

# Appendix B: Hydraulic Symbols

## Introduction

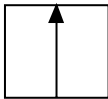
This appendix introduces the basic symbols used in hydraulic schematics. An explanation is provided on the basic building blocks used to generate the symbol for a solenoid valve. In addition to the hydraulic symbols, some general symbols frequently used in hydraulic schematics are also shown. In addition, examples are also provided to clarify the symbol generation process.



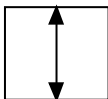
# HYDRAFORCE

## Basic Hydraulic Symbols

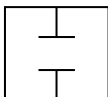
The basic symbol for a hydraulic valve is a rectangle, which represents the valve enclosure. Lines within the rectangle indicate the flow directions between the valve inlet and outlet openings. These openings are known as *ports*. Either a single rectangle or multiple rectangles are used to show the change in flow conditions. A single rectangle is used to show that only one flow path exists through the valve. Multiple rectangles indicate more flow paths, and show how the path is changed.



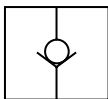
A single arrow represents oil flowing from one port. The arrow indicates which direction the oil is flowing.



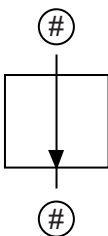
An arrow in each direction represents oil flowing to and from either port.



The “T” (tee) indicates that oil is blocked from flowing to or from that port. Two Ts indicated that the flow is blocked at both ports shown. This symbol implies that the hydraulic control element within the valve is a spool.



This symbol represents the check valve symbol. It indicates that the top port is blocking the flow of oil to the bottom port. It is implied that when the pressure at the bottom port exceeds the pressure at the top port, oil can flow from the bottom to the top port. It is further implied that the construction consists of a ball or poppet on a seat.

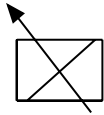


The numbers within the circles in this symbol represent the port numbers and the direction of flow. In addition, their location on the symbol indicates the neutral position of the valve. Small lines are added to the outside of the box to further indicate the ports.

In addition to these symbols, there another set which indicate how the valve is being controlled, or how it changes position. These symbols are smaller than the first set and are shown to the right or left of the rectangle which they control. These are shown below.



This symbol indicates a solenoid coil and can be attached to either side of the symbols shown on the previous page. If the symbol contains two slash marks in opposite directions, it indicates that there are two solenoid coils acting. The armatures can be actuated in two directions.



Variable power applied to the coil is represented in this symbol.



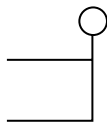
A coil with a manual override is represented in this symbol.



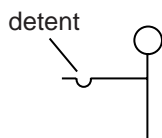
This symbol indicates a spring and can be attached to either side of the box.



This symbol indicates a spring with a variable setting.

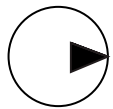


This symbol represents a manual operator.



This symbol represents a manual operator with detent.

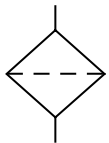
The following symbols are general symbols which are frequently used in describing hydraulic applications.



