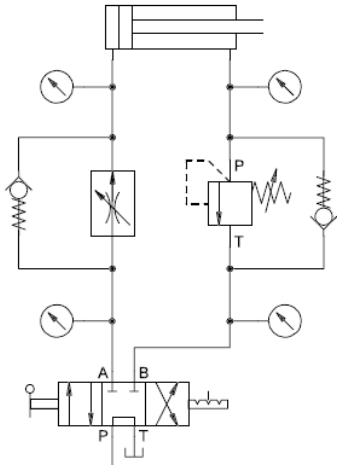


بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

# ***Hydraulic & Pneumatic Circuits***



**Tanta University**



**Faculty of Engineering  
Mechanical power  
Engineering Dept.**

## ***Lecture (6)***

***on***

# ***Components of Hydraulic Action and Control***

***By***

***Dr. Emad M. Saad***

*Industrial Engineering Dept.*

*Faculty of Engineering*

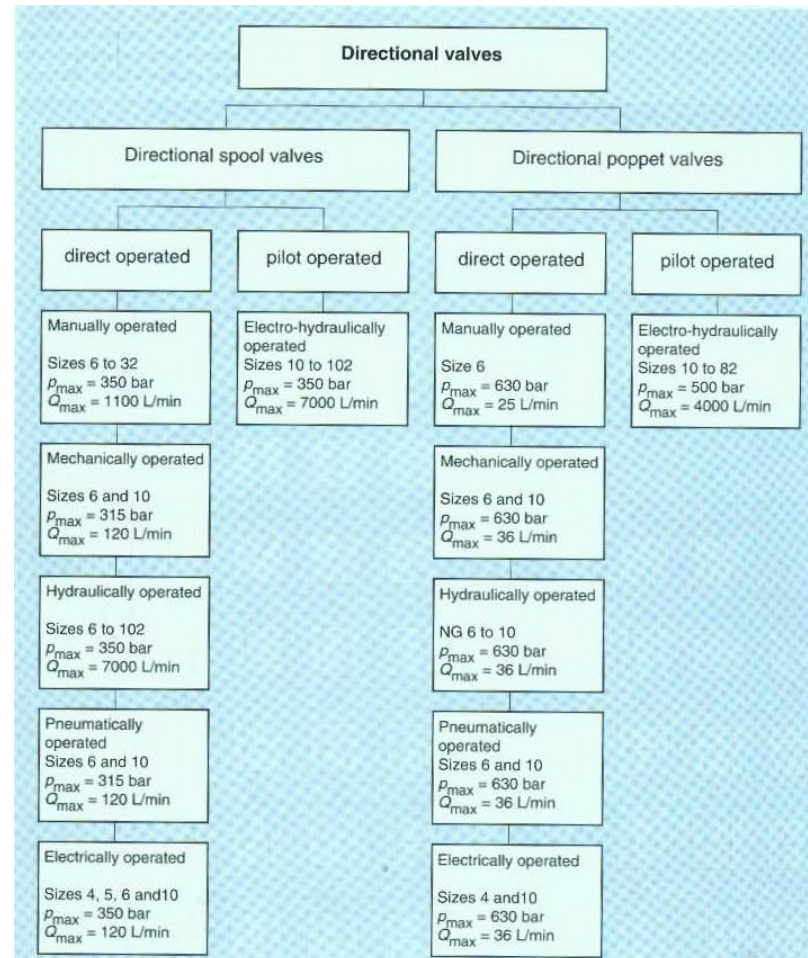
*Fayoum University*

**2014 - 2015**



# Directional Control Valves

3

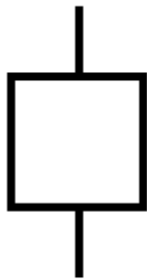




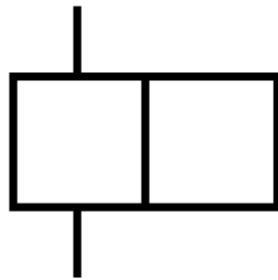
# Directional Control Valves

4

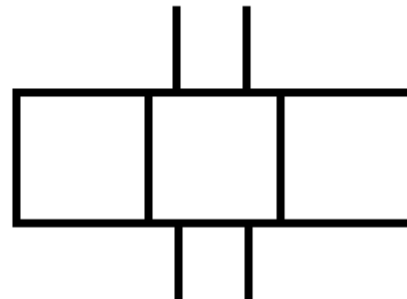
## Valve Position



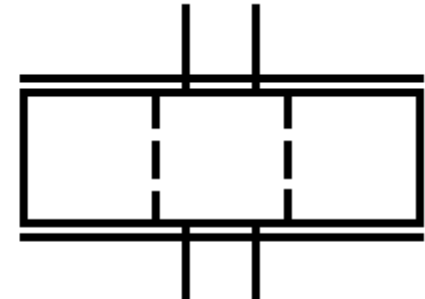
One-position  
(or infinite  
position  
single envelope)



Two-position



Three-position



Infinite-position

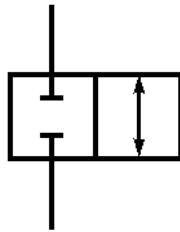




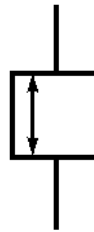
# Directional Control Valves

5

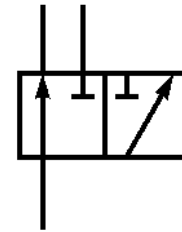
## Valve Port and way



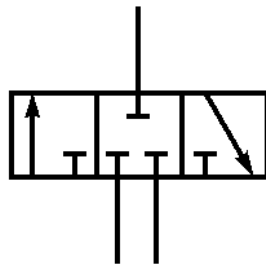
Two-way, two-position,  
two-port, normally  
closed



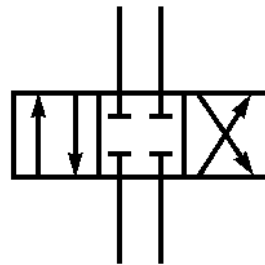
Two-way, infinite-position,  
two-port, normally closed



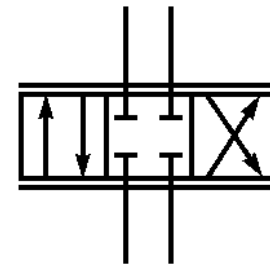
Three-way, two-position,  
three-port



Three-way, three-position,  
three-port, all ports blocked  
in center position, normally  
centered



Four-way, three-position,  
four-port, all ports blocked  
in center position, normally  
centered



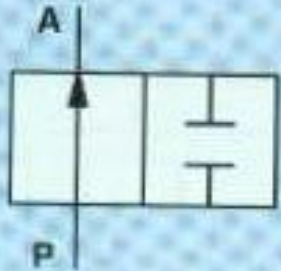
Four-way, infinite-position,  
four-port, all ports blocked  
when valve is in normally  
centered position



