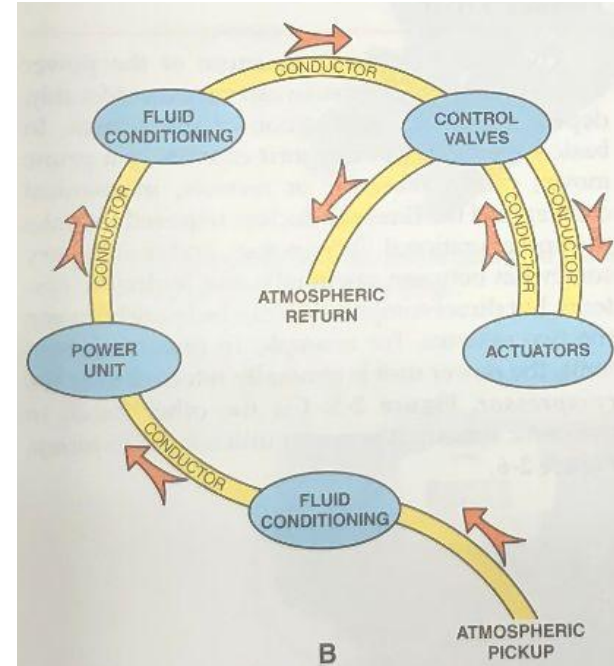
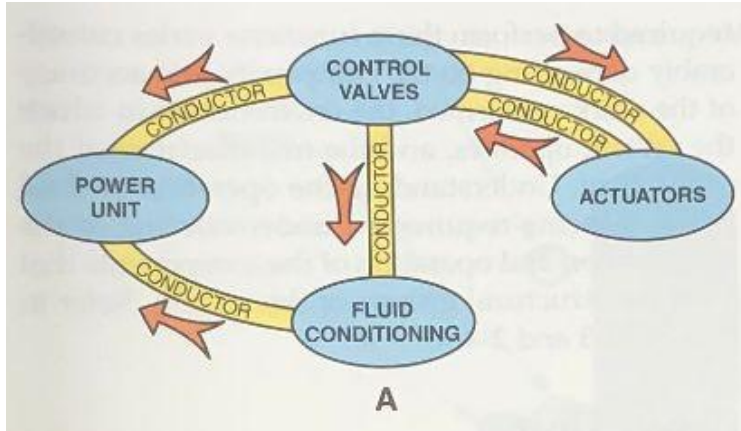


# Fluid Power

John R. Leeman  
8/3/21

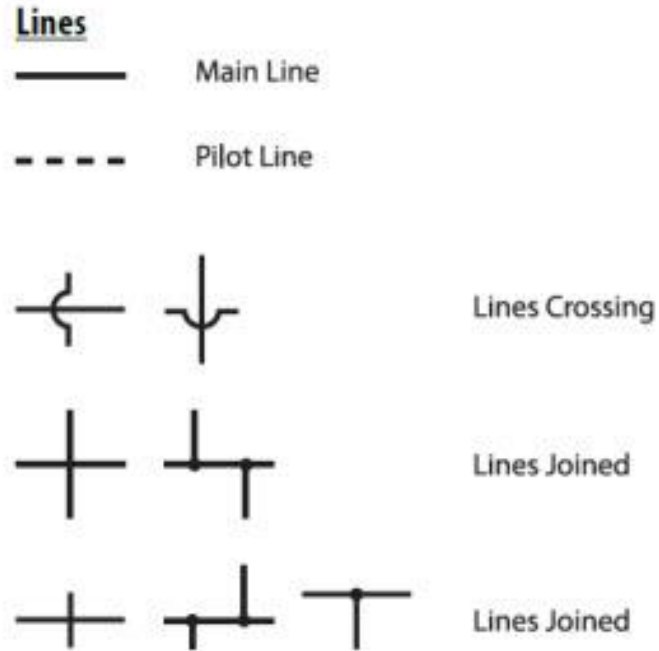
Fluid power systems consist of components to condition, power, conduct, control, and utilize fluids for force amplification



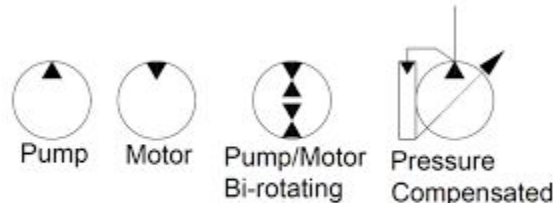
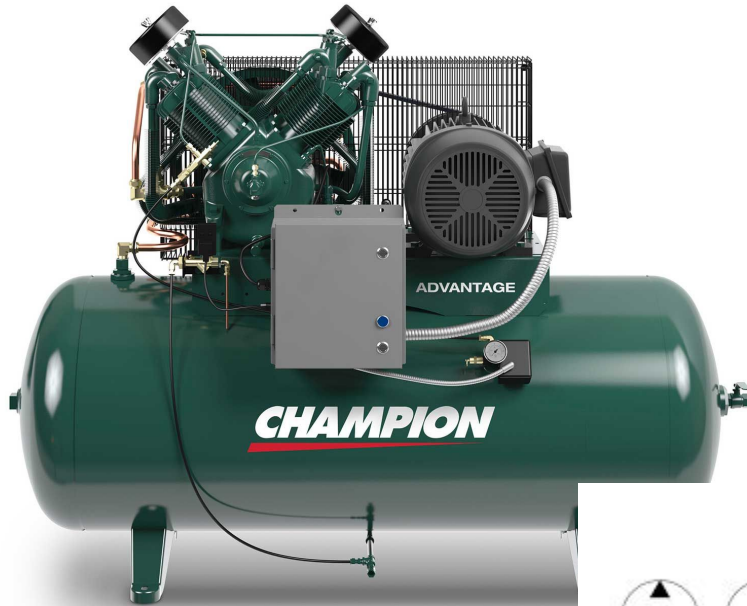
Hydraulic and air hoses, fittings, etc come in MANY varieties



