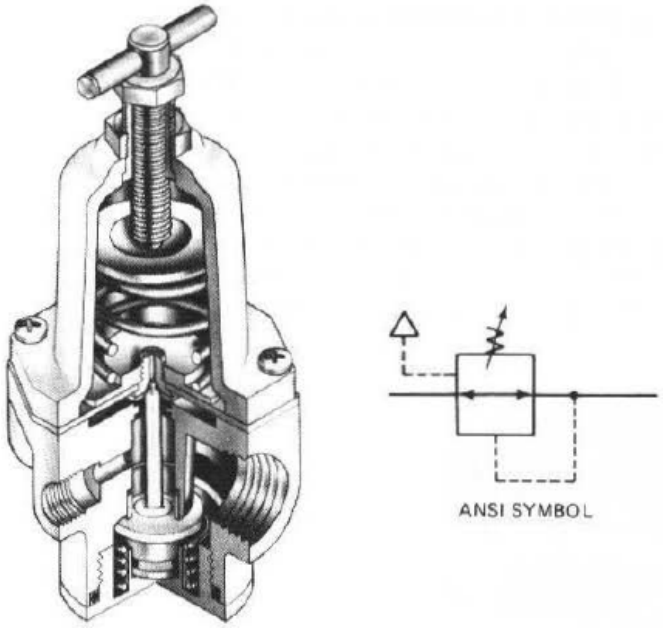
Air control valves

Air control valves are used to control the pressure, flow rate, and direction of air in pneumatic circuits.

Pneumatic pressure control valves

Pressure regulator

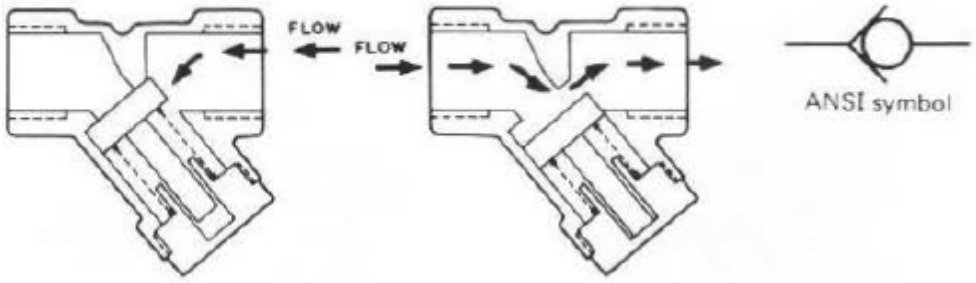
Pneumatic pressure control valves are air line regulators that are installed at the inlet of each separate pneumatic circuit. As such, they establish the working pressure of the particular circuit. Sometimes air line regulators are installed within a circuit to provide two or more different pressure levels for separate portions of the circuit. A cutaway view of an actual pressure regulator is given in Figure. The desired pressure level is established by the T-handle, which exerts a compressive force on the spring. The spring transmits a force to the diaphragm, which regulates the opening and closing of the control valve. This regulates the air flow rate to establish the desired downstream pressure.



Pneumatic direction control valves

Check valve

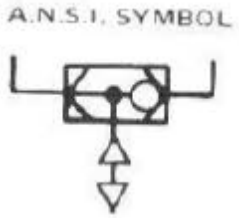
In Figure, we see a check valve that shuts off instantaneously against reverse flow and opens at low cracking pressures in the forward direction. As shown in the schematic views, the disk seals before reverse flow is established, thus avoiding fluid shock on reversal of pressure differential. Although the design shown has a metal body, lightweight plastic body designs with fittings suitable for plastic or metal tubing are also available.



