

## Solenoid Valves

### Principles of Operation

A solenoid valve is a combination of two basic functional units:

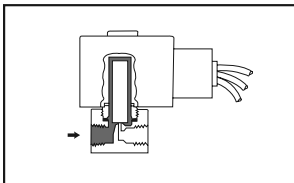
- A solenoid (electromagnet) with its core
- A valve body containing one or more orifices

Flow through an orifice is shut off or allowed by the movement of the core when the solenoid is energized or de-energized. ASCO valves have a solenoid mounted directly on the valve body. The core is enclosed in a sealed tube, providing a compact, leaktight assembly.

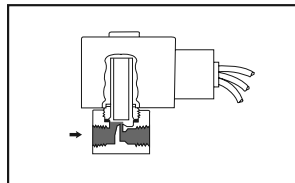
### Direct Acting Valves (Figures 1A, 1B)

When the solenoid is energized in a direct acting valve, the core directly opens the orifice of a Normally Closed valve or closes the orifice of a Normally Open valve. When de-energized, a spring returns the valve to its original position. The valve will operate at pressures from 0 psi to its rated maximum.

The force needed to open the valve is proportional to the orifice size and fluid pressure. As the orifice size increases, so does the force required. To open large orifices while keeping solenoid size small, a Pilot Operated construction is used.



**Figure 1A:**  
Direct Acting,  
Normally Closed Valve,  
De-Energized



**Figure 1B:**  
Direct Acting,  
Normally Closed Valve,  
Energized

### Internal Pilot Operated Valves (Figures 2A, 2B)

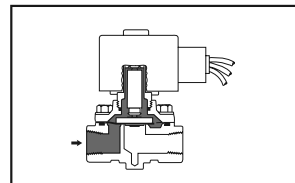
Normally, these valves have a pilot and bleed orifice which enable them to use line pressure for operation.

When the solenoid is de-energized, the pilot orifice is closed and full line pressure is applied to the top of the piston or diaphragm through the bleed orifice, providing seating force for tight closure.

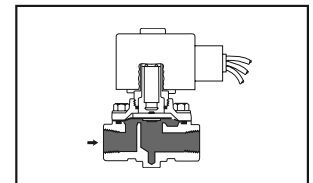
When the solenoid is energized, the core opens the pilot orifice, relieving pressure from the top of the piston or diaphragm via the outlet side of the valve. The line pressure then opens the valve by lifting the diaphragm or piston off the main orifice.

Two constructions are available for 2-way valves:

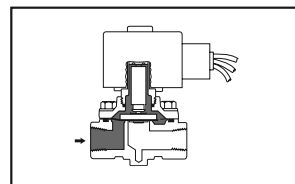
- Floating diaphragm or piston which requires a minimum pressure drop across the valve to remain in the open position (Figures 2A, 2B).
- Hung-type diaphragm or piston held open mechanically by the solenoid core. The valve opens and remains open with zero pressure drop (Figures 3A, 3B).



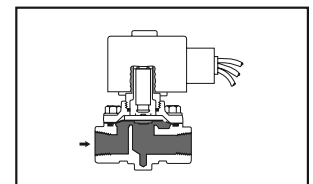
**Figure 2A:**  
Pilot Operated, Normally  
Closed Valve,  
De-Energized



**Figure 2B:**  
Pilot Operated,  
Normally Closed Valve,  
Energized



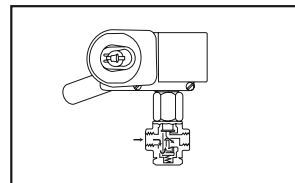
**Figure 3A:**  
Pilot Operated, Normally  
Closed Valve,  
De-Energized



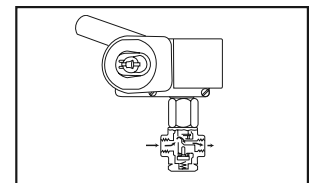
**Figure 3B:**  
Pilot Operated,  
Normally Closed Valve,  
Energized

### Manual Reset Valves (Figures 4A, 4B)

Manual reset valves must be manually latched into position and will return to their original position only when the solenoid has been energized or de-energized, depending on construction