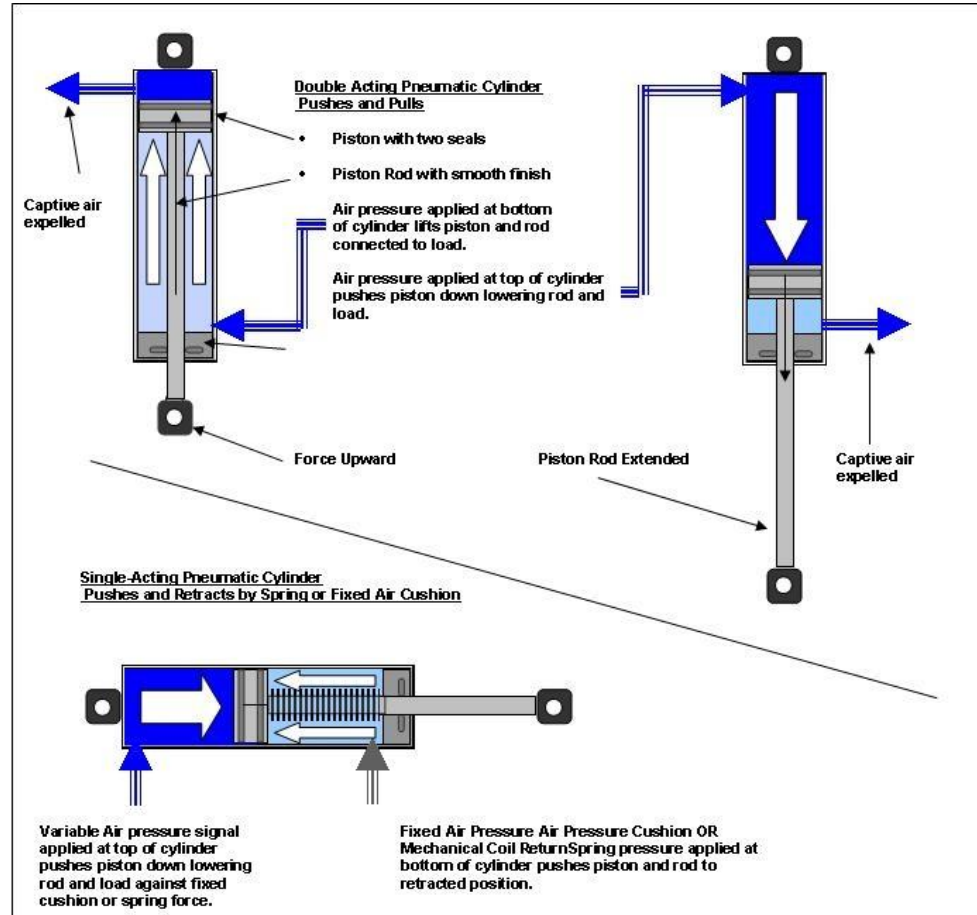
# Fluid conductors are drawn like electrical conductors



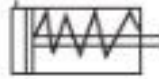
# Power units provide the energy the system needs to move fluids



# Cylinders are one of the most common actuators and come in several varieties



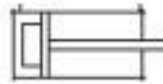
# Cylinders are one of the most common actuators and come in several varieties



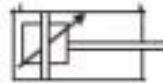
Cylinder (Spring Return)



Cylinder Double Acting  
(Double Rod)



Cylinder Double Acting  
(Single fixed cushion)



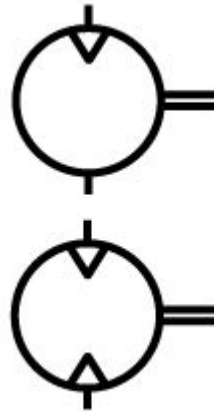
Cylinder Double Acting  
(Two adjustable cushions)