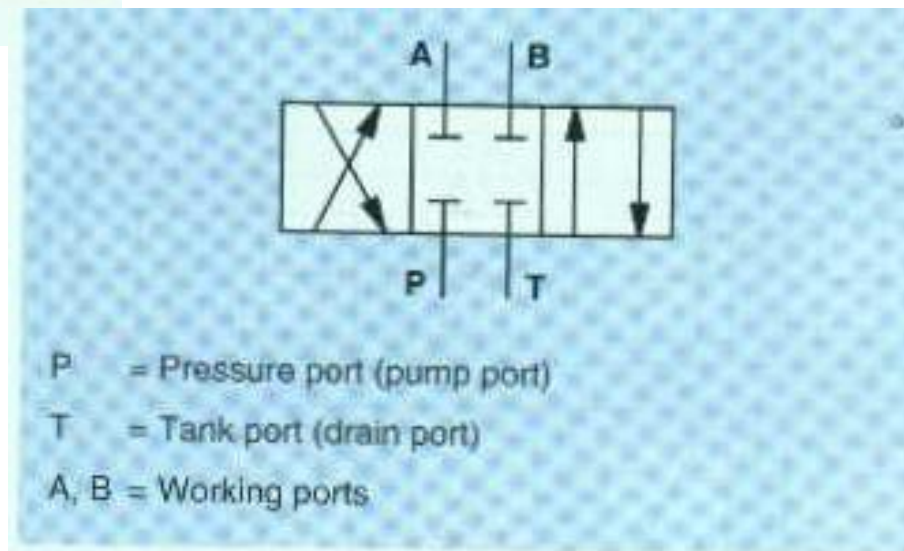
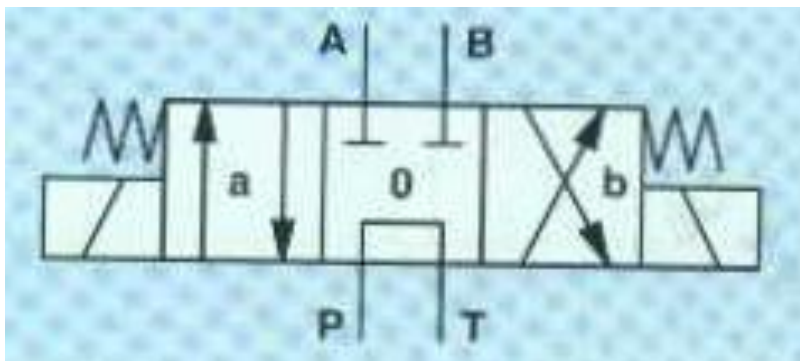


# Directional Control Valves

6



2/2 way directional valve



P = Pressure port (pump port)

T = Tank port (drain port)

