Humphrey® Air-Piloted Valves

TECHNICAL SECTION

GENERAL INFORMATION
DESCRIPTION

Description

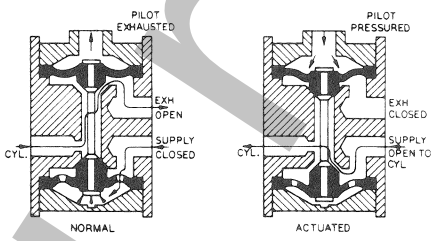
125 Series	.125-inch (3.2mm) orifice 2- and 3-way valves of diaphragm-poppet design.
250 Series	.250-inch (6.4mm) orifice 2- and 3-way valves of diaphragm-poppet design.
500 Series	.500-inch (12.7mm) orifice 2- and 3-way valves of diaphragm-poppet design.
501 Series	.500-inch (12.7mm) orifice 2-, 3-, and 4-way valves of piston-poppet design.
590 Series	.625-inch (15.9mm) orifice 2- and 3-way valves of diaphragm-poppet design.
42, M42	.220-inch (5.6mm) orifice 4-way valves of patented floating O-ring spool design. Three different types of valves for in-line, manifold, and stackable mounting.

The following types of air pilot are offered on various Humphrey Air-Piloted valves.

Single Air Pilot	A conventional single air pilot/spring return, enhanced by small volume of pilot chamber for rapid response to pilot signal.
Ultra-low Pilot/ Interface Valves	These valves amplify weak (low pressure) or erratic pilot signals for interfacing with higher supply pressures.
Momentary Air Pilot	**"AA" Type Valves, Momentary Pilot/ Maintained Position.** Provides unique control methods not offered in conventional equivalents. Also compensates for minor pilot fitting leaks.
Double Air Pilot	**Double Solid Diaphragm Type Valves.** Humphrey diaphragm-poppet valves are available with double solid diaphragms. This is a conventional type of double air pilot which is enhanced by the small volume of the pilot chambers for rapid response to the pilot signals. Valves of this design feature a positive pressure open and close. Consult factory.
	Spool Valves. A conventional double air pilot that maintains last actuated position.

Diaphragm-Poppet Valve Principle of Operation

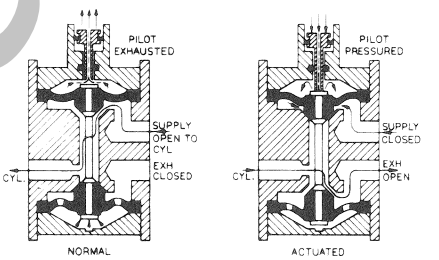
Basic Normally Closed Valve (250A shown)



NORMAL Design employs principle of imbalance wherein the supply pressure is applied to the greater effective area on the bottom side of the lower diaphragm.

ACTUATED Valve is actuated when pilot air is applied to the greater effective area of the top diaphragm. Supply pressure assists the spring in returning valve to normal position.

Basic Normally Open Valve (250A shown)



NORMAL Design employs principle of imbalance wherein the supply pressure is applied to the greater effective area on the bottom side of the top diaphragm.

ACTUATED Valve is actuated when pilot air is applied to the greater effective area of the booster piston and top diaphragm. Supply pressure assists the spring in returning the valve to normal position.

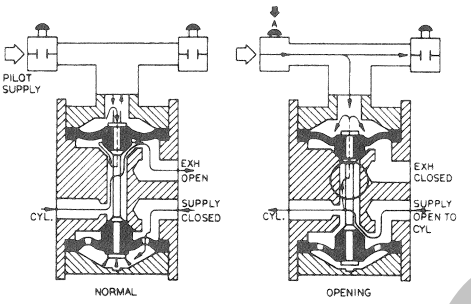
A booster piston is standard on 250-4A valves and normally open 125 and 250 Series valves. Booster pistons are optional in normally closed 125 and 250 Series valves used to amplify low pressure pilot signals.