Differential Pressure

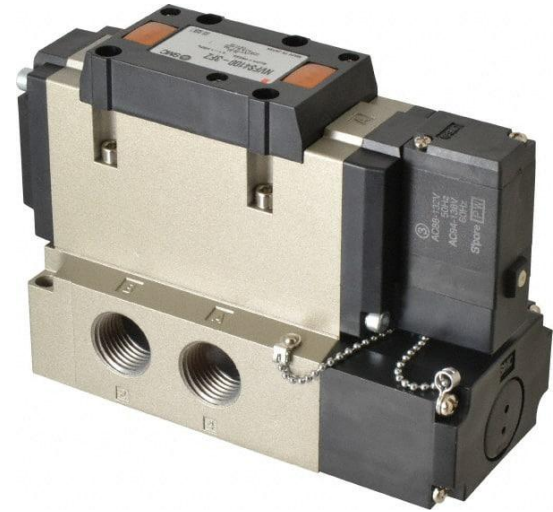


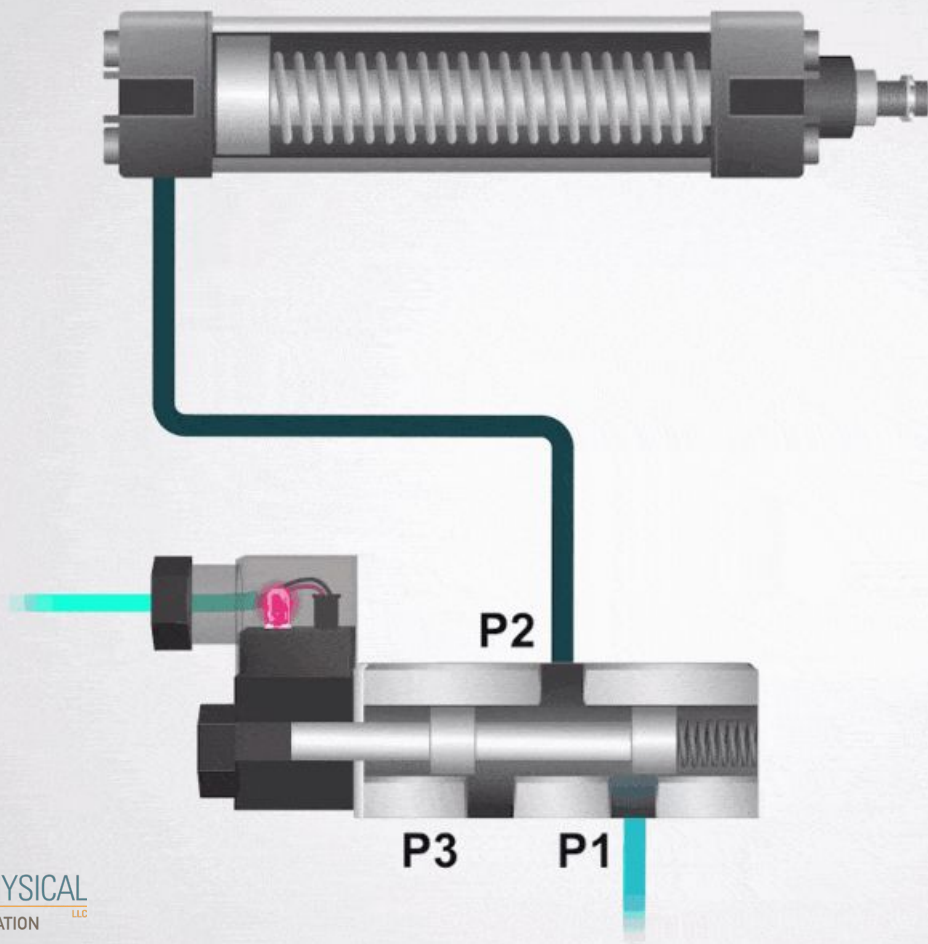
# Motors are another convenient tool



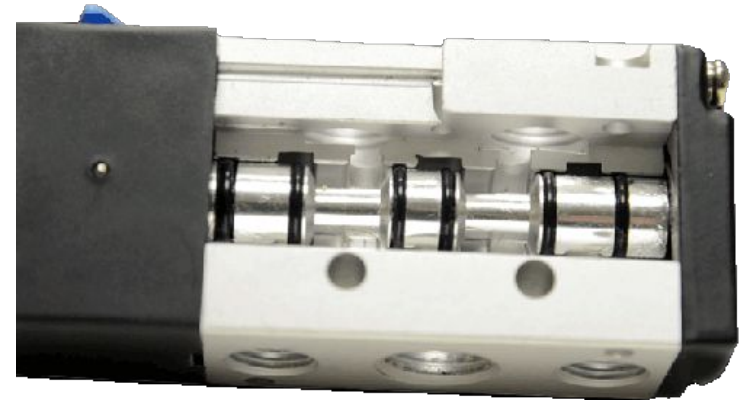
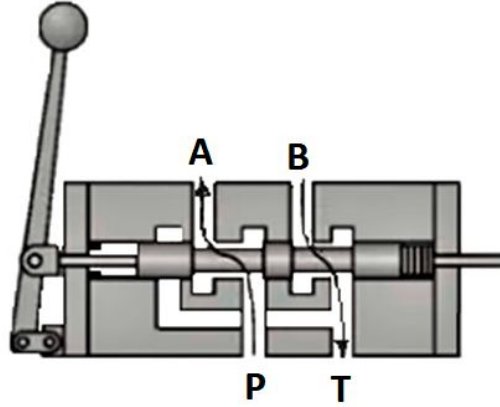
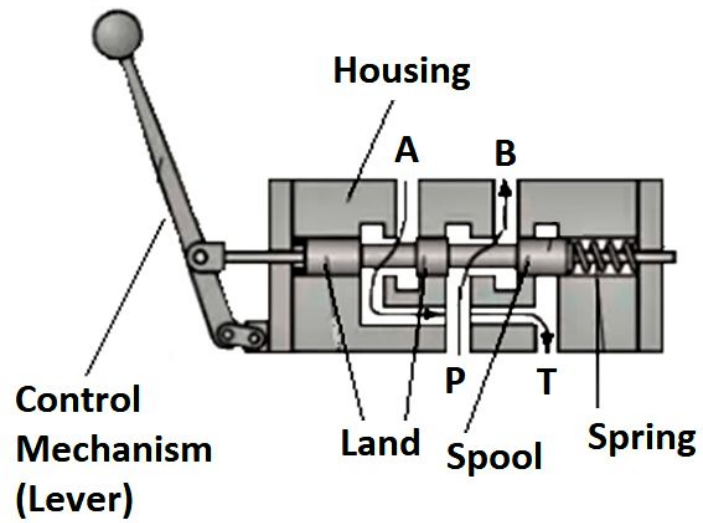