Shuttle valve

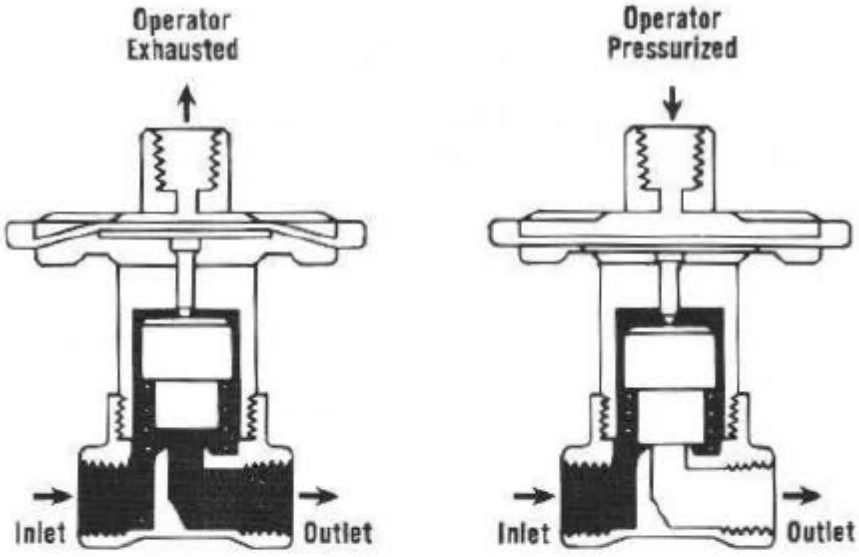
A pneumatic shuttle valve automatically selects the higher of two input pressures and connects that pressure to the output port while blocking the lower pressure. This valve has two input ports and one output port and employs a free-floating spool with an open-center action. At one end of the spool's travel, it connects one input with the output port. At the other end of its travel, it connects the second input with the output port. When a pressure is applied to an input port, the air shifts the spool and then moves through the sleeve ports and out the output port. When the pressure is removed from the input port, the air in the output port exhausts back through the shuttle valve and out one of the input ports. It normally exhausts out the input port through which it entered. but there is no guarantee and it may exhaust out the other. If a signal is applied to the second input port, a similar action takes place.

If while one input is pressurized, the second input port receives a pressure that is 1.5 psig greater than the first, the higher pressure will appear at the output. If the second input is the same as the first, no change will take place until the first signal is exhausted. Then, as it drops in pressure, the second input will predominate.

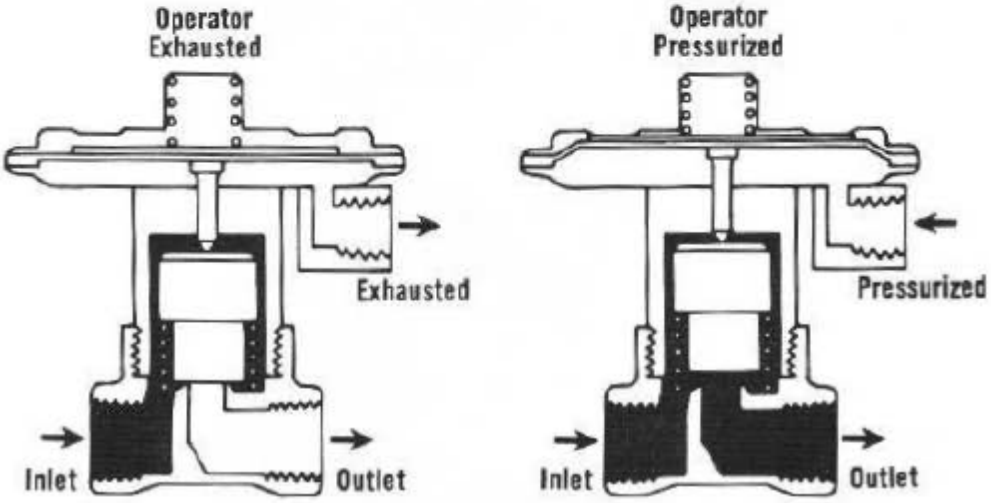


Directional Control two-way valve

In Figure, we see an air-operated (air-piloted), two-way, pneumatic valve. As shown, this valve is available to operate either normally open or normally closed. The poppet-type construction provides a tight shutoff, and variations in the pilot air pressure or main line pressure do not affect the operation of these valves. The pilot pressure need not be constant. These valves will handle dry or lubricated air and provide long life.



Normally Open



Normally Closed

Three-way and four-way Directional Control valve

A multipurpose three-way or open-exhaust four-way, push-button directional control valve.

The four-way valves may also be used as normally open or closed three-ways by plugging the appropriate cylinder port. Exhaust is through two screened ports I see Figure. Since these ports cannot be plugged, four-way valves may not be used as two-ways. The force required to operate these valves is 2.5 lb.

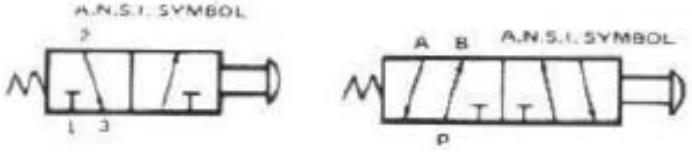
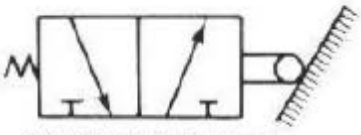
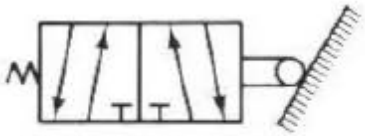


Figure shows a palm-button directional control valve. The large mushroom heads are extra heavy duty operators specifically designed to survive the day-after-day pounding of heavy, gloved hands in stamping press, foundry and other similar applications. The large, rounded button is padded with a soft synthetic rubber cover, which favors the operator's hand.