A, B = Working ports

4/3 way directional valve with designation of ports



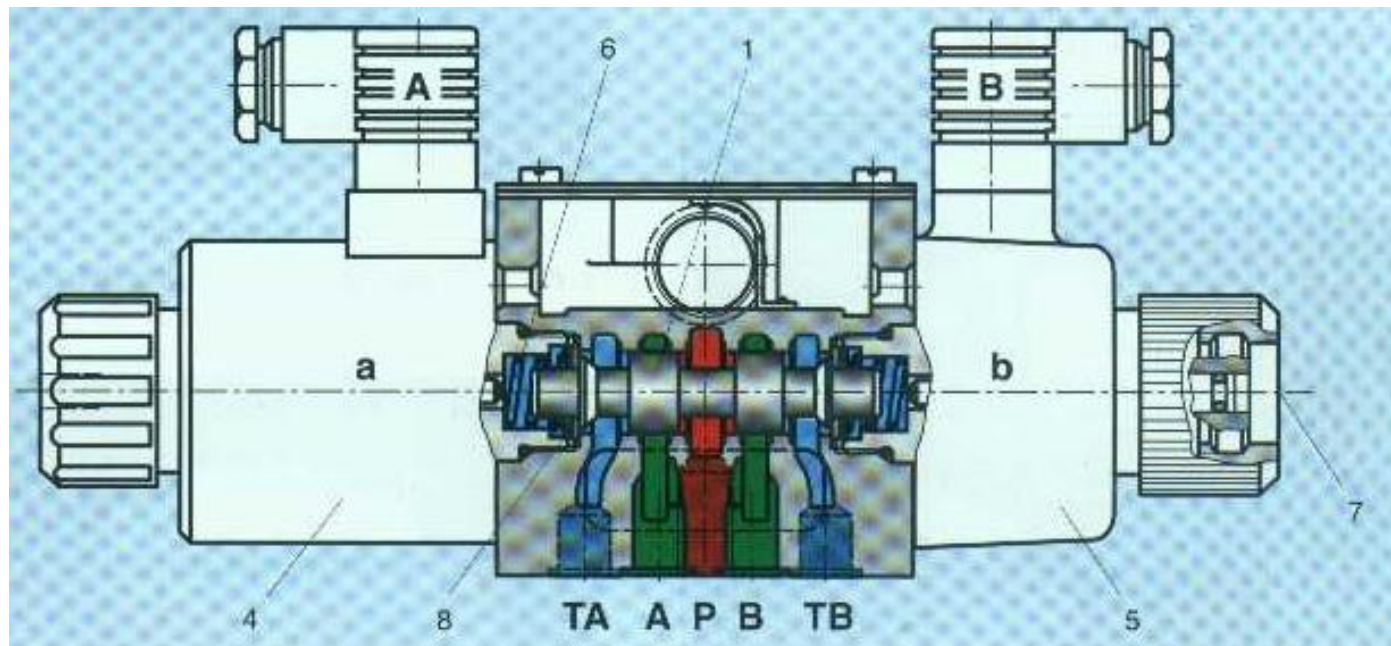




# Directional Control Valves

7

1. Spool
4. Solenoid
5. Solenoid
6. Spring
7. Hand emergency operator
8. Spring bad





# Directional Control Valves

8

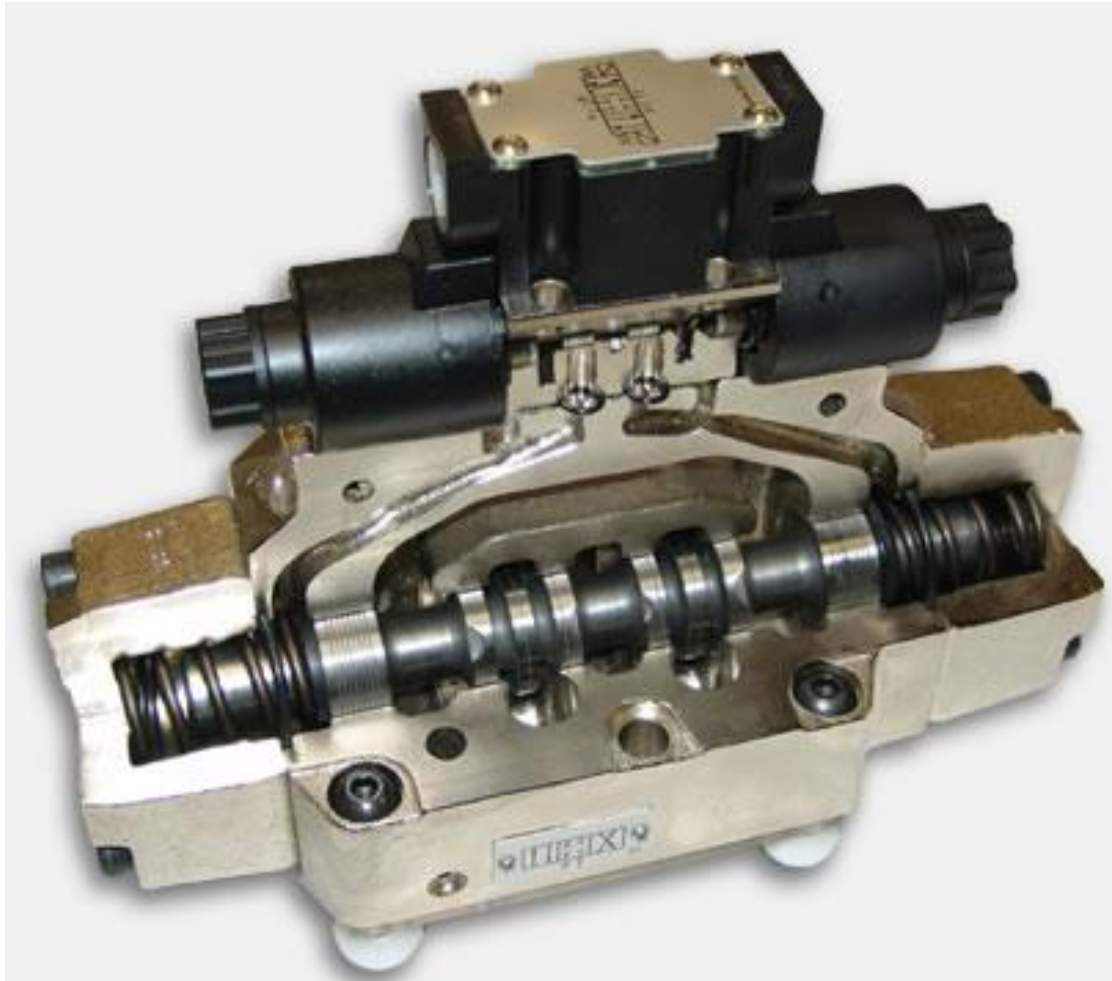






# Directional Control Valves

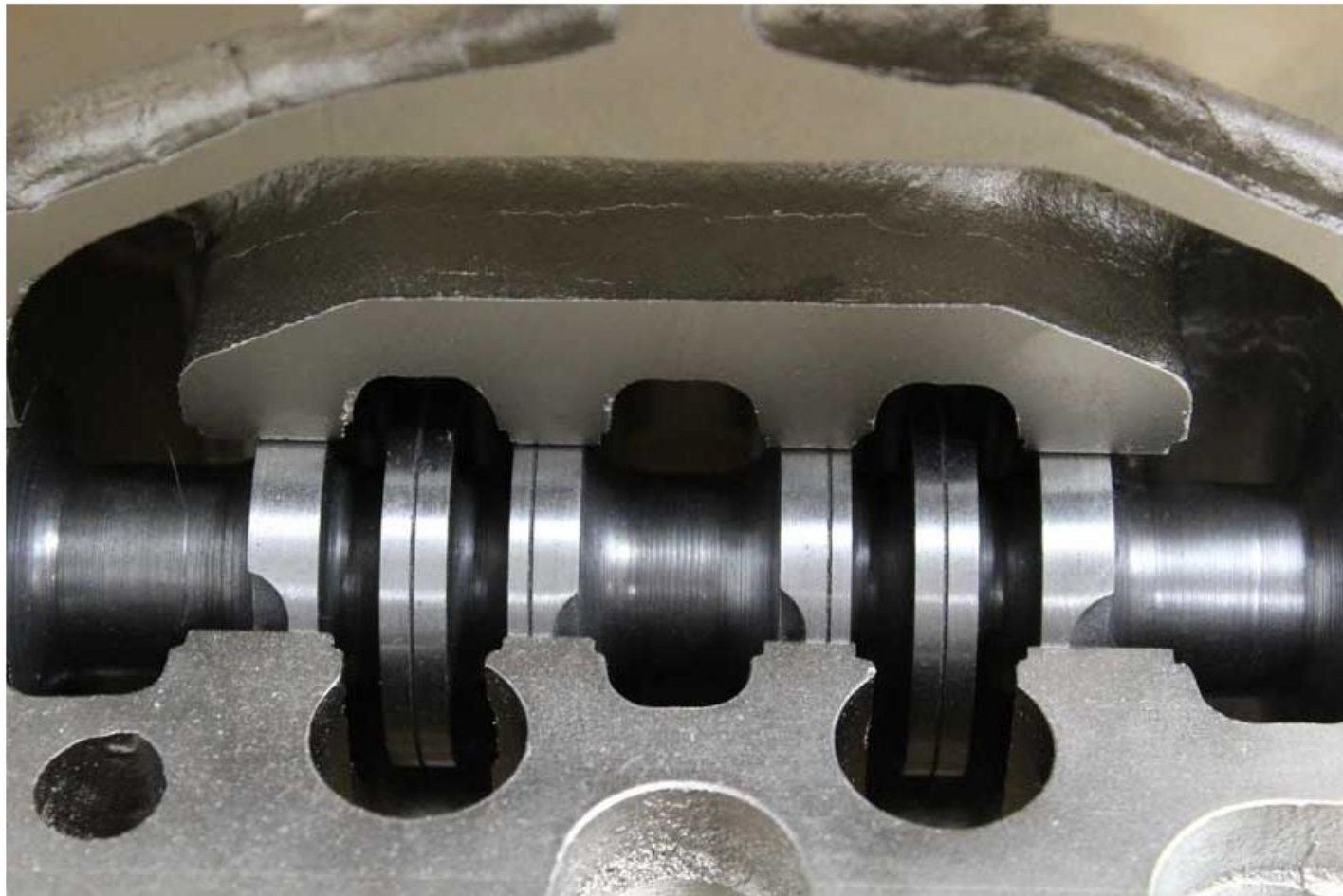
9





# Directional Control Valves

10

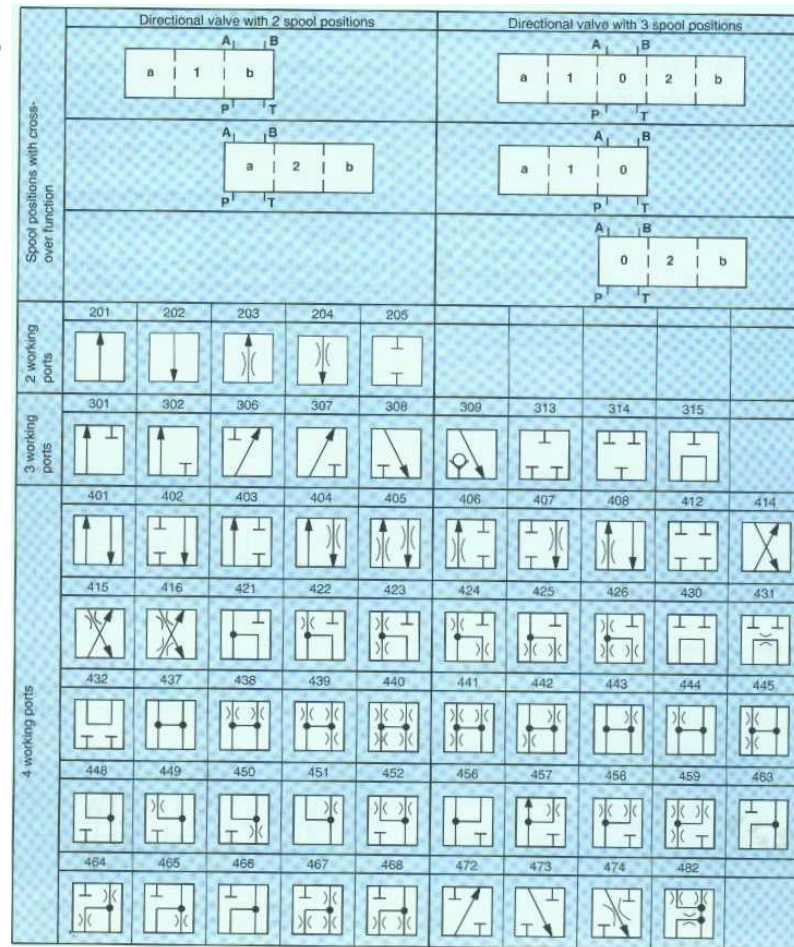




# Directional Control Valves

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## Center Conditions





# Directional Control Valves

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## Center Conditions

	Open Center	Closed Center
System idling time	Consumes a high percentage of operating time.	Consumes a small percentage of operating time.
Pump	Fixed displacement pump is to be used.	Variable displacement pump can be used.
Actuator	A single actuator is to be independently powered.	The system must operate more than one actuator using more than one independent control valve.
Operating control valve	Manual or electric operators are to be used.	Pilot oil pressure must come from the system.
Machine response time	Not critical, since the system must be brought to pressure after the control valve is shifted from the center position.	Critical.