# Control valves direct our fluid with manual, fluid, or electrical inputs

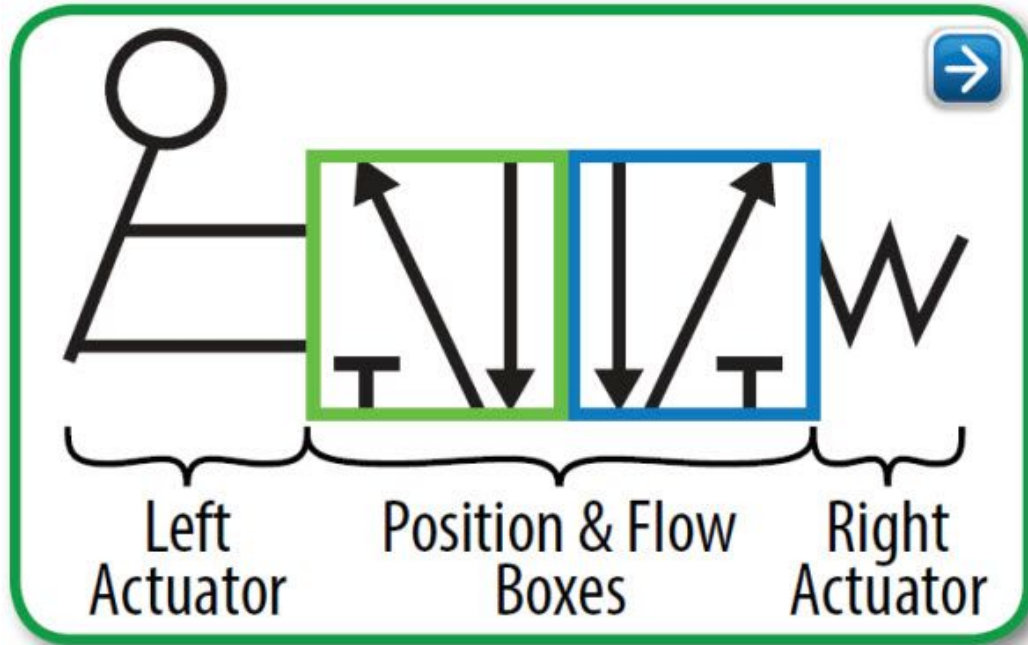




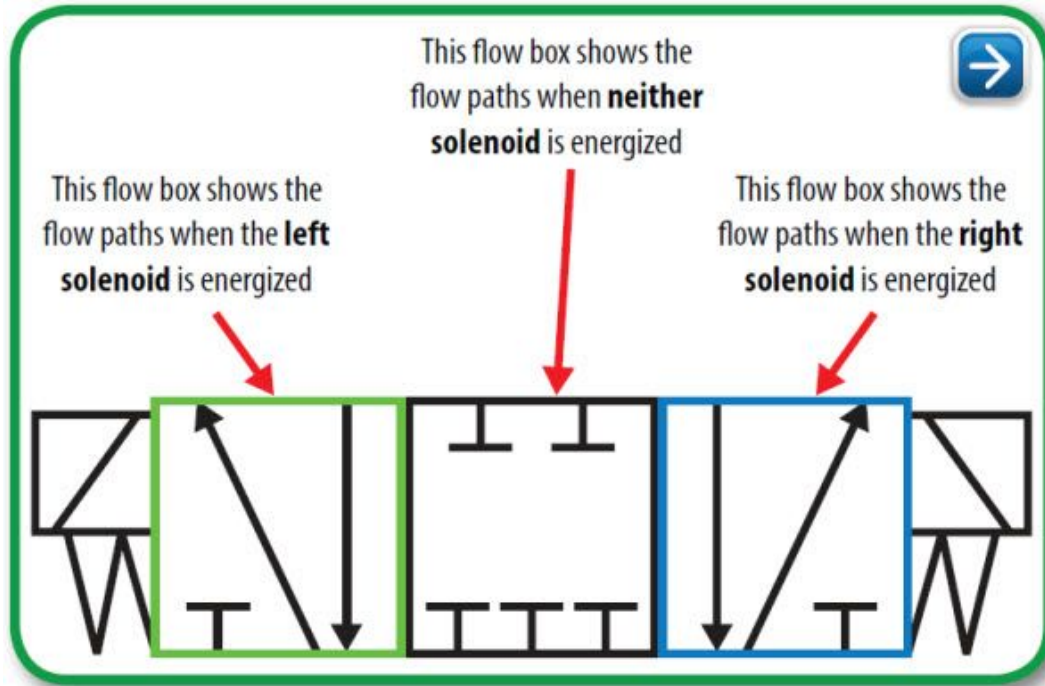
**REALPARS**



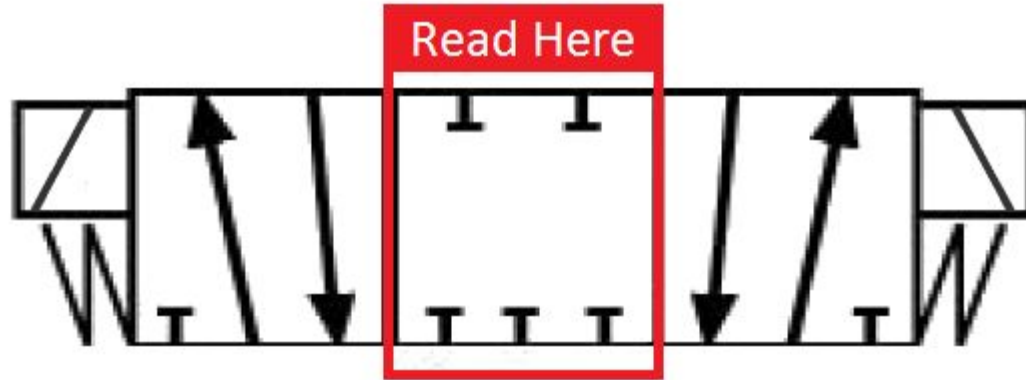
Reading the valve nomenclature can be confusing at best



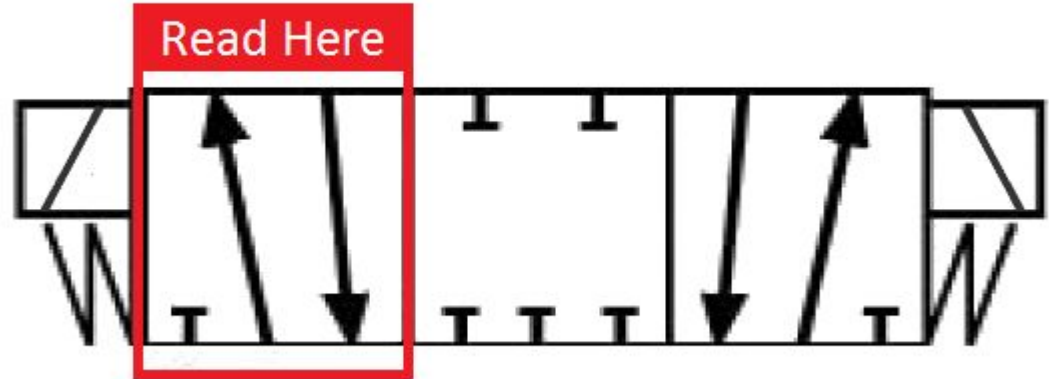
# Reading the valve nomenclature can be confusing at best