"AA" Series Air-Piloted Valves

Momentary signal, maintained position

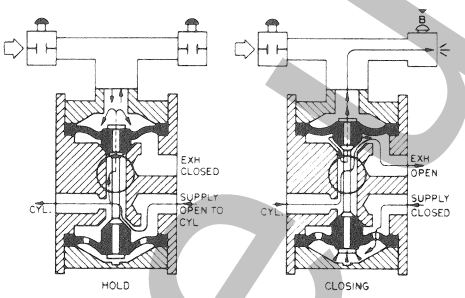
Humphrey "AA" Air-Piloted Valves permit interlocking and sequencing. They combine the advantages of a positive pressure system and a double bleeder system without incurring the disadvantages of either.

The following principle of operation applies to all "AA" diaphragm-poppet valves, including 501AA piston-poppet valves.



NORMAL Design employs principle of imbalance wherein the supply pressure is applied to the greater effective area on the bottom side of the lower diaphragm.

OPENING A momentary signal from pilot valve A (2-way) initiates opening of the "AA" valve. Supply pressure proceeding to the cylinder port feeds to the pilot system to complete the lightning-fast opening.



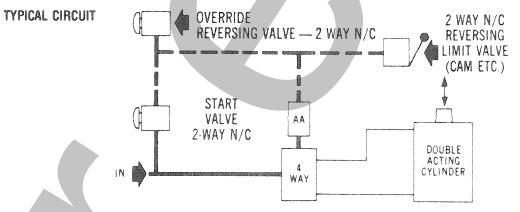
HOLD In the "Hold" actuated position, the internal compensating orifice compensates for minor leaks present in the pilot system.

CLOSING Momentary actuation of valve B (2-way) initiates exhaust of the pilot pressure and the "AA" valve begins to close. The internal orifice vents any remaining pilot pressure through the exhaust port, completing the closing.

PLEASE NOTE: The internal compensating orifice of a Humphrey "AA" Air-Piloted Valve serves to connect valved and pilot pressures and their media. Consequently, valved and pilot pressures will equalize, and valved and pilot media will mix.

Humphrey "AA" valves will close automatically when, due to loss of supply pressure or a sudden and large increase in downstream usage, internal pressure drops below approximately 12 psig. In such events, an "AA" valve can be reopened only by actuating valve A to restore pressure conditions.

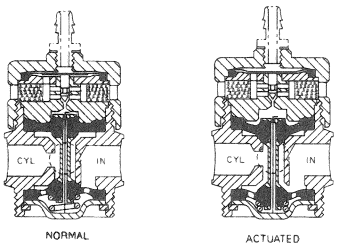
"AA" valves can be opened or closed from two or more stations. Multiple stations enable convenient location of valves to override normal sequences.



The "AA" valves may be opened and/or closed from two or more stations. Multiple stations offer conveniently located valves to override normal sequence.

NOTE: This circuit drawing is for descriptive purposes only. Proper, safe functioning of any system which employs the components as shown, or in any other manner, must be ensured by the designers or user.

Interface Valves (Ultra Low Pilot)



NORMAL Design employs principle of imbalance wherein the supply pressure is applied to the greater effective area on the bottom side of the lower diaphragm. Pressure is also fed to the top diaphragm through an orifice in the stem and is vented through bleed orifice.

ACTUATED The valve is actuated by low pressure pilot air which clocks the bleed orifice to allow internal pressure to be applied to the greater effective area of the top diaphragm.

PORT IDENTIFICATION (Varies by model. Specific port identification appears on individual model drawings.)

IN	Pressure supply port.
CYL or OUT	Delivery port.
CYL NO	Delivery port, normally open (passing).
CYL NC	Delivery port, normally closed (not passing).
CYL 1	Delivery port, normally open (passing).
CYL 2	Delivery port, normally closed (not passing)
C1	Delivery port, normally open (passing)
C2	Delivery port, normally closed (not passing).
NC	Normally closed (not passing).
NO	Normally open (passing).
EXH	Exhaust port. Vent to atmosphere.