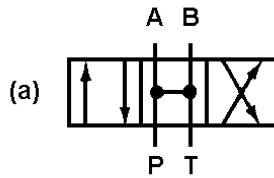




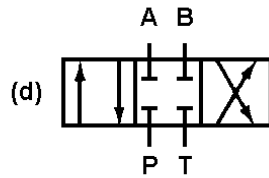
# Directional Control Valves

13

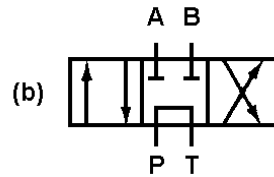
## Center Conditions



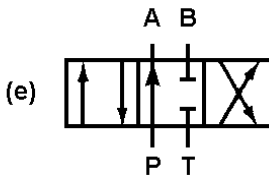
All ports open



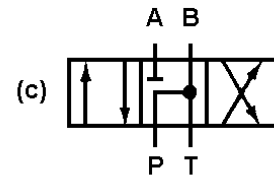
All ports blocked



P to T, A and B blocked  
(tandem center)

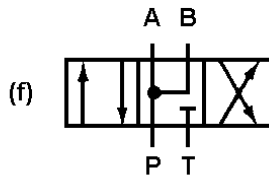


P to A, B and T blocked



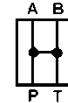
P to B and T, A blocked

Open center



P to A and B, T blocked

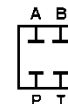
Closed center



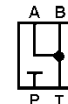
TYPE  
"0"



TYPE  
"3"



TYPE  
"2"



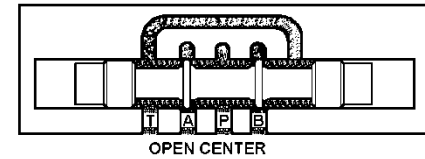
TYPE  
"6"



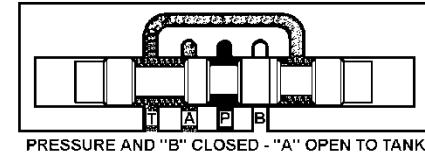
TYPE  
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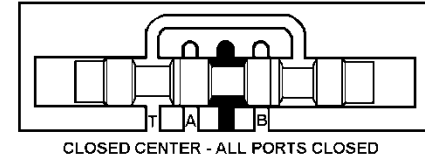
TYPE  
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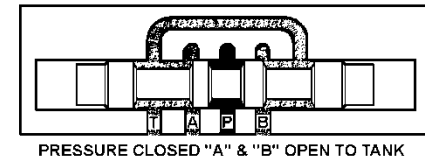
OPEN CENTER



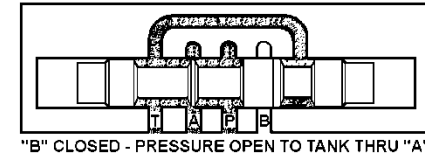
PRESSURE AND "B" CLOSED - "A" OPEN TO TANK



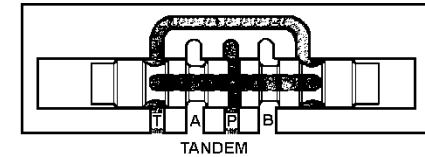
CLOSED CENTER - ALL PORTS CLOSED



PRESSURE CLOSED "A" & "B" OPEN TO TANK



"B" CLOSED - PRESSURE OPEN TO TANK THRU "A"



