

# **Pneumatics Workbook Symbology**

**Festo  
Learning Systems**



## Symbol Design

The symbols used in this workbook are based on ISO (The International Organization for Standardization) standards 1219 parts 1 and 2.

Symbols are used to represent fluid power components in circuit diagrams. These symbols illustrate the function of each component but do not indicate the design principle on which it is constructed. Valve position changes are commonly referred to as switching positions.

Description	Symbol
Valve switching positions are represented by squares. If a valve has more than one square it is most likely a directional control valve.	
The number of adjacent squares indicate the number of switching positions the valve has.	
The function and working principle are drawn inside the squares. <b>RULE OF THUMB:</b> An arrow in a square means that the symbol is a valve of some sort.	
Lines inside the square indicate a “flow path”. Arrows show the direction of the flow.	
Shut-off positions are identified in the squares by lines drawn at right angles across the flow path. They are called “plugs” and look like the letter “T”.	
Flow path junctions (or connections) are represented by a dot.	
The connections (inlet and outlet ports) are shown by lines drawn on the outside of the square representing the normal (at rest) or initial position.	
Other positions are made by shifting the squares until the flow paths correspond to (or line up with) the connections.	

## Description

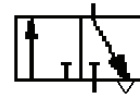
## Symbol

Letters such as “O”, “a”, “b”, and “c” are used to label valve positions. Valve with 3 positions. O indicates the valves “neutral” position.

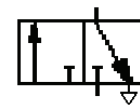


In valves which can be reset (by means of a spring for example), the normal or initial position is the position assumed by the moving parts of the valve in its un-actuated state.

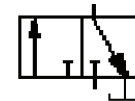
A triangle located directly on the outside of the symbol is an exhaust (when using compressed air) to atmosphere **RULE OF THUMB: Check the color of the triangle. A white triangle means that the system is using compressed air (or some other compressed gas). A black triangle means that it is a hydraulic system.**



A triangle not directly connected to the symbol is an exhaust path with a pipe extension.



This symbol shows a return to tank on a hydraulic valve.



To insure that the valve is properly installed the connections are labeled with capital letters or with numbers. **RULE OF THUMB: Letters are normally used with hydraulic components (P, A, B, and T). Numbers are normally used with pneumatic components (1, 2, 3, 4, 5, 12, 14, 13,15) NOTE: Some pneumatic components have been manufactured with alphabetical port labeling (see below).**

<u>Port connection</u>	<u>Alphabetical (hyd.) port labels</u>	<u>Alphabetical (pneu.) port labels</u>	<u>Numerical (pneu.) port labels</u>
Working lines (output from component)	A, B	A, B	2, 4
Leakage	L	-	-
Supply (incoming from energy source)	P	P	1
Exhaust (pneumatic components only)	-	R, S	3, 5
Tank (hydraulic components only)	T	-	-
Pilot	X, Y, Z	X, Y, Z	12, 14, 16, 18

The designation of a valve is based on the number of ports and the number of switching positions. The first number in the designation specifies the number of ports. The second number specifies the number of switching positions in the valve.

Example:

3/2 directional control valve:            3 ports, 2 switching positions (2 squares)

4/3 directional control valve:            4 ports, 3 switching positions (3 squares)

## Directional Control Valves

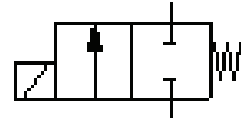
Description	Normal Position	Symbol
2/2 directional control valve	closed	
2/2 directional control valve	Open (or passing)	
3/2 directional control valve	closed	
3/2 directional control valve	open	
3/3 directional control valve	closed	
4/2 directional control valve	open (or passing)	
4/3 directional control valve	closed center	
4/3 directional control valve	float center	
4/3 directional control valve	tandem center	
5/2 directional control valve	open (or passing)	

## Directional Control Valves

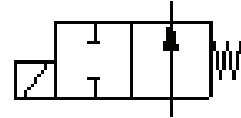
### Description

### Symbol

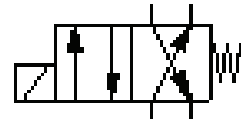
2/2 directional control valve / single solenoid actuated /  
spring return / normally closed



