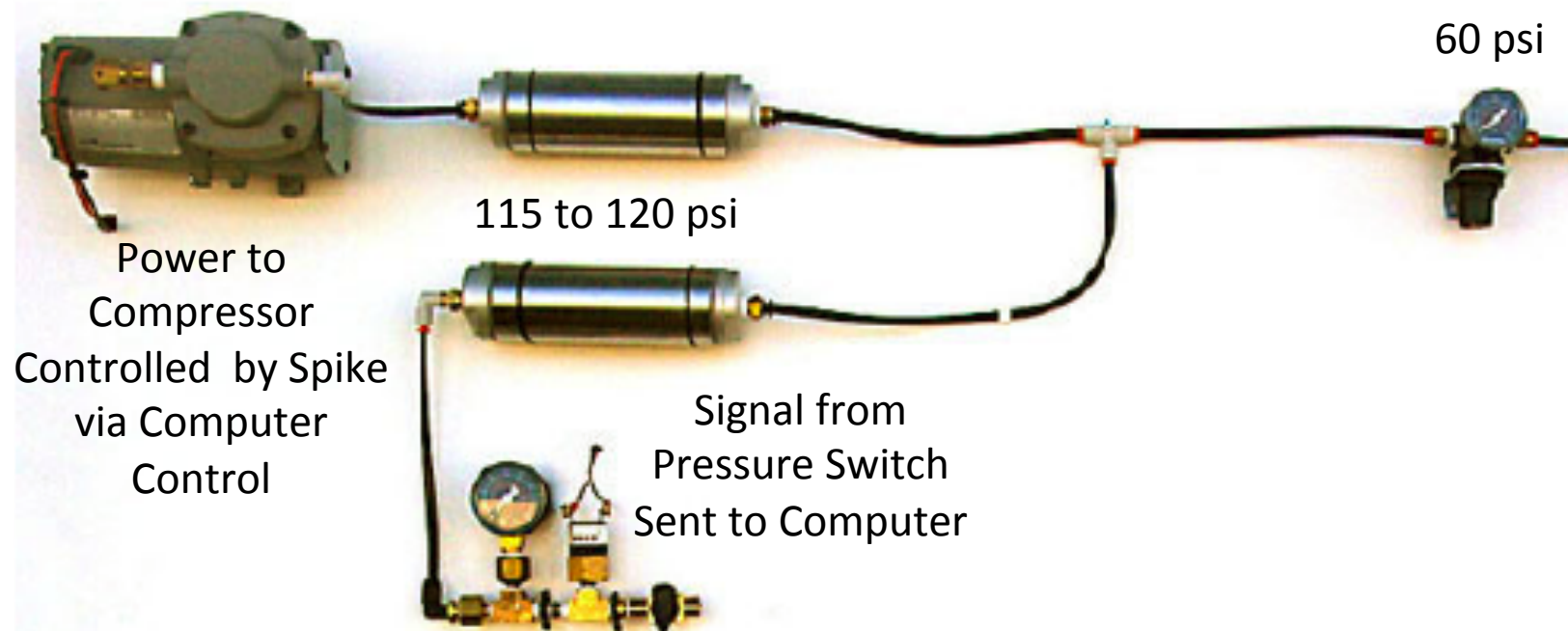


# FRC Pneumatics System

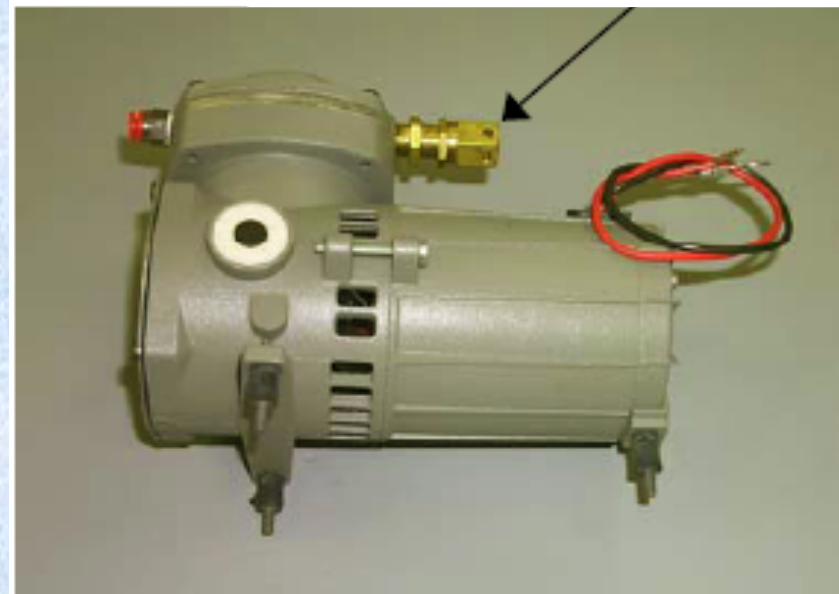
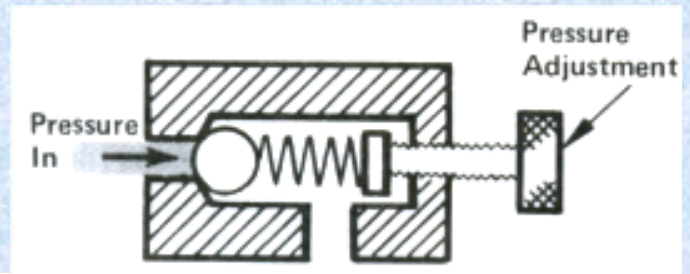
# Pressure Generation, Storage & Regulation



