and on the plunger/spring, they should be thoroughly cleaned and inspected for damage. If no damage is found the solenoid assembly can be reassembled. If damage is present, the solenoid assembly should be replaced.

GENERAL COMMENTS - PARAGRAPH 12 - MANUAL OVERRIDE LEFT ACTIVATED



If a turn locking manual override is left in the activated position, the valve will operate when the override is again cycled, from on to off and back to on, but will fail to operate electrically. This happens because the override is holding the plunger in its activated position.

1. Verify that locking type overrides are in their normal deactived position and that non-locking overrides have not become stuck.

GENERAL COMMENTS - PARAGRAPH 13 - DEFECTIVE COIL OR WIRING

Coils used by Automatic Valve seldom burn out when operated within listed voltage limits.

1. Verify that the operating voltage is correct per Paragraph 10.

2. Verify that there is no dirt in the plunger per Paragraph 11.

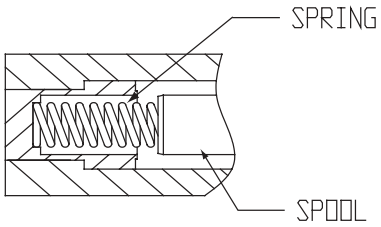
3. Verify that washdown applications have not caused thermal shock.

4. Verify the integrity of the coil by shutting electrical power off and using an ohmmeter to check continuity. If the coil is open, it is burned out and must be replaced. If there is coil continuity, the electrical system should be checked for loose or broken connections and for worn or defective switches and contacts.

5. If cam operated switches are part of the electrical system, check for worn or loose cams.

TROUBLESHOOTING

GENERAL COMMENTS - PARAGRAPH 14 - BROKEN SPRING



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

1. Broken springs must be replaced and are included in service kits.

GENERAL COMMENTS - PARAGRAPH 15 - MECHANICAL BINDING

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

1. Turn air and electrical power off.
2. Follow all safety precautions recommended by the manufacturer of the equipment.
3. Make mechanical inspections and adjustments as required.

GENERAL COMMENTS - PARAGRAPH 16 - CAM OR ROLLER ADJUSTMENT

When cam activated valves fail to activate, check cams and rollers for proper alignment or wear.

1. Make any required adjustments.
2. Replace worn cams and rollers.

GENERAL COMMENTS - PARAGRAPH 17 - MAINTENANCE

1. When disassembling, carefully place parts in same order of removal.
2. Refer to “Installation” section for lubrication, installation, and maintenance.
3. Reassemble parts in reverse order of disassembly.

GLOSSARY

Ambient Temperature: The temperature of the immediate environment.

ATEX: European Community directive concerning equipment and protective systems intended for use in potentially explosive atmospheres.

CE: Conformite Europienne - Certification of a product to indicate that the product satisfies all the regulations governing safety laid down by the European Community. Products displaying this mark can be freely distributed within the markets of the European Community. Consult the Factory for information on products certified by CE.

Celsius, Degree: A unit of temperature measurement abbreviated °C. Celsius temperatures are calculated from Fahrenheit temperatures by the following formula:

$$C = \frac{5(F - 32)}{9}$$

CSA: Canadian Standards Association - Provides certification services for manufacturers who, under license from CSA, wish to use the appropriate CSA marks on certain products of their manufacturer to indicate conformity with CSA standards. Consult the Factory for information on products conforming to CSA standards.

Cv: Measure of calculating flow of a valve (or other pneumatic device) that takes into effect the temperature, pressure, pressure drop, and flow.

Detent: A devise for retaining movable parts in one or more fixed positions; usually a spring-loaded device fitting into a depression. Positions of parts are changed by exerting sufficient force to overcome the detent spring, or by releasing the detent.

DIN 43650/DIN 43650C: International standard for 3-pin connectors.

Fahrenheit, Degree: A unit of temperature measurement abbreviated °F. Fahrenheit temperatures are calculated from Celsius temperatures by the following formula:

$$F = \frac{9}{5} C + 32$$

Fluid: A liquid or a gas.

FM: Factory Mutual Insurance Company partnership recognized as a Nationally Recognized Testing Laboratory(NRTL) under 29 CFR 1910.7.

kPa: Kilopascals - International measure of pressure. 145 psig = 1000 kPa.

Media: The fluids used in a fluid power system. In a pneumatic system they are gases such as air, nitrogen or various inert gases.

Media Temperature: The temperature of the fluid within a valve or other device.

NEMA 4: National standard for enclosure protection. Provides protection against dirt, dust, water hosedown and rain.

NEMA 7: National standard for enclosure protection. Provides protection in Hazardous Locations. (presence of flammable vapours)

Pressure Range: The range of inlet pressures with which a device can operate satisfactorily.

psi: Pressure - pounds per square inch - A measure of force per unit area.

psia: Absolute Pressure - pounds per square inch absolute - The sum of atmospheric pressure and gauge pressure.

psig: Gauge Pressure - pounds per square inch gauge - Pressure above or below atmospheric pressure.

PTB: Physikalisch Technische Bundesanstalt - The National Institute of Natural and Engineering Sciences and the highest technical authority for metrology and physical safety engineering of the Federal Republic of Germany.

scfm: Flow Rate - standard cubic feet per minute - The volume or weight of fluid passing through a conductor per unit of time.

Signal: A fluid or electric command to the valve actuator causing the valve to change position.

Standard Air: Air at a temperature of 68°F, a pressure of 14.69 pounds per square inch absolute (psia), and a relative humidity of 36 per cent (0.0750 pounds per cubic foot). In gas industries the temperature of standard air is usually specified as 60°F.

Vacuum: Pressure less than atmospheric pressure.