Reading the valve nomenclature can be confusing at best

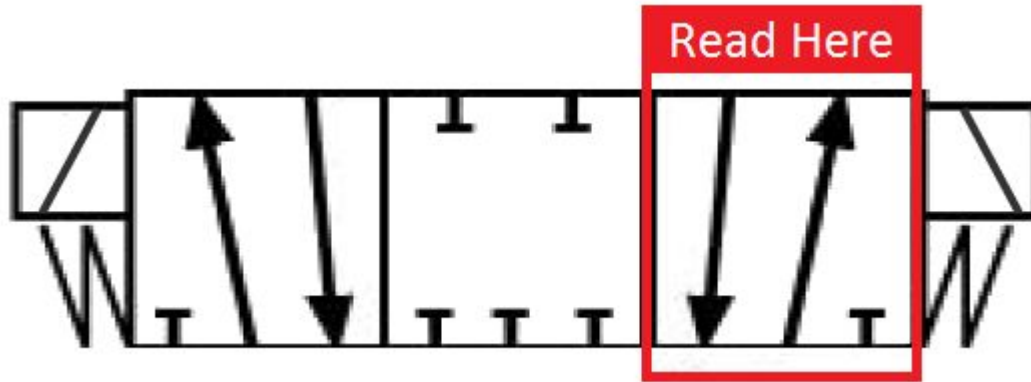


Reading the valve nomenclature can be confusing at best

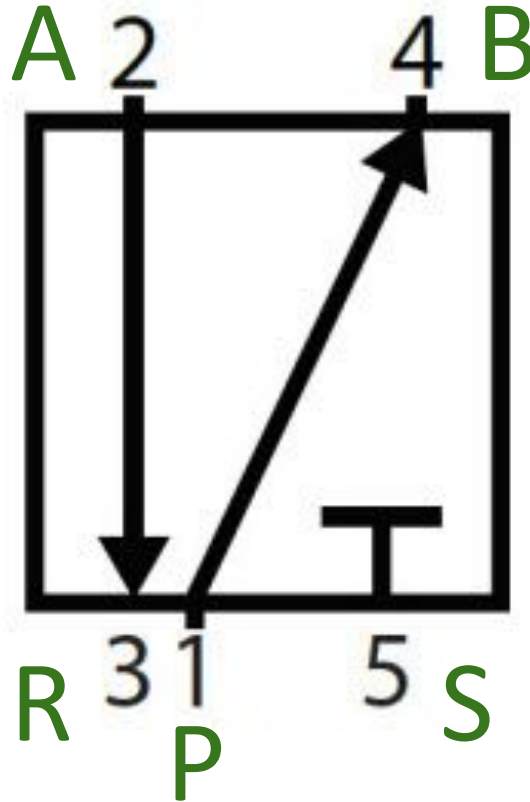




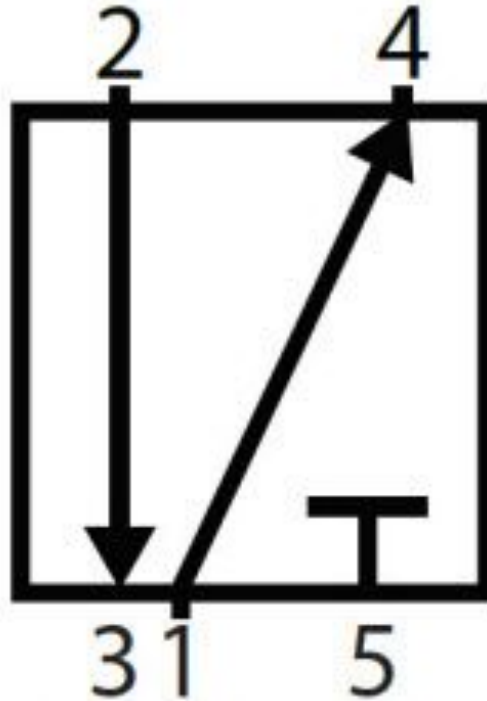
