

GENERAL INFORMATION ON AAA VALVES

AAA valves are spool-type with 4-way action, and are intended primarily for control of air cylinders, or air motors.

Soft seal models, which include all listings are for air service only. They are offered in a complete size range from 1/4" to 2". O-rings give tight sealing between all ports. They may be used on air or inert gas or on low vacuums up to 26" Hg. Soft seal valves should not be used on liquid service.

BODY SIZES

Soft seal valves, which include all listings, are built in 5 body sizes. The 1/4" and 3/8" valves are housed in the smallest body. Both are identical except for a slight difference in flow capacity (see page 46). The 1/2" valves are in the next larger body. The 3/4" and 1" valves are in a still larger body. They have a flow area equal to a 3/4" diameter hole. They are identical in appearance but have a slightly different flow capacity (page 46). A still larger body with 1-3/8" diameter flow area is used for 1-1/2" and 2" valves. These two sizes are the same except for NPTF body ports on the 1-1/2" models and 2" subplate ports on the 2" models.

MOUNTING

AAA valves in general can be mounted in any position. But for safety, any valve which does not have springs or detents to hold the spool in position should be mounted with the spool horizontal unless pressure is continually applied to hold the spool in position.

MODELS FOR SUBPLATE MOUNTING

Subplate mounting is offered in all body sizes except NAMUR and B- Series stack valves. Small body valves have flow area equal to 5/16" hole and can mount on subplate with 1/4" or 3/8" connections. 3/4" and 1" valves have flow area of 3/4" hole and can mount on subplates with 3/4" or 1" connections.

4-WAY ACTION

AAA valves have 4-way spools for control of reversible cylinders and similar devices. Soft seal models can be used as 3-way valves by plugging the unused cylinder port, or as 5-way valves by using the dual exhaust ports as inlets and the inlet port as a single exhaust.

THESE SAFETY PRECAUTIONS MUST BE OBSERVED

1. Do not operate solenoid valves above 150 psi on the pilot section! Use "externally piloted" valves for pressures above 150 psi. (160 psi on alternate solenoids)
2. Mount 2-position, no-spring models with spool horizontal to avoid accidental spool drift due to vibration.
3. Foot-operated valves should have OSHA approved safety guard.
4. Although AAA valves are virtually trouble-free through millions of normal cycles, they should be disassembled and inspected periodically, depending upon conditions.
5. Do not over lubricate! For further information contact factory.

OPERATING PRESSURES

Maximum operating pressure is 250 psi. On solenoid valves maximum pressure is 150 psi (160 psi on alternate solenoid operators). If higher pressures up to 250 psi are required, solenoids must be externally piloted. For pressures above 250 psi consult factory for special high pressure valves.

Some valves must have a minimum pressure for reliable shifting of spool. Consult individual description of valves.

On air service, valves will tolerate surge pressures to 1000 psi without permanent damage to bodies or seals, but for safety and reliable operation they should not be used above rated pressure. Differential PILOT models will not operate on vacuum nor on line pressure less than 25 psi. Operating limitations are covered in more detail on page 44.

STANDARD TEMPERATURE RANGE

Unless otherwise stated in the particular valve description: -20°F TO 250°F (-29°C to 120°C).

Caution: if it is possible that the ambient temperature may fall below freezing, the medium must be moisture free to prevent internal damage or unpredictable behavior.

Consult factory for special modifications that can be made for higher or lower temperatures.

MATERIALS OF CONSTRUCTION

Bodies of 1/4" and 3/8" sizes are pressure cast aluminum. Larger bodies are heat treated aluminum castings. Spools are machined from light-weight aluminum alloy bar stock, and specially treated to produce a glass-hard surface finish. End caps are steel, zinc alloy or aluminum. Viton O-rings are standard on 1/4" and 3/8" bodies; Buna-N O-rings are standard on larger bodies. O-rings are installed in body grooves, not around the spool.

LIFE EXPECTANCY

AAA Products International air valves have been field tested to over 40 million cycles. For best results use filtered and coalesced (dry) air.