Installation
Humphrey Air-Piloted Valves can be mounted in any position in most environments within the parameters stated in the specifications. Location near water, oil, or in dusty conditions typically has no adverse affect on performance. Interface (ultra low pilot) valves, however, can be affected by contamination entering the pilot chamber or by excessive shock loads.

Mounting
Valves can be mounted directly in the supply line, or with body mounting threads, mounting holes, or lugs. Some models are designed specifically for manifold mounting or stacking. Optional mounting bases (Code 21) are available for several of these valves. The Code 21 mounting base can be used for either base mounting or panel mounting.

125 Series valves, except models 125AH and 125AL, are available with optional panel mounting nuts (Code 22).

Consider mounting valve with close nipple connection to air cylinder for mounting simplicity, faster cylinder response, and reduced air consumption. (Use two 3-ways as a low cost 4-way to operate double acting cylinders in this same manner.)

Use as 2-Way Valves
Single air pilot 3-way valves can be used as 2-ways by plugging the exhaust port. Exception: "AA" models cannot be used as 2-ways.

For factory installation of plug, specify *Code 2* in the model number when ordering. Example: *125A-2-10-20*.

These valves (except "AA" type) can also be used as 2-ways to trap pressure between valve and downstream device; however, pressure under the top diaphragm may cause extrusion of the valve's stem through the bottom diaphragm if pressure exceeds 80 psig, or if supply pressure is removed.

NOTE: 2-way valves can be used as 3-ways by removing the exhaust port plug.

Humphrey Interface diaphragm-type valves cannot be used as 2-ways venting to atmosphere since venting evacuates the pilot chamber. However, this feature can sometimes be used to system/circuit advantage. Example: Broken outlet connection or line can cause "automatic" valve closing. Interruption of supply causes loss of pilot signal, thus closing the valve.

Use as 3-Way Valves
4-way valves can be used as 3-ways by plugging the normally open or normally closed delivery port.

Use as Normally Open (passing)
Models 125A and 250A can be ordered as normally open by specifying *Code 11*. Example: *250A-3-11-21*. Note that models 125A and 250A have a minimum pressure rating of 10 psig (.68 bar) when used normally open. Model 501A is a universal valve (*Code 12* indicates Universal) and can be used normally closed, normally open, or as a selector or diverter valve, 0-125 psig (0-8.6 bar).

Use as Normally Closed (not passing)
Models 125A-3-11 and 250A-3-11, both normally open (passing) valves, can be used as normally closed (not passing) by connecting the supply to the EXH port. In this mode, the CYL port remains the delivery port. The IN port becomes the exhaust port.

Use as a Selector Valve
Models 125A-3-11, 250A-3-11, and 501A-3-12 can be used as a selector valve.

Models 125A-3-11 and 250A-3-11

Connect high pressure (75 psig/5.1 bar maximum) to EXH port. EXH port is normally closed (not passing) to CYL port. Connect low pressure (50 psig/3.4 bar maximum) to IN port. IN is normally open (passing) to CYL port. When pilot is applied, the IN port closes allowing the higher pressure to flow from EXH to CYL port.

Model 501A-3-12

Connect one pressure to the NO port. Connect second pressure to the NC port. When pilot is applied the NO port closes allowing pressure to flow from NC to CYL port.

Use as a Diverter Valve
Models 125A-3-11 and 250A-3-11

Connect supply pressure to the CYL port, which is normally open (passing) to IN port. EXH is normally closed (not passing) to CYL port. When pilot pressure is applied IN port closes allowing pressure to flow from CYL to EXH port.

Model 501A-3-12

Connect supply pressure to CYL port which is normally open (passing) to NO port. NC port is normally closed (not passing) to CYL port. When pilot is applied NO port closes allowing pressure to flow from CYL to NC port.

Media/Pressure
Humphrey Air-Piloted Valves are designed for use with compressed air or inert gases generally from 0 to 125 psig (8.6 bar). Air piloted vacuum valves are rated for vacuum in the range of 0-29.5 inches Hg. Super-Quick Exhaust valves are rated for pressures of 150 psig (10.7 bar) maximum. Certain valves have minimum operating pressures. Consult individual valve specifications for details.