Reading the valve nomenclature can be confusing at best



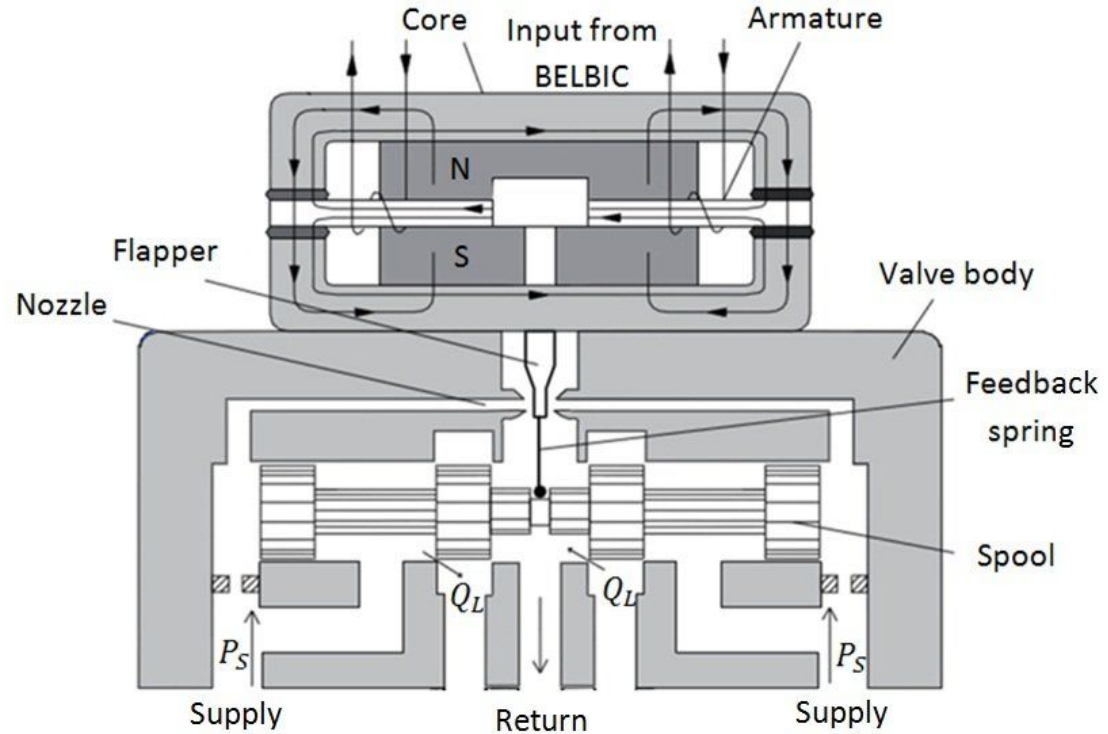
Ports are the number of endpoints shown in a single box



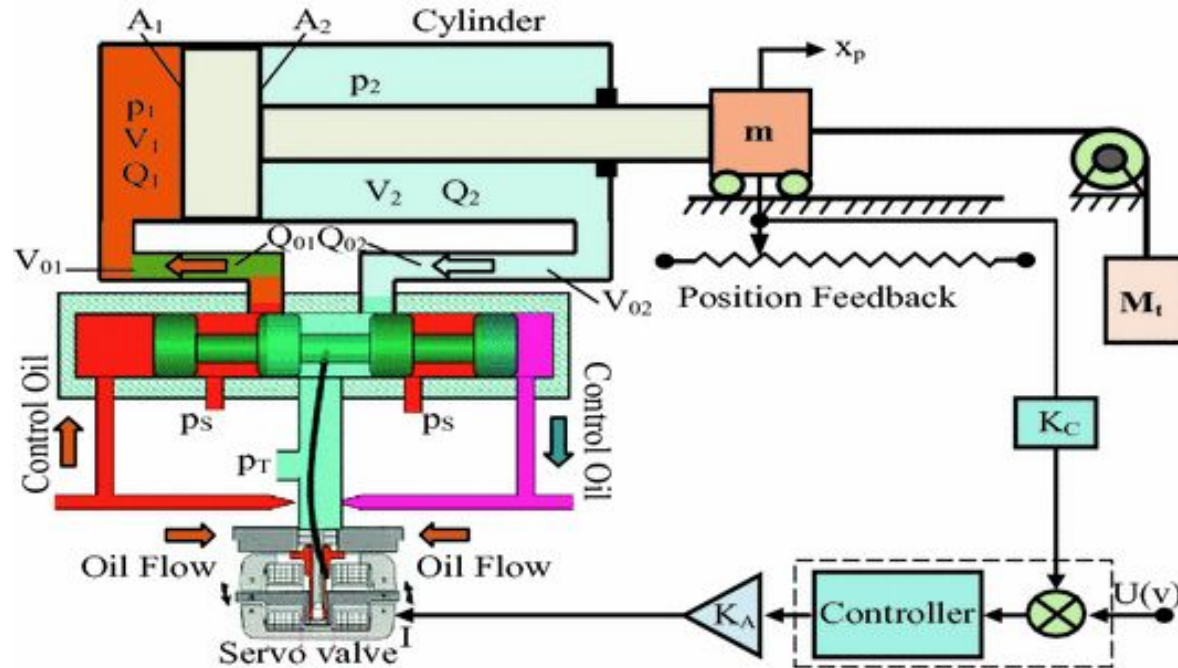
# Ports vs. Ways can get confusing when buying a valve