TANDEM



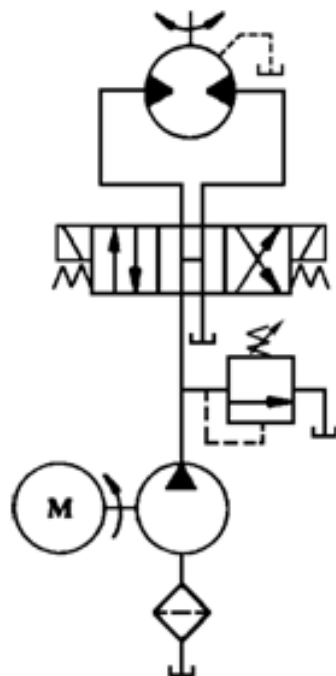




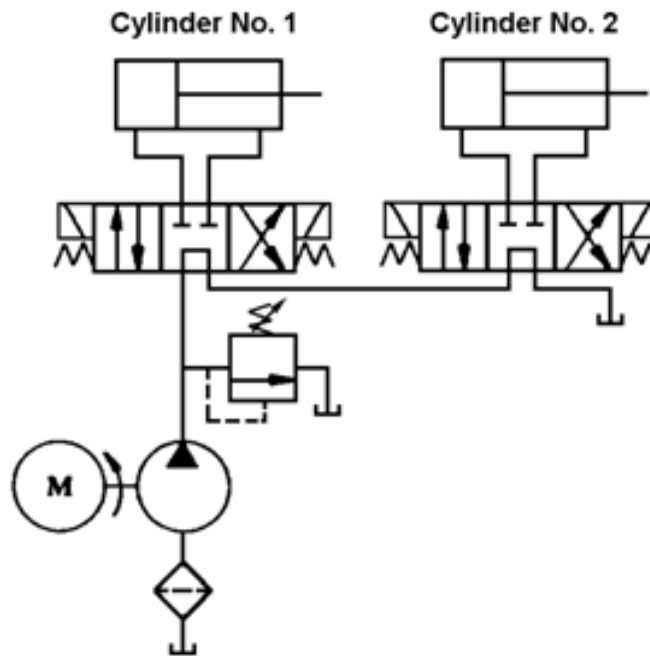
# Directional Control Valves

14

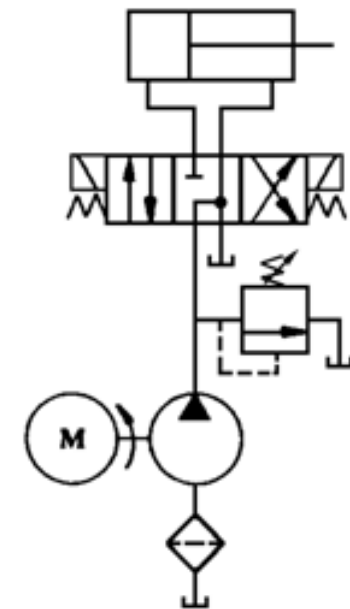
## Open-center valve circuits



Open center, all ports connected



Open tandem center



Open center, pump and one cylinder port to drain, other cylinder port blocked

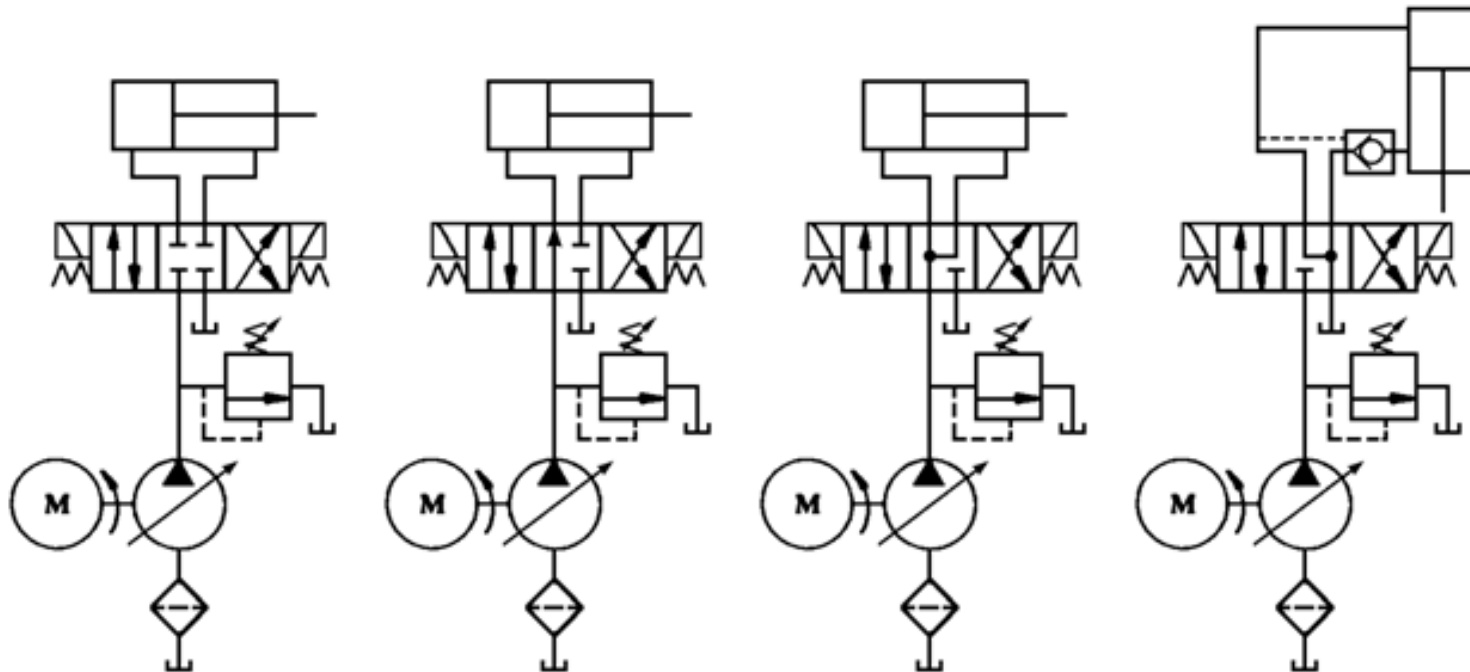




# Directional Control Valves

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## Closed-center valve circuits



Closed center,  
all ports blocked

Closed center, pump  
to one cylinder port,  
other cylinder port and  
reservoir port blocked

Closed center, pump  
to both cylinder ports,  
reservoir port blocked

Closed float center

—

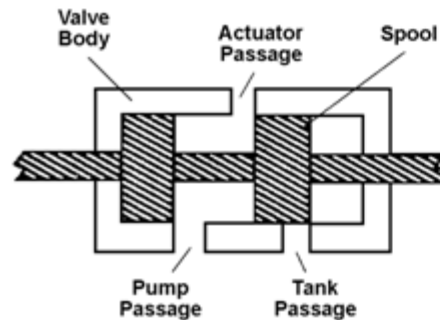




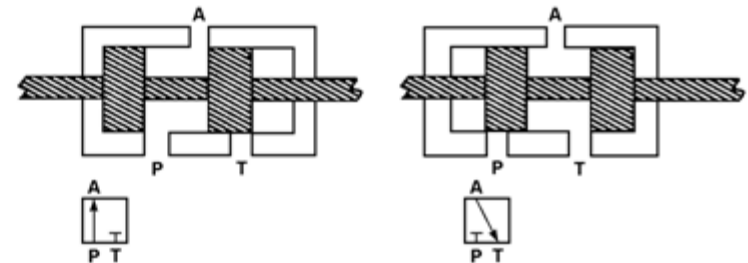
# Directional Control Valves

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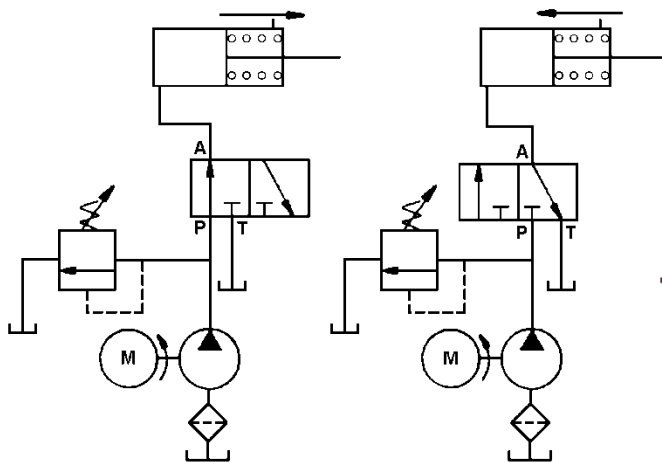
## Three-Way Directional Valve



Parts of a 3-way directional valve



Function of 3-way directional valve



Three-way two-position directional valve in a circuit





# Directional Control Valves

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## Directional Valve Sizes and Ratings

Directional control valves used in industrial hydraulic applications come in five basic sizes -1/4", 3/8", 1/2", 3/4", and 1 1/4". It is common industrial practice to rate the valves respectively at 3-5 GPM (1 GPM = 3.785 L/min), 10-12 GPM, 20 GPM, 35 GPM, and 100 GPM. At this nominal GPM rating the pressure differential from P to A or B to T is approximately 40 PSI (2.76 bar).

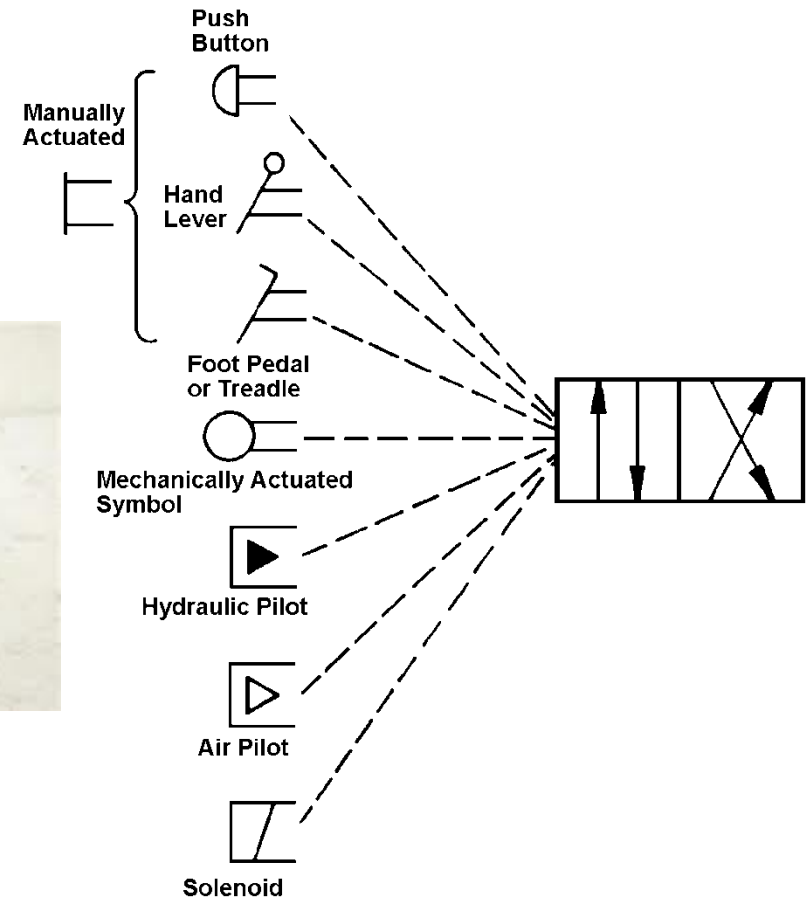
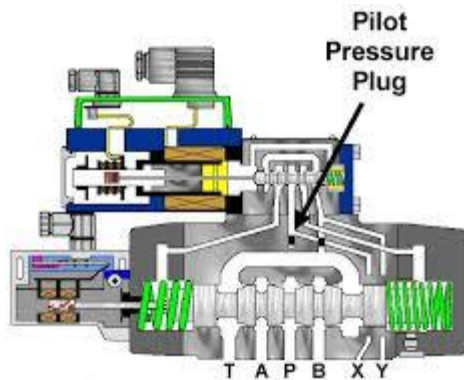