FACTORY PRE-LUBRICATION

All valves are pre-lubricated at the factory using Magalube®-G teflon based all purpose grease. Valves are suitable for, and perform best in a low lube service.

For long life, use an air line filter/lubricator installed no further than 8 to 10 feet from the valve. The filter should be rated 25 pm or finer. Use a high grade of petroleum base non-detergent lubricating oil no heavier than **SAE IOW**. **DO NOT OVER-LUBRICATE**. This could cause the spool to stick.

CAUTION! Do not use questionable fluids in air line lubricators. Do not use petroleum oil with detergent additives. Detergents, volatile or aromatic fluids may swell rubber seals in valves and cylinders. Never use cooking or vegetable oil as a lubricant.

When cleaning AAA valves after extended service, lubricate the valve spool with AAA high film strength grease, or, use O-ring grease which is usually available from supply houses which sell O-rings. Magalube®-G is included in all valve repair kits for proper valve maintenance. Never use any kind of oil, cup grease, or automobile chassis lubricant.

RECOMMENDED LUBRICATION

AAA Products International recommends the use of Magalube®-G in all of its products. This lubricant is rated to serve under load conditions up to 1,450 psi, temperature ranges from -35°F to 458°F, mechanically and chemically stable, water resistant, and reduces the need for repetitive re-application. We do not recommend any lubricants that include cleaners or solvents. These types of lubricants have a tendency to swell the O-Rings and reduce the performance of the valve. O-Rings must be replaced once they swell.

CONSTRUCTION FEATURES OF AAA VALVES — Soft Seal Types

One secret to the superior performance of AAA valves is the large spool diameter. The diameter is 25% to 50% larger than competitive valves, giving more positive shifting on pilot operated and solenoid valves, less wear and longer life on the standard O-ring seals, and larger flow area in a given size because so many more flow grooves can be cut around the larger diameter spools.

FULL RATED PRESSURE

The use of O-ring seals between ports permits the application of full rated pressure on any port. O-rings are standard commercial sizes and compounds available world wide from any supply house. The valve is constructed to confine the O-rings in a manner making it impossible to pinch, bite, or pop them out under the most adverse operating conditions.

SYMMETRICAL CONSTRUCTION

The valve body and the spool are completely symmetrical end to end. This means that the spool and/or end caps may be reversed in the valve body. This is sometimes a great convenience in mounting or plumbing.

METERING

The double taper of the flow grooves gives AAA valves much better throttling characteristics on manual valves than is usual for spool valves, and tends to reduce shifting shock on solenoid and pilot operated models.

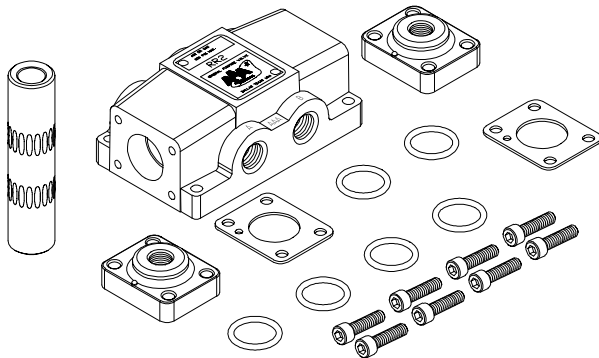
FULL FLOW

Flow area through the valve is generously designed, exceeding in most cases the size rating of the valve. Consequently, the flow losses though the valves are lower than might be expected. See page 46.

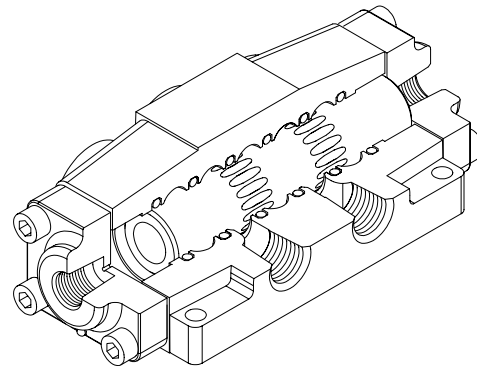
SIMPLICITY — MINIMUM OF PARTS

Designed for simplicity and minimum number of parts. Seals are standard O-rings and are available worldwide. If they should need replacing (after millions of cycles), the job can be quickly and easily done, without service or parts drawings. There are no small loose parts to be damaged or lost, and no hidden seals to leak.