Servo valves are commonly used for precision control of hydraulic systems

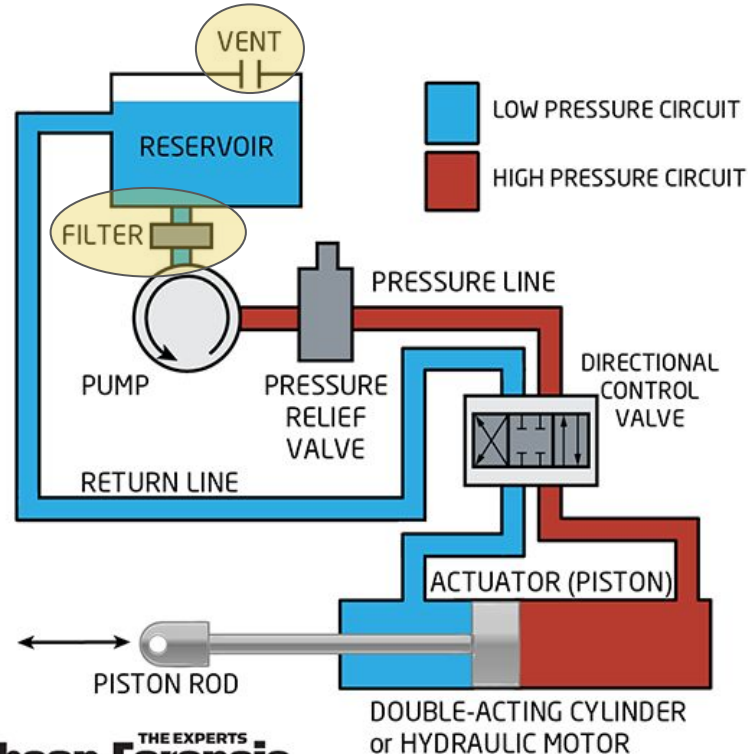


Servo valves are commonly used for precision control of hydraulic systems

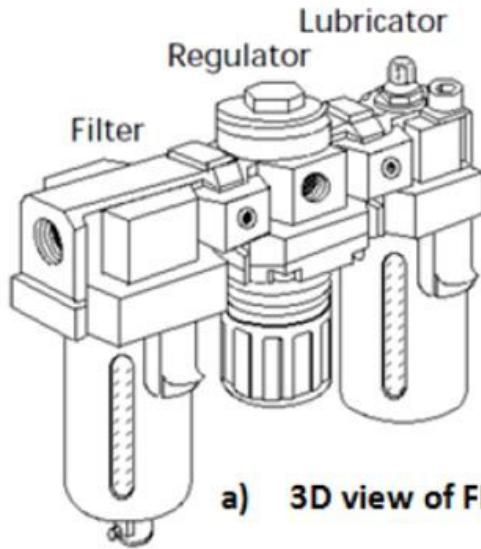


# Fluid conditioning for hydraulics is relatively straightforward

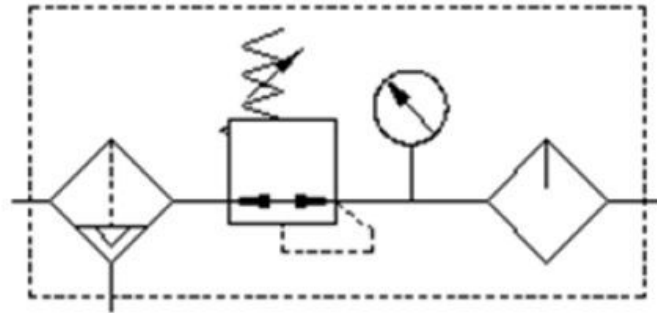
## Basic Hydraulic System



# Pneumatics has a few more steps



a) 3D view of FRL unit















b) Symbol for FRL unit






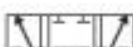




# Keeping a table of symbols is handy since we don't do this full time

## Actuator Symbols

	Manual		External Pilot
	Push Button		Piloted Solenoid with Manual Override
	Lever		Lever Operated, Spring Return
	Foot Operated		
	Mechanical		
	Spring		
	Detent		
	Solenoid		
	Internal Pilot		