**Figure 4A:**  
No Voltage Release  
Manual Reset Valve,  
Un-Latched, De-Energized



**Figure 4B:**  
No Voltage Release  
Manual Reset Valve,  
Latched, Energized

## Types of Solenoid Valves

### 2-Way Valves (Figures 1A, 1B, 2A, 2B, 3A, 3B)

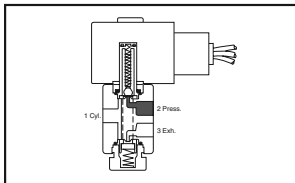
Two-way valves have one inlet and one outlet pipe connection. They are used to allow or shut off fluid flow, and are available in either:

Normally Closed – closed when de-energized and open when energized.

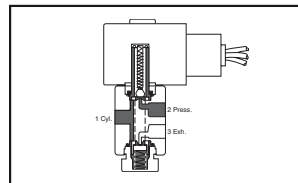
Normally Open – open when de-energized and closed when energized.

### 3-Way Valves (Figures 5A, 5B)

Three-way valves have three pipe connections and two orifices (when one is open, the other is closed, and vice versa). They are commonly used to alternately apply pressure to and exhaust pressure from the diaphragm operator of a control valve, single-acting cylinder, or rotary actuator.



**Figure 5A:**  
Three-Way  
Normally Closed Valve,  
De-Energized



**Figure 5B:**  
Three-Way  
Normally Closed Valve,  
Energized

Three modes of operation are available:

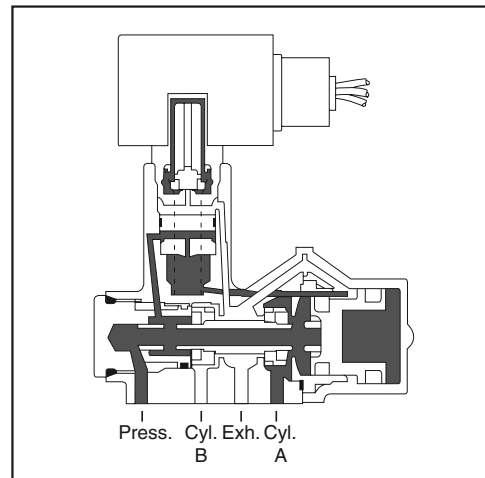
Normally Closed – when the valve is de-energized, the pressure port is closed and the cylinder port is connected to the exhaust port. When the valve is energized, the pressure port is connected to the cylinder port and the exhaust port is closed.

Normally Open – when the valve is de-energized, the pressure port is connected to the cylinder port and the exhaust port is closed. When the valve is energized, the pressure port is closed and the cylinder port is connected to the exhaust port.

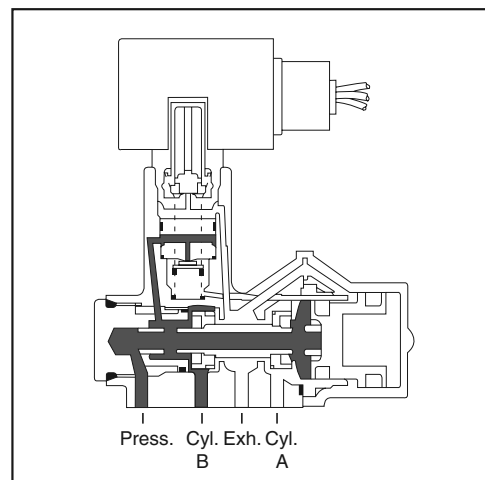
Universal – allows the valve to be connected in either the Normally Closed or Normally Open position to select one of two fluids or to divert flow from one port to another.

### 4-Way Valves (Figures 6A, 6B)

Four-way valves are generally used to operate double-acting cylinders or actuators. They have four or five pipe connections: one pressure, two cylinder, and one or two exhausts. In Position A, pressure is connected to one cylinder port, the other is connected to exhaust. In Position B, pressure and exhaust are reversed at the cylinder ports.



**Figure 6A:**  
Four-Way Valve, De-Energized



**Figure 6B:**  
Four-Way Valve, Energized





















