These quality valves are stocked in the U.S.A. and Canada. Refer to bulletin A-266 for your local distributor.



Component Parts of 1/4" Double Piloted Valve



Cut-away View of 1/4" Double Piloted Valve

VALVE SEALS

AAA valves are virtually trouble-free through millions of cycles if these simple lubricating instructions are followed. Some oils may swell the rubber seals in valves and cylinders of any brand, and may cause binding. To determine if seals are swelled in AAA valves, remove one O-ring from the body and slip it over the spool. If the clearance between O-ring and spool is 0.005" or more all around, the ring is swelled from its original shape. A small amount of swelling will not usually impair valve performance, and sometimes the valve will still perform reliably with as much as 1/32" all around. See page 62 on how to replace O-rings.

AAA spool valves use standard size O-rings available almost anywhere in the world. Specially built or non-standard valves may have been furnished with special O-rings to suit special operating conditions. When inquiring from the factory, give all model numbers and engineering numbers appearing on the valve nameplate.

Standard size rings are used and these are available everywhere. Six rings, of 70 or 75 Shore hardness are used in the body of each valve.

Valve Size	O-Ring Size	Material
1/4" & 3/8"	3/4"x15/16"	Viton A
1/2"	1-1/8"x1-3/8"	Buna-N
3/4" & 1"	1-3/8"x1-5/8"	Buna-N
1-1/2" & 2"	2-1/4"x2-5/8"	Buna-N

SPECIAL INFORMATION ON AAA SOLENOID VALVES

AAA solenoid valves are “solenoid controlled, pilot operated” type. The spool is shifted by air pressure tapped off the valve inlet. The solenoid is not directly connected to the spool; when energized, it opens a miniature orifice to admit air pressure to the end of the main spool. This pressure produces the physical force for shifting the spool. Electrical

power required determined by the solenoid style used. Due to the type of construction, a coil will not burn out if both solenoids of a double solenoid model should accidentally be energized at the same time. Coils removed from valve solenoid sleeve may be damaged if energized. Place coils on sleeves before energizing.

Pressure Limitation on Solenoid Valves

Solenoid valves which are assembled for “internal pilot” operation must be used in the range of 150 psi to 50 psi minimum on ESO and ESY models, and 25 psi minimum for ESR and ESS non-spring models. They will not operate on vacuum, or on a pressure outside this range.

Solenoid valves ordered with option “Z” or converted to use external pilot pressure (in the range specified in the preceding paragraph), can handle pressure from vacuum to 250 psi on their main ports.