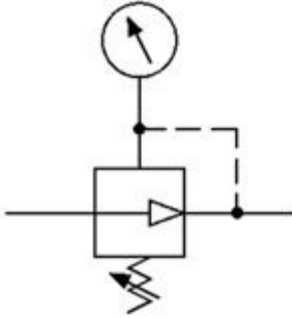
## Directional Control Valve Symbols

	2-position, 2-way, 2 ported
	2-position, 3-way, 3 ported
	2-position, 4-way, 4 ported
	2-position, 4-way, 5 ported
	3-position, 4-way, 4 ported Closed Center
	3-position, 4-way, 5 ported Closed Center
	3-position, 4-way, 5 ported Pressure Center
	3-position, 4-way, 5 ported Open Center

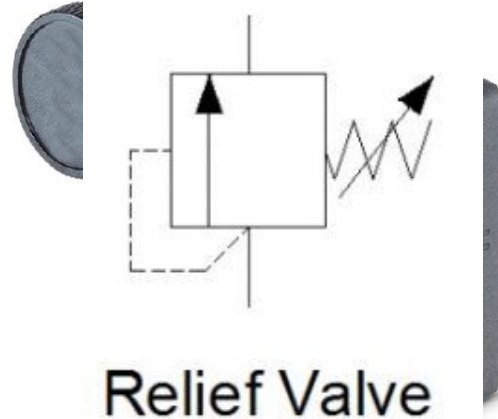
Regulation of system pressure is also important, but very similar



**OMAX<sup>®</sup>**

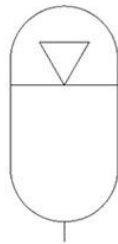


**AIR REGULATOR**

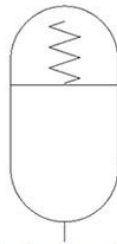


**Relief Valve**

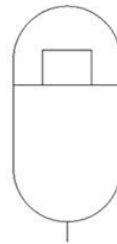
# Accumulators are like fluid power capacitors



Accumulator



Spring Loaded  
Accumulator



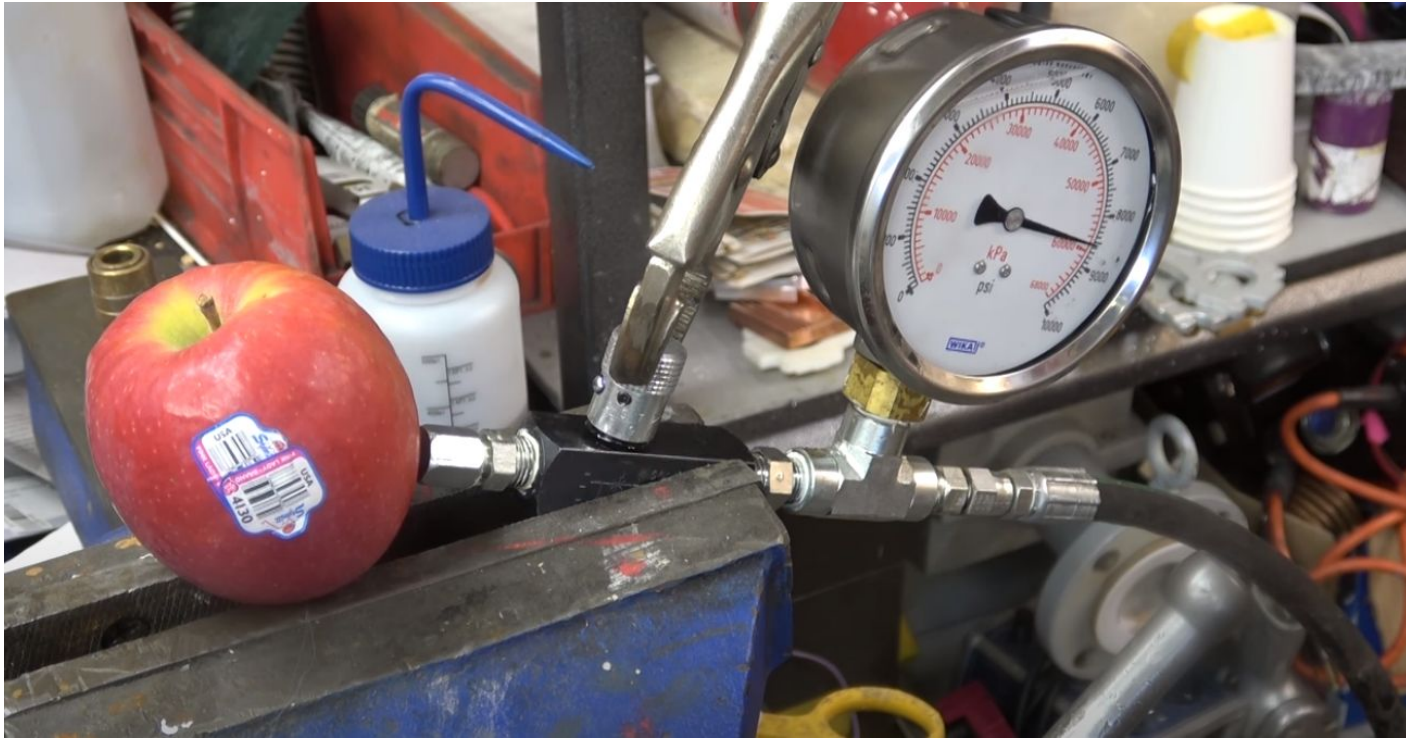
Weighted Accumulator

# Pneumatics store a dangerous amount of energy!





# Hydraulics can cause injection injury and severe burns



# Common things to look for

- Blocked lines
- Bad filters
- Worn seals
- Moisture in the system
- Stuck valves
- Leaking conduits
- Bad pressure reliefs