Diaphragm-poppet type models require no lubrication, filtration, or special preparation of media. They can also be used as air pilot controls for water, oil, instrument air, and other gases. Pilot pressure is isolated from valved media by the solid top diaphragm. For controlling liquids, consider the optional brass body available on 125, 250, 500, and 590 Series valves. Specify *w/BRB* when ordering. Consult factory for details. Please provide specifics regarding application.

Some valve models are vulnerable to contaminated or moisture-laden compressed air. To promote proper functioning and long life in such instances, appropriate air treatment equipment should be installed. Consult your air filter, regulator, and lubricator supplier.

Temperature

The normal temperature range of these valves with Buna N seals (nitrile, supplied as standard) varies from model to model. Please check individual model specifications for details. Diaphragm-poppet type valves are available with fluoro-elastomer seals for higher temperatures (to 400°F/204°C), or for mild chemical resistance. Specify *w/ VAI* when ordering.

Lubrication

Whereas no lubrication of any kind is necessary with Humphrey diaphragm-poppet Air-Piloted Valves (125, 250, 500, and 590 Series), if lubricating oil is used, it must be compatible with Buna N. Lubrication compatibility problems can sometimes be satisfied with fluoroelastomer seals option. Specify *w/VAI* when ordering.

Piston-poppet or detented spool valves (501 and 42) do require lubrication and filtration for optimum performance due to the dynamic seal.

Thin or low viscosity oils (spindle oil, machine oil, etc.) do not provide a good residual film of lubrication and may cause seals to swell. Likewise, some lubricants may cause swelling or deterioration of the valve's seals, therefore lubricant/seal compatibility must be confirmed. Read specifications carefully. If there is any doubt, consult factory.

Plumbing

Humphrey Air-Piloted Valves will function with low pressure or restricted volume media supplies with two exceptions: Interface (ultra low pilot) and "AA" type valves. Some valves have minimum operating pressures. Check individual valve specifications for details.

Performance of Air-Piloted Valves can be adversely affected by pilot supply lines of insufficient diameter or excessive length, and by the rate of pilot signal pressure rise. For optimum performance, pilot supply lines should be of .250-inch (6.4mm) outside diameter, and as short as possible.

Before connecting fittings and tubing, blow all foreign material from these components. If using a sealant, take extra care the sealant does not enter valve causing malfunction and/or leaks.

Recommended torque for 1/8 NPT and 1/4 NPT fitting installation is 60-80 and 130-150 inch-pounds (6.8 and 14.7 Newton-meters) respectively.

Most 125 Series Air-Piloted Valves are available with optional bottom inlet for plumbing convenience. Specify *w/BIN* when ordering.

CAUTION: Compressed air is powerful and may be dangerous. Before attempting to remove a component from an air line or 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.

Metric Ports

Although these valves are produced using the inch system, all drawings show the metric equivalent in millimeters (indicated by slanted numbers).

All port connections are available in metric as follows:

125 Series	Available with 1/8 BSP instead of 1/8 NPT.
500 Series	Available with 1/2 BSP instead of 1/2 NPT.
501 Series	Available with 1/2 BSP instead of 1/2 NPT.
590 Series	Available with 3/4 BSP instead of 3/4 NPT.
42 Series	Available with 1/4 BSP instead of 1/4 NPT.

Specify metric port threads by using letter *E* as a model number prefix. Example: *E125A* (with 1/8 BSP ports rather than 125A with 1/8-inch NPT ports).

Flow Rates/C_V

Humphrey recommends "fill/exhaust times", which are related to various chamber sizes, as the best method for calculating total valve and device (specifically, cylinder) response time. Humphrey recognizes the industry's use of flow coefficient C_V as a comparison standard.

Consequently, Humphrey offers three types of flow data. The National Fluid Power Association's standards for C_V, the scfm flow rate determined by flowing to atmosphere, and Humphrey's preferred "fill/exhaust times". Fill/exhaust times, while not being highly precise, are sufficien for most application needs and provide a simple, straightforward system.