Diagrams of Internally and Externally Piloted Solenoid Valves

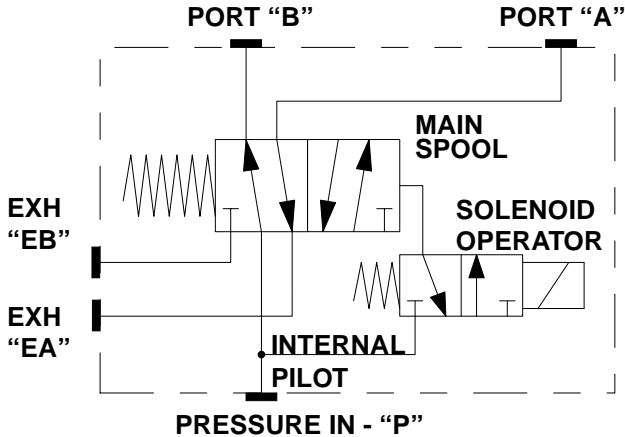


Diagram of Internally Piloted Valve

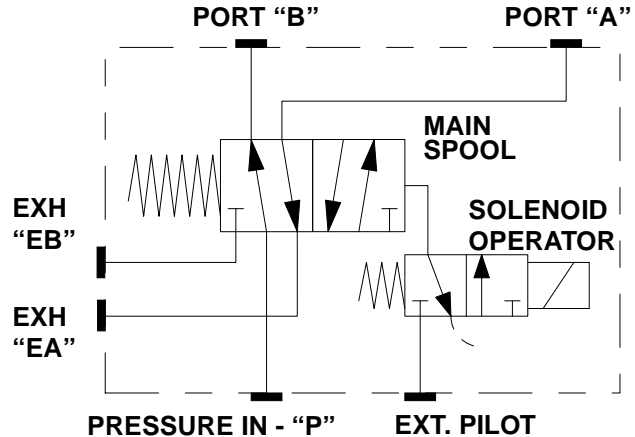


Diagram of Externally Piloted

INTERNALLY PILOTED SOLENOID VALVES. The diagram shows how AAA solenoid valves obtain their shifting power by tapping into the valve inlet inside the valve itself. If inlet pressure is above or below the limits stated in the paragraph above the diagram, the valve must make use of an outside source of shifting power. It should be factory ordered with suffix “Z” following the regular model number, and will be furnished with the electric operator connected to an external pilot pressure port as shown in the diagram above. Example: ESO4Z.

FIELD CONVERSION TO EXTERNAL PILOT. Any solenoid valve can be field converted from internal to external piloting, and vice versa. Procedure varies according to body size. Details for all models are given with their listings.

PRESSURE LIMITATION ON DIFFERENTIAL PILOT VALVES

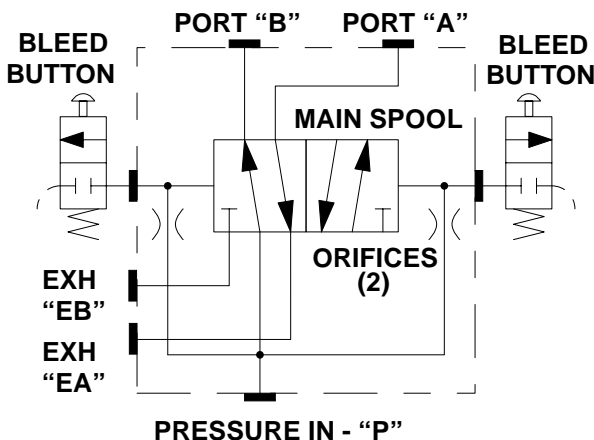


Diagram of Differential Pilot Valve

Differential PILOT models are special types in which full line pressure is maintained on both ends of the main spool. To shift the spool, one or the other bleed buttons on the end caps must be momentarily pressed. This vents pressure from one end, permitting pressure on the other end to shift the spool. This diagram shows the working principle.

A minimum of 25 psi is required for reliable shifting of non-spring models. Minimum pressure for spring offset and 3 position models is 50 psi. They will not operate correctly on compressed air lines of less than 25 psi. They are not suitable for liquids. By careful design they can be built in a 3-position, spring centered configuration. One such model is listed on page 13.

The bleed buttons can be removed from the valve body and mounted on 1/4" hose or tube extensions for shifting the valve from a few feet away. Any other 2-way normally closed (N.C.) valve, manual, cam, or solenoid, can be substituted for either or both bleed buttons.

FLOW DIAGRAMS FOR AAA VALVES

The basic porting of all AAA valves is 4-way for control of double-acting cylinders, reversible air motors, and similar devices. They can be used for 3-way service by plugging the unused cylinder port, leaving unused exhaust port open. They can be used for 5-way service by using the exhaust ports as inlets and the pressure port as a single exhaust.