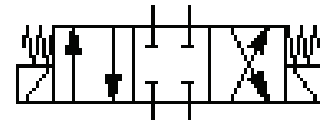
2/2 directional control valve / single solenoid actuated /  
spring return / normally open



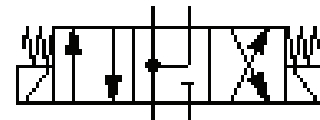
4/2 directional control valve / single solenoid actuated /  
spring return



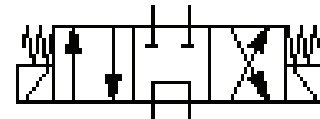
4/3 directional control valve / double solenoid actuated /  
spring centered / closed center



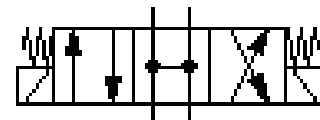
4/3 directional control valve / double solenoid actuated /  
spring centered / regenerative center



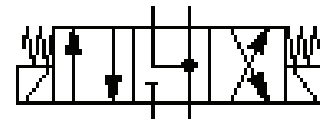
4/3 directional control valve / double solenoid actuated /  
spring centered / tandem center



4/3 directional control valve / double solenoid actuated /  
spring centered / open center



4/3 directional control valve / double solenoid actuated /  
spring centered / float center



## Types of Valve Actuation

Depending on the application directional control valves can be actuated by a variety of methods. The actuation symbols are drawn horizontally against the squares.

Description	Symbol
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**Manual Control**  
General (non-specific)



Push button



Lever



Foot pedal



**Mechanical Control**

Plunger



Spring



Roller



Idle roller lever



**Electrical Control**

Solenoid



**Air Pressure Control**

Air actuated



Air applied to the main valve through a pilot valve



**Detented**

Notches indicate number of positions. Vertical line indicates normal, or initial position.







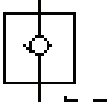
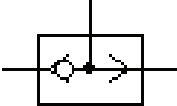
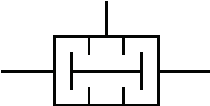
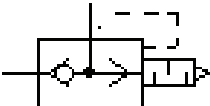
## Energy Conversion

Description	Symbol
Compressor	
Hydraulic pump	
Vacuum pump	
Motor (pneumatic)	
Motor (reversible—pneumatic)	
Motor (rotary actuator—pneumatic)	
Motor (hydraulic)	

## Actuators

Description	Symbol
Single acting cylinder, retraction by external force	
Single acting cylinder, retraction by spring	
Double acting cylinder	
Double – ended double acting cylinder	
Differential cylinder	
Double ended cylinder with end position cushioning	
Telescopic cylinder	
Pressure intensifier	

## Check Valves

Description	Symbol
Check valve	
Spring - loaded check valve	
Pilot operated check valve	
Shuttle valve (OR gate)	
Two pressure valve (AND gate)	
Quick exhaust valve	

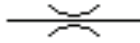

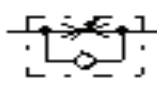
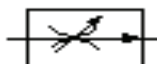
## Shutoff Valves

Description	Symbol
Shutoff valve	



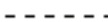


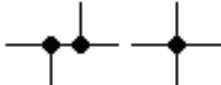

## Pressure Control Valves

Description	Symbol
Pressure relief valve (pneumatic)	
Pressure relief valve (hydraulic)	
Sequence valve (hydraulic)	
Sequence valve (pneumatic)	
3 - way pressure reducing valve	
Pressure regulator valve (hydraulic)	
Pressure regulator valve (pneumatic)	

## Flow Control Valves

Description	Symbol
Restrictor	
Flow control valve (Variable restrictor)	
One way flow control valve (flow control with bypass check valve)	
Pressure compensated flow control valve	

## Energy Transmission

Supply source (pressure)	
Working line	
Control line (pilot)	
Exhaust (or drain) line	
Flexible line (hose)	
Connection point (lines connected)	
Lines crossing	

Description	Symbol
Muffler	
Receiver (reservoir)	
Gauge	
Filter	
Water separator	
Filter and water separator	
Lubricator	
Service Unit (filter, regulator and lubricator)	
Hydraulic Power Unit (HPU)	