# Compressor & Relief Valve

Test Relief  
Valve Before  
Competition

Relief Valve Should Pop at 125 psi



# Pressure Switch

- Switch Opens at About 115psi
- Switch Closes at About 95psi
- Short Switch to Test  
Compressor Pop Off Valve  
Setting

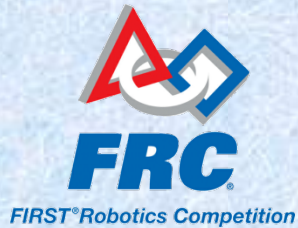




# Plug Valve

Valve Must Be  
Plumbed to Relieve  
All System Pressure  
When Opened



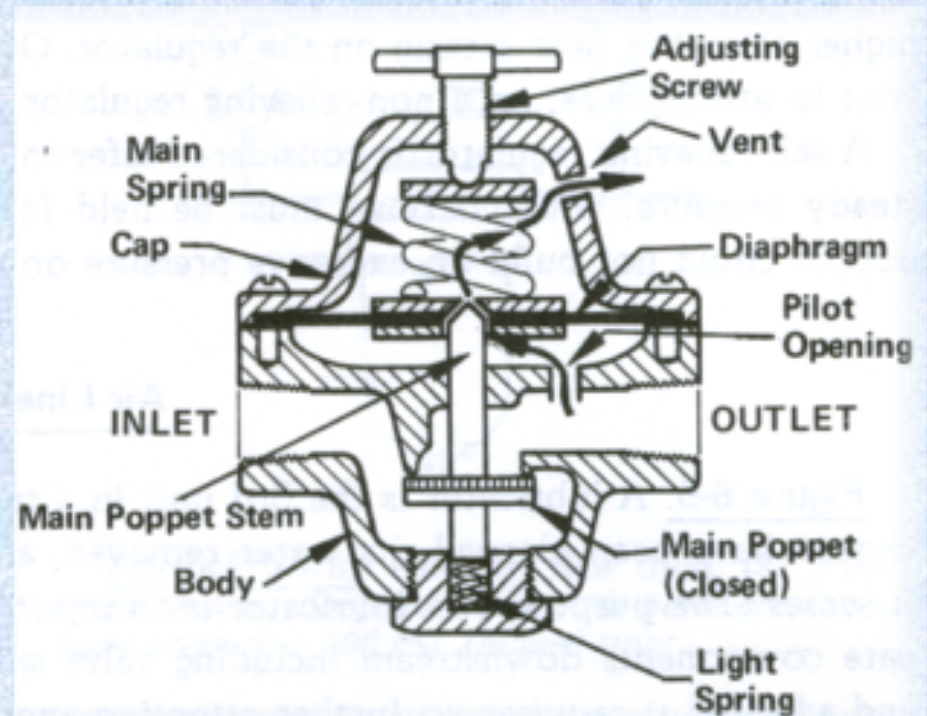