Fill/Exhaust Times (Seconds)

			Fill Time (Sec) (0 to 90 psig)		Exhaust Time (Sec) (100 to 10 psig)	
Model	C_V	SCFM @100 psig	Chamber	(cu. in.)	Chamber	(cu. in.)
125A	0.2	20	0.150	1.50	0.200	2.00
250A	0.8	50	0.045	0.45	0.080	0.80
250-4A	0.8	50	0.045	0.45	0.080	0.80
500A	2.2	185	0.013	0.13	0.034	0.26
501A	2.4	220	0.012	0.12	0.019	0.19
501-4A	2.0	155	0.017	0.17	0.022	0.16
590A	3.8	250	0.014	0.098	0.036	0.23
42A	0.37	37	0.085	0.637	0.185	1.60

NOTE: Normally closed and Normally open flow rates, C_V etc. vary slightly and can cause slight deviations from these specifications.

Example of how to calculate fill/exhaust times:

Model 125A-3-10-20
One Air Line (0.125 I.D. x 36-inch long)

100 psig supply
Air Cylinder (2-inch bore x 4-inch stroke)

Volume =
0.785 x Diameter squared x stroke or length

Cylinder Volume	= 12.56 cubic inches
Air Line Volume	= 0.43 cubic inches
Total Circuit Volume	= 12.99 or 13 cubic inches

Time to Fill 13 cubic inches =
130% of .150 sec. for 10 cubic inches = 0.195 sec.

Time to Exhaust 13 cubic inches =
130% of .200 sec. for 10 cubic inches = 0.260 sec.

Total Cycle Time = 0.455*

*Although this result is not exact, it is sufficient for most application needs and provides a simple, straightforward system.

Flow Controls

Diaphragm-poppet and piston-poppet valves (125, 250, 500, 501, and 590 Series): Flow controls should be placed between valve and device being actuated. Installation of flow controls in valve exhaust ports is not recommended as back pressure may cause valve to malfunction (mid-position).

Detented spool valves, such as 42, will accept flow controls in exhaust ports of in-line valves. Consider using the specially designed Speed Control (*Code 73*) for manifold valve applications.

Mufflers

A muffler may be installed in valve exhaust port(s) to muffle the sound of exhausting media. Mufflers must be porous enough not to impede exhaust function.

A canister-type muffler is recommended. Sintered bronze mufflers are not recommended because they easily become plugged, especially when used with unrefined media. If sintered bronze mufflers are used, routine cleaning or replacement should be part of a regular maintenance program.

Packaging

Individual components are packaged in corrugated boxes for protection. Boxes show the valve model number for easy product identification.

Customers purchasing large quantities may prefer to reduce unpacking cost by ordering in bulk. Bulk packs contain multiple units. Consult factory.

Troubleshooting

Valve malfunction problems are normally caused by circuit design errors, improper valve application, or improper plumbing.

Past experience indicates that the following are frequent causes of problems and should be investigated:

- Confirm presence of pressure; blocked or defective fittings are frequent causes of circuit start-up problems.
- Confirm adequate pilot pressure to shift valve. See specifications for pilot pressure requirements.
- When using diaphragm-poppet valves in low temperatures, diaphragms may become stiff. This may require increasing the rated pilot pressure to actuate the valve.
- When using diaphragm-poppet valves with dirt laden media, it is possible that the diaphragm seat(s) can become contaminated, preventing the valve from shifting properly. This can be corrected by disassembling and cleaning the valve.
- If, after a considerable time in use, a diaphragm-poppet valve fails to shift properly under adequate pilot pressure, the problem may be a ruptured top diaphragm. This can be corrected by repairing the valve with the proper Humphrey seals repair kit.

Warranty

All valves have a one year warranty from date of manufacture. This warranty includes repair and/or replacement at no charge should the product be deemed defective due to workmanship and/or material. See Humphrey Air Valves General Catalog.

Valves outside one year warranty may be repaired with Humphrey Seals Repair Kits or parts ordered from the parts list.