# Directional Control Valves

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## Directional Valve Actuators





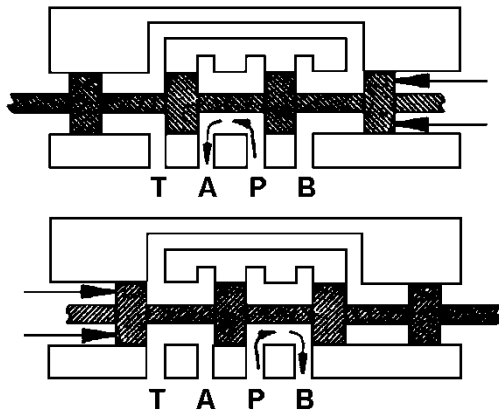


# Directional Control Valves

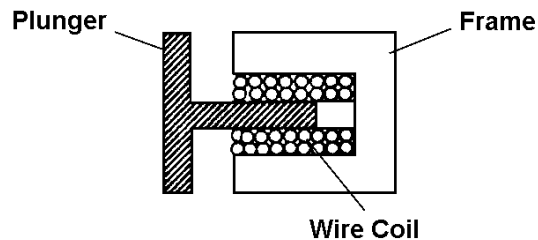
19

## Directional Valve Actuators

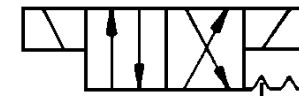
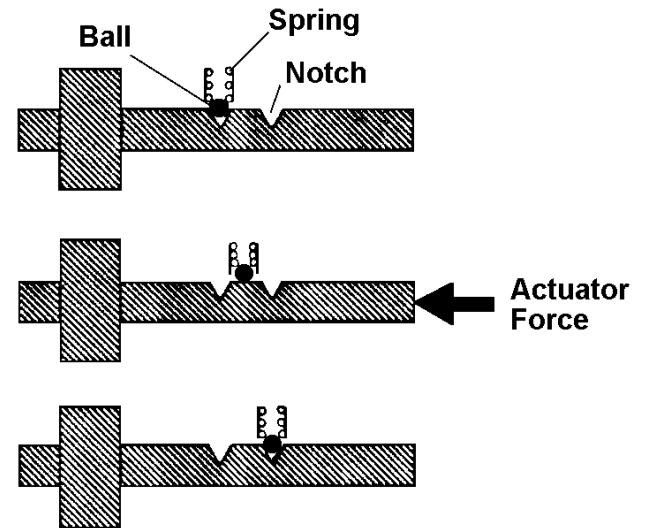
### Pilot Operation



### Solenoid Operation



### Detents



Two-Position, Solenoid  
Operated, Detented,  
4-way Directional Valve





# Directional Control Valves

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## Solenoid Limitations

- (1) Where a hydraulic system is used in a wet or explosive environment, ordinary solenoids may not be used.
- (2) Where the cycle life of a directional valve must be extremely long, an electrically controlled solenoid valve is not generally used.
- (3) The force, which can be developed by them to shift a directional valve spool, is limited. As a matter of fact, the force required to shift a directional valve spool is substantial in the larger sizes. As a result, the directional valves which use solenoids directly to shift a spool are generally only the 1/4" (3-5 GPM) and 3/8" (10-12 GPM) sizes. The 1/2" (20 GPM), 3/4" (35 GPM), and 1 1/4" (100 GPM) are operated by hydraulic pilot pressure.

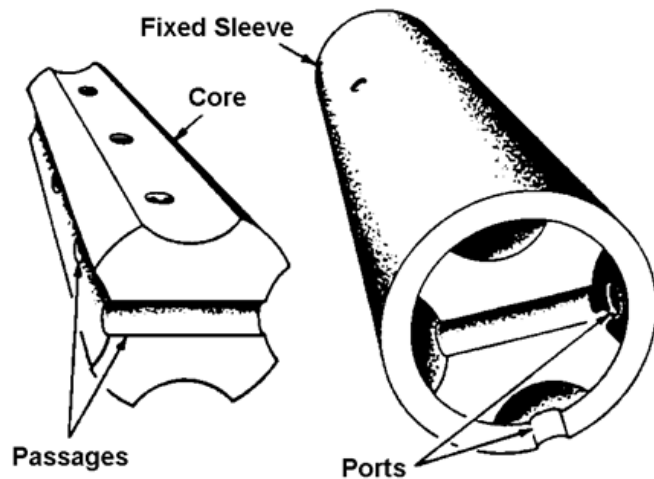




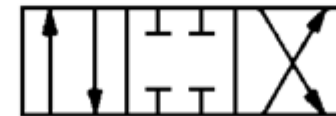
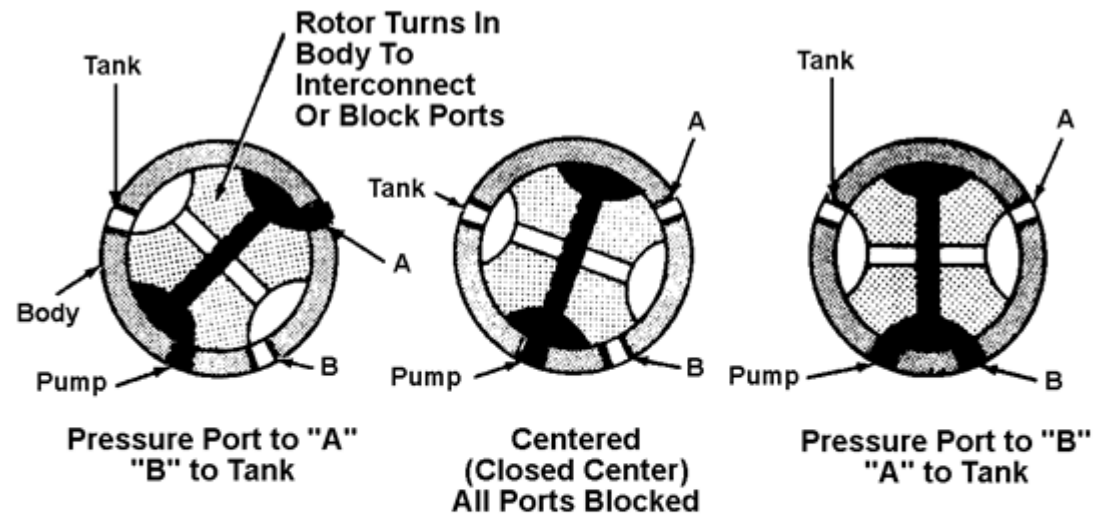
# Directional Control Valves

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## Rotary Directional Valves