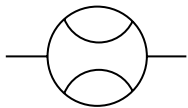
**PUMP**



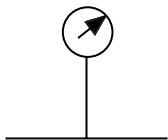
**TANK (RESERVOIR)**



**FILTER**



**FLOW METER**

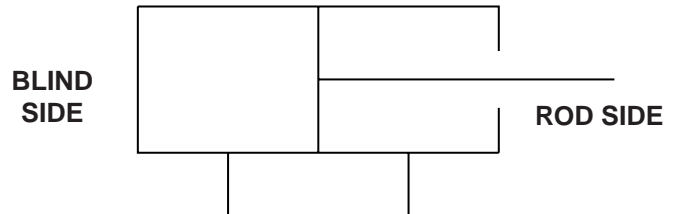


**PRESSURE SENSOR**

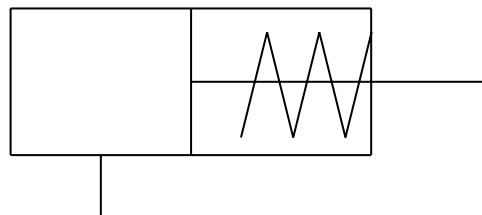


**HYDRAULIC MOTOR**

**DOUBLE ACTING CYLINDER**



**SPRING RETURN  
SINGLE ACTING CYLINDER**

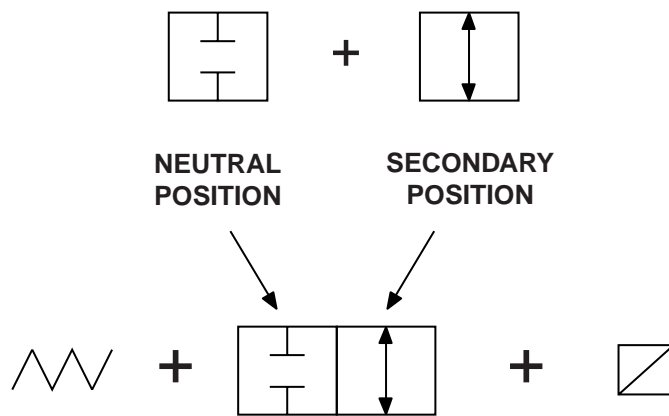


The following section walks through some examples of various symbols for solenoid directional control valves.

Create a symbol for a valve with two ports that blocks flow in the neutral position (or when no power is applied to the solenoid). In the second position, both ports are connected, allowing flow in either direction. Assume the spring holds the valve in the neutral position and the solenoid moves the valve into the secondary or energized position. Also assume that the valve is a spool type. To summarize these criteria:

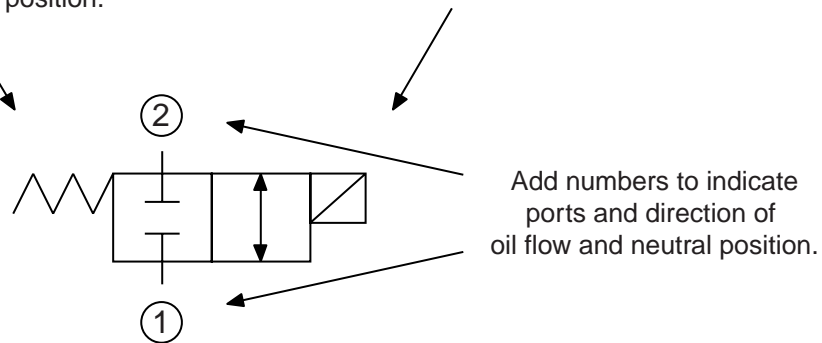
- 2 ports
- neutral position, (both blocked)
- spool type
- energized position, (flow in both directions)

The symbol for these criteria is:



Add spring to neutral position to show that the spring is responsible for holding the valve in this position.

Add solenoid to second position to show that it moves or holds the valve in this position.



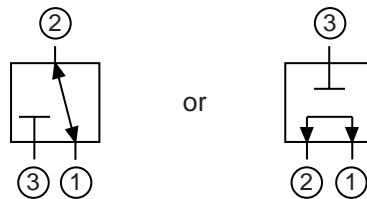
Add numbers to indicate ports and direction of oil flow and neutral position.

In this example we will create a symbol for a valve with three ports.

The symbol will include:

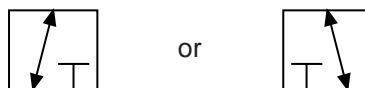
- flow paths
  - neutral position: port 2 is connected to 1, flow is allowed in both directions, port 3 is blocked
  - second position: port 2 and 3 are connected, flow is bidirectional, port 1 is blocked
- spool type valve
- spring holds the valve in the neutral position
- solenoid coil holds the valve in the second position

Draw Box for Neutral Position

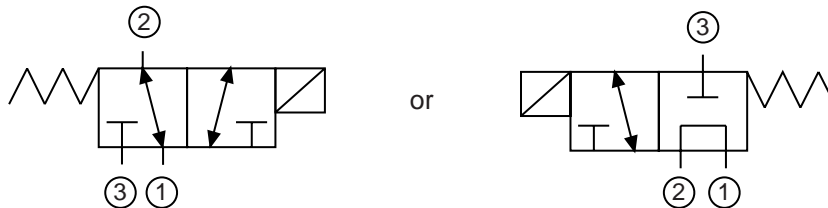


(there can be several variations)

Draw Box for Secondary Position



Combine steps 1 and 2. Add spring next to the neutral position and add solenoid next to secondary position.



Notice that the neutral position on the symbol shown to the right is on the right side of the symbol. By convention, because we read from right to left, the neutral position is typically on the right, but can also be shown on the left.