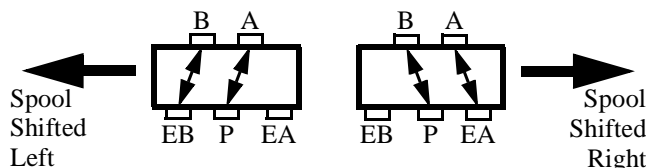
The diagrams on this page show direction of flow through the valves when the spool is shifted or a solenoid is energized. If cylinder action is opposite to that desired — if the cylinder retracts instead of extending when a valve is shifted — the connecting lines between valve and cylinder should be interchanged, either at the valve port holes or at the cylinder port holes (but not at both places).

MANUAL, FOOT, PILOT-OPERATED, DIFFERENTIAL PILOT, CAM, AND PISTON MODELS

All Sizes AAA Valves

Please note on manual lever valves, due to lever action, the spool moves in a direction opposite to knob movement. On differential pilot valves, the spool moves toward the end of the valve with the bleed button which was actuated.

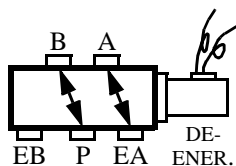
With spool shifted to the left, the “P” (pressure) port is connected to “A” port while “B” port is connected to exhaust “EB” port. Exhaust Port “EA” is blocked at this time.



With spool shifted to the right, the “P” (pressure) port is connected to “B” port while “A” port is connected to exhaust “EA” port. Exhaust Port “EB” is blocked at this time.

1/4" THROUGH 1" SOLENOID VALVES

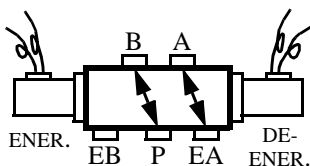
See page 36 for flow pattern through 1-1/2" and 2" models.



SPOOL SHIFTED →

Single Solenoid, 2-Pos. Models

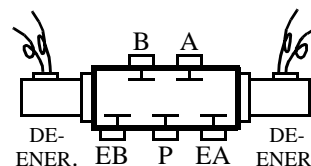
Standard factory assembly is with solenoid coil on the right side, when viewing side of valve with three port holes. When the solenoid is de-energized, flow through the valve will be as shown in the diagram above. Energizing the solenoid reverses the flow pattern. If the solenoid valve has spring return action, current must be maintained on its coil to keep the spool in a shifted position.



SPOOL SHIFTED →

Double Solenoid, 2-Pos. Models

With the left solenoid energized, porting will be as shown in the diagram above. Spool will shift and remain in shifted position if either solenoid is momentarily energized. Preferred mounting position is with spool axis horizontal to prevent accidental spool drift. NOTE: Single solenoid valves with pilot pressure return (SR models) have the same action as double solenoid, 2-position models, and the same flow pattern.



SPOOL CENTERED

Double Solenoid, Spring Centered

With both solenoids de-energized, the spool will be centered and all ports will be blocked (on standard closed center spool). With left solenoid energized, flow will be as shown in the center diagram above. To keep the spool in a shifted position, current must be held on the appropriate coil.

AIR FLOW RATINGS AND VALVE SHIFT TIME

Tests were conducted on AAA valves at the Fluid Power Institute Testing Laboratories of the Milwaukee School of Engineering on two samples each of six valve models.

Results of these tests apply to all soft seal valves including the B Series stack valves.

RATED FLOW. Flow factor tests were made with the valve outlet vented to atmosphere and flow in the sonic region. The average flow factor was calculated from tests over a range of inlet pressures. The factor was then used to calculate expected flow at 100 psig.

Rated Flow in SCFM

Valve Model	ESS2	ESS3	ESS4	ESS6	ESS8	ESS12
Port Size	1/4"	3/8"	1/2"	3/4"	1"	1-1/2"
Flow Factor	15.6	17.9	42.5	90.1	96.3	328.0
SCFM Flow	77.0	88.8	210.8	446.9	477.7	1627
Cv Factor	1.70	1.95	4.64	9.97	10.7	36.3

Flow in the above table was calculated for 100 psig (114.7 psia) inlet pressure. At other inlet pressures, flow will be in proportion to psia inlet pressure.