Parts of a rotary spool valve



Graphical Symbol

Rotary four-way valve

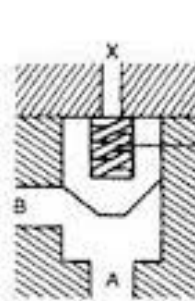
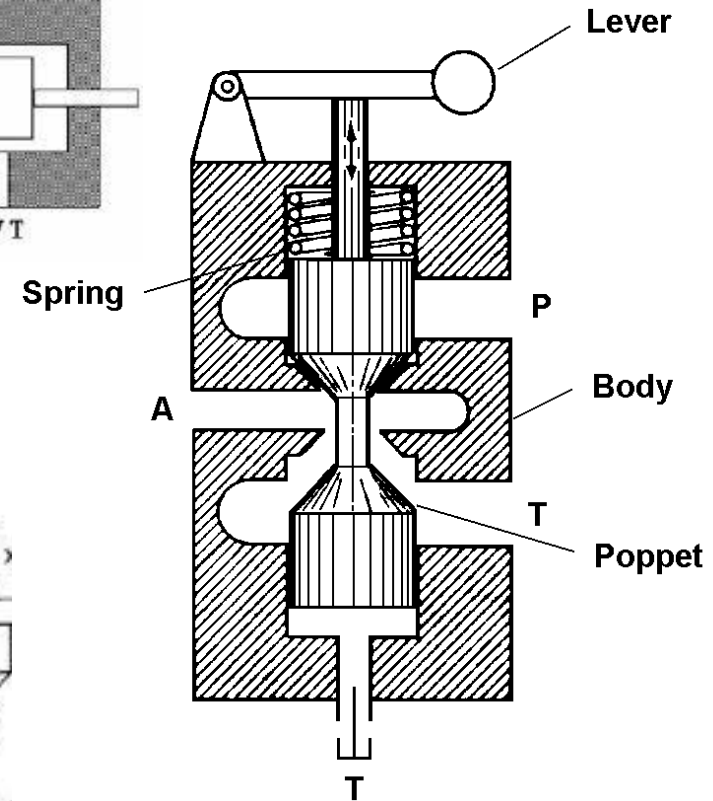
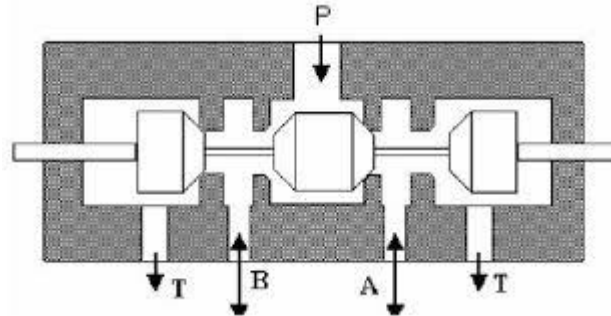
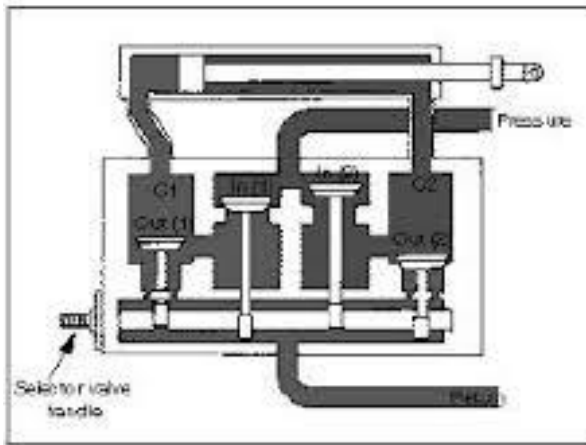




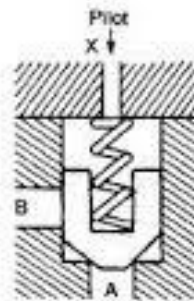
# Directional Control Valves

22

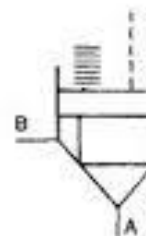
## Poppet Directional Control Valves



(a) Open



(b) Closed (on application of pilot)



(c) Symbol.



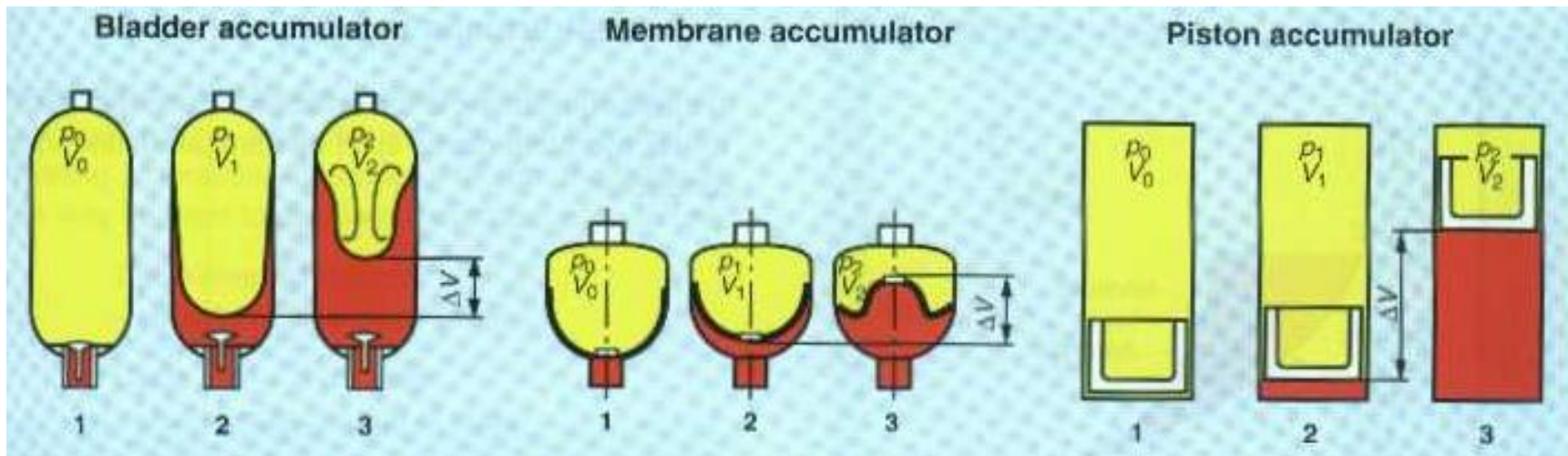


# Hydraulic Accumulators

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Accumulator Symbol

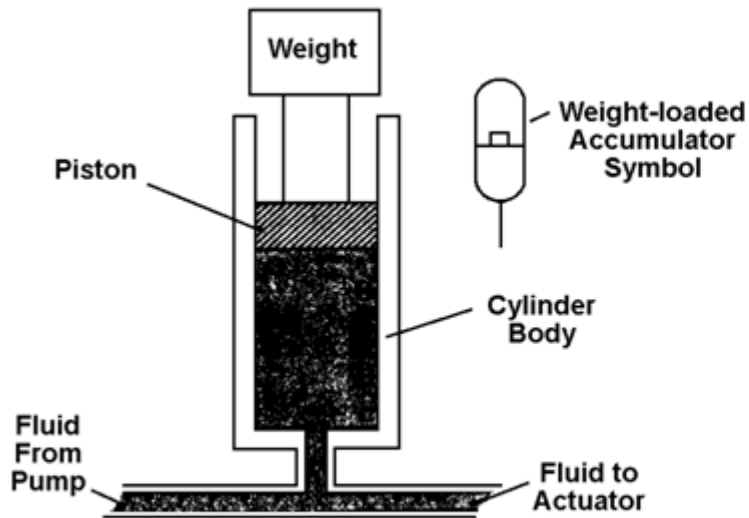




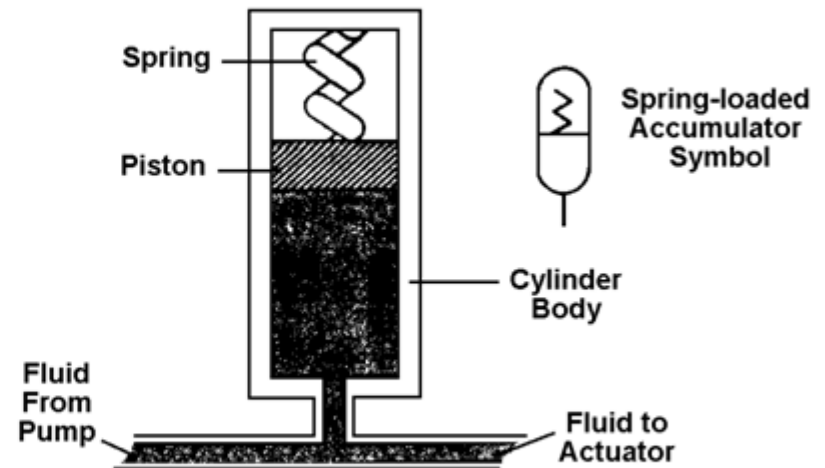


# Hydraulic Accumulators

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**Weight-loaded accumulator**