In figure, we see a limit valve that uses a roller-level actuator. These directional control valves are available as multipurpose three-ways or open exhaust four-ways. This type of valve is normally actuated by a cylinder piston rod at the ends or limits of its extension or retraction strokes.





In figure, we see a hand-lever-operated four-way directional control valve. The hand lever is used with two- or three-position valves. Hand movement of the lever causes the spool to move. The lever is directly connected to the spool. Octents, which provide a definite "feel" when the spool is in a specific position, are available.

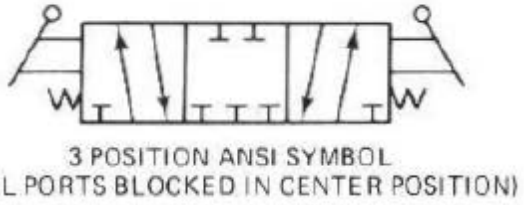
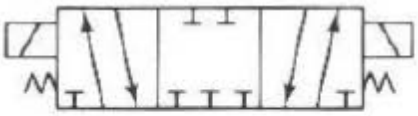
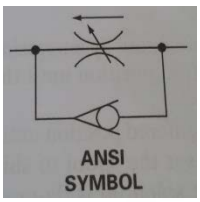


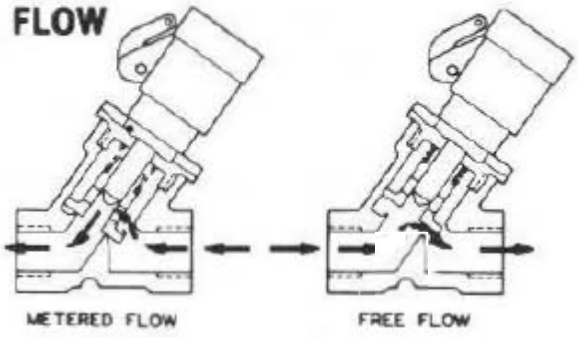
Figure illustrates the internal construction features of a four-way. Two position, solenoid-actuated directional control valve. The single-solenoid operator shown will move the spool when energized, and a spring will return the spool when the solenoid is deenergized. Using two solenoids, a two-position valve can be shifted by energizing one solenoid momentarily. The valve will remain in the shifted position until the opposite solenoid is energized momentarily.
Three-position valves will remain in the spring-centered position until one of the solenoids is energized. Energizing the solenoid causes the spool to shift and stay shifted until the solenoid is deenergized. When the solenoid is deenergized, the spool will return to the center position.



Pneumatic flow control valve

As shown, a spring-loaded disk allows free flow in one direction and an adjustable or controlled flow in the opposite direction. Flow adjustment is performed by a tapered brass stem that controls the flow through the cross hole in the disk. The adjustable knob contains a unique locking device that consists of a plastic metering knob and thumb latch pawl. The valve bonnet is scribed with graduations to serve as a position indicator for the stem. When the pawl is in the up position, it creates a friction lock on the knurled bonnet, and the knob cannot rotate. When the pawl is at 90° to the knob, the knob is free to rotate. Mounting in any position will not affect operation.





EXAMPLE

A pneumatically powered impact tool requires 50 scfm of air at 100 psig. What size valve (C_v) should be selected for this application if the valve pressure drop should not exceed 12 psi and the air temperature is 80°F?

Solution Convert the temperature and downstream pressure into absolute units.

$$T = 80 + 460 = 540°R$$

$$P_2 = 100 + 14.7 = 114.7 \text{ psia}$$

Next solve Eq. (10-9) for C_v and substitute known values.

$$C_v = \frac{Q}{22.7}\sqrt{\frac{T}{(P_1 - P_2)(P_2)}} = \frac{50}{22.7}\sqrt{\frac{540}{12 \times 114.7}} = 1.38$$

Thus any valve with a C_v of 1.38 or greater can be selected. If a C_v less than 1.38 is selected, excessive pressure drops will occur, leading to system malfunction. However, selecting a C_v that is much greater than 1.38 will result in a greatly oversized valve, which increases the costs of the pneumatic system.