# Pressure Tank

Tanks used in Past  
Include 16 Cubic  
Inch, 32 Cubic Inch  
and 41 Cubic Inch



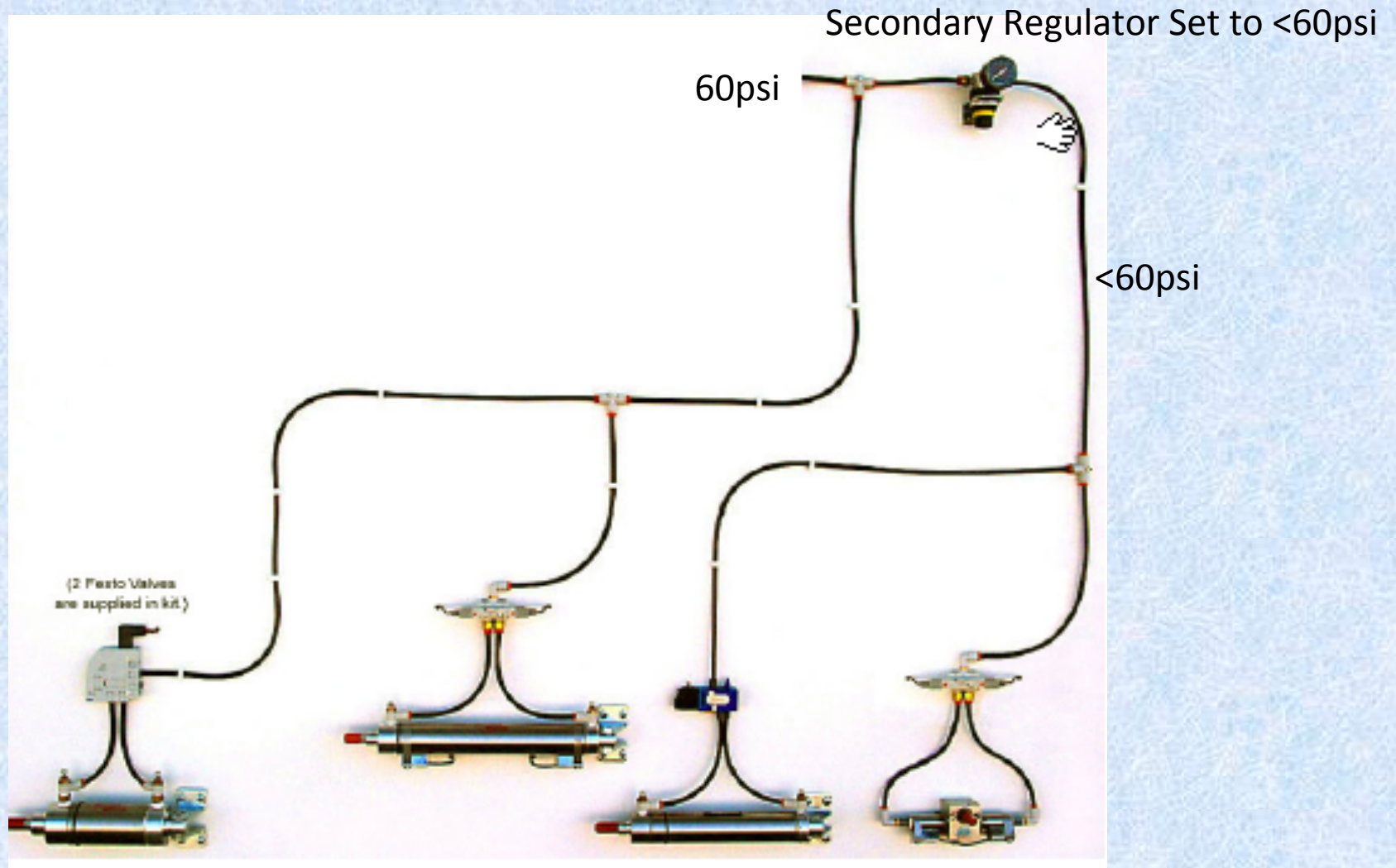
# Primary Regulator



- Set to a Max of 60psi for Working Pressure
- Pay Attention to the Direction of Flow When Installing



# Working Pressure Portion

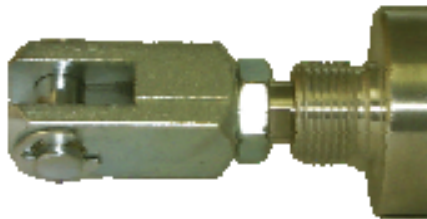




# Cylinder (Actuator)



Double Acting  
Single Ended

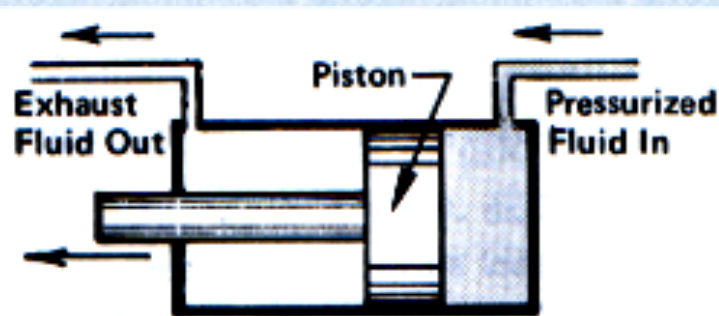