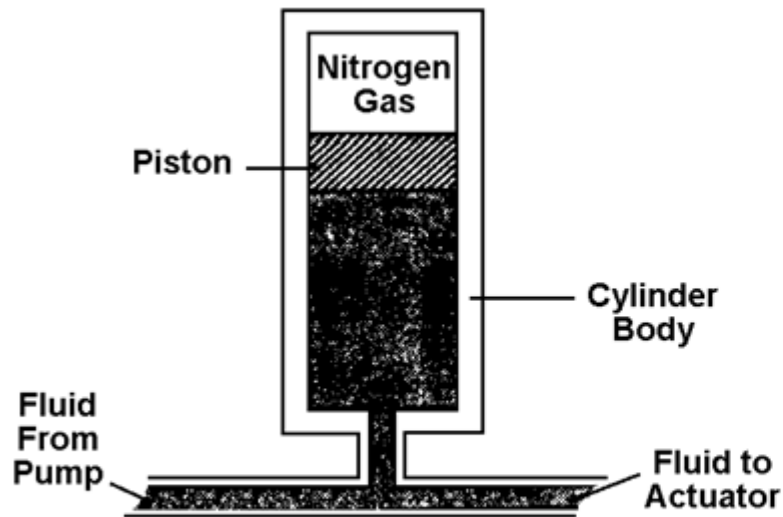
**Spring-loaded accumulator**



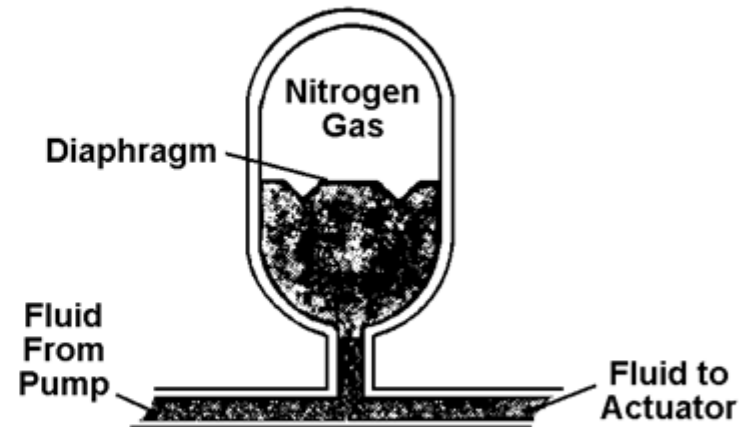


# Hydraulic Accumulators

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**Piston type accumulator**



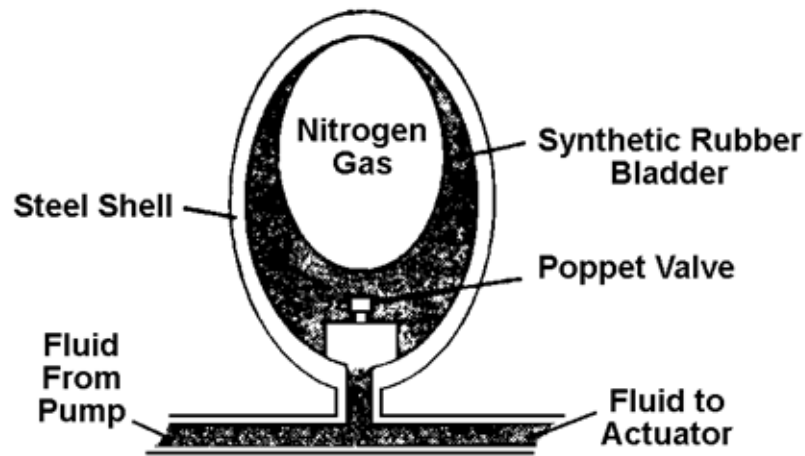
**Diaphragm type accumulator**



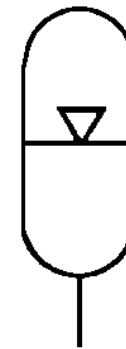


# Hydraulic Accumulators

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Bladder type accumulator



Hydro-Pneumatic Accumulator Symbol



# Hydraulic Accumulators

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# Hydraulic Accumulators

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*Piston accumulator*

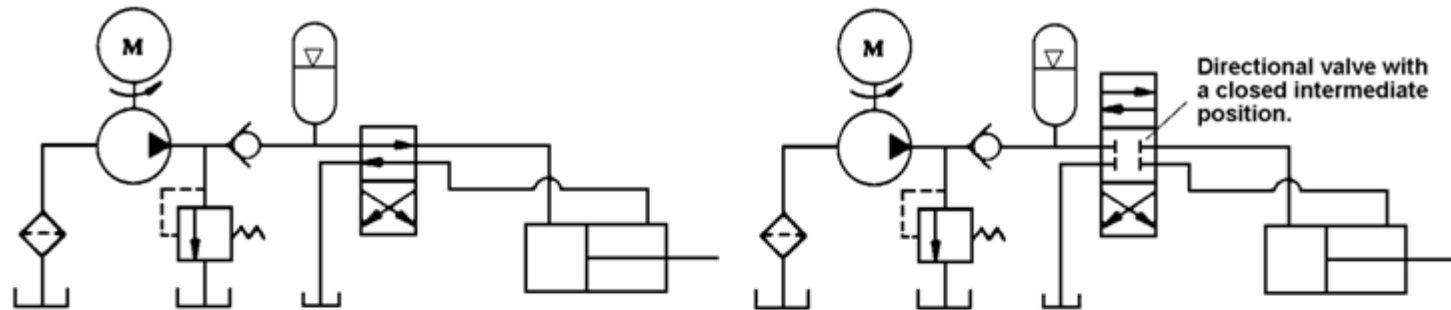




# Hydraulic Accumulators

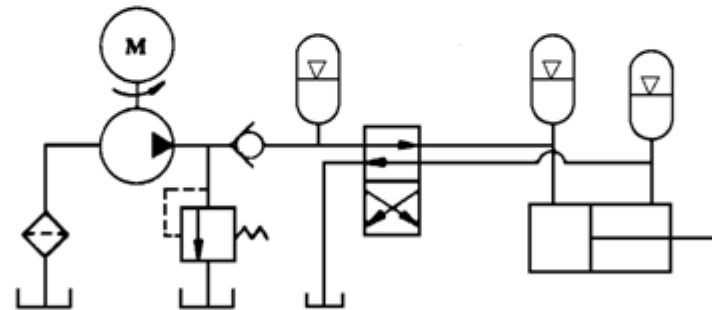
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## Accumulators in a Circuit



Maintaining system pressure

Developing system flow



\* Safety Note: In any accumulator circuit, a means should be available of automatically unloading the accumulator when the machine is shut down.

Absorbing shock