Example ESS2 at 80 psig (94.7 psia) inlet pressure:

Ratio of 94.7 to 114.7 is: $94.7 \div 114.7 = 0.826$

Flow at 80 psig = $0.826 \times 77.0 = 63.6$ SCFM.

Tests were made on solenoid models, but flow is related only to the valve body and not the actuator.

RESPONSE TIME. With the valve initially shifted to communicate 150 psi inlet pressure to a blocked cylinder port the total elapsed shifting time was measured between the instant of energization of the opposite solenoid and build up of 90% of full steady state flow in the other cylinder port, which was vented to atmosphere. The result is a measure of the "Blocked to Open Shift Time".

In another test, with the valve initially shifted to a port which was vented to atmosphere, the total elapsed time was measured between the instant of energization of the opposite solenoid and build-up of 90% of full steady state pressure in the other cylinder port which was blocked. The result is a measure of "Open to Blocked Shift Time":

Response Times in Milliseconds

Valve Model	SS2	SS3	SS4	SS6	SS8	SS12
Blocked*	91.0	95.0	74.2	147	147	147
Open†	80.0	67.5	67.5	152	170	105

*Blocked to Open response time.

†Open to Blocked response time.

These tests were made over a range of 50 to 150 psi.

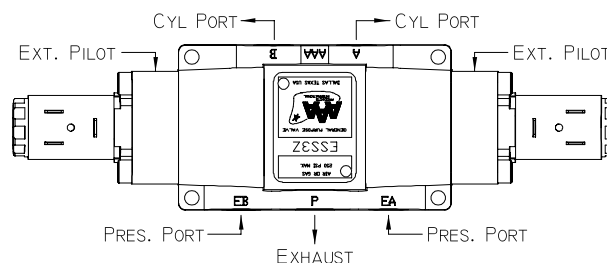
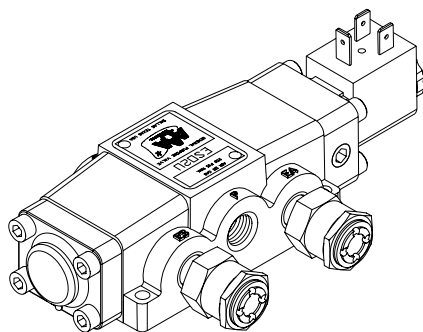
The shifting time is quite satisfactory for almost all applications, but for faster response a larger orifice can be supplied on special order.

LIMITATIONS ON VACUUM OPERATION

The five main ports on AAA valves can be operated on industrial vacuum to 28" Hg, based on a 30" barometer. O-rings between all ports give tight sealing. While AAA valves are basically 4-way, they can be used for 3-way service by plugging the unused A or B port.

All manually and mechanically actuated models can be used on vacuum service. To use solenoid operated models on vacuum they must be ordered with option "Z" or field reconnected for external pilot operation. An external source of air pressure, 50 to 150 psi, must be available for pilot pressure. Field conversion is explained with each model listing.

Model ESO2U valve showing MFC flow controls



Model ESS3Z connected for 5-Way service

EXHAUST FLOW CONTROLS WITH AAA VALVES

Standard AAA valves are built with dual exhaust ports. A needle valve may be screwed into each exhaust port, giving meter-out speed control of an associated air cylinder or air motor in both directions of travel.

Model MFC flow controls, listed on page 47, are provided for this purpose. They not only give adjustable speed control but have a built-in muffler to reduce exhaust noise. They are available up to 1/2" size.

USING AAA VALVES FOR 5-WAY SERVICE

A 5-way application is one using two inlet pressure levels, or in which inlet pressure is derived from two different sources for use in the same circuit. Another type of 5-way application is for conserving air on the return stroke of double-acting cylinders.

Standard AAA soft seal valves may be used for 5-way service with these exceptions: solenoid and differential pilot valves must be re-connected to use an external source of 50 to 150 psi pilot pressure. Stack valve sections cannot be used for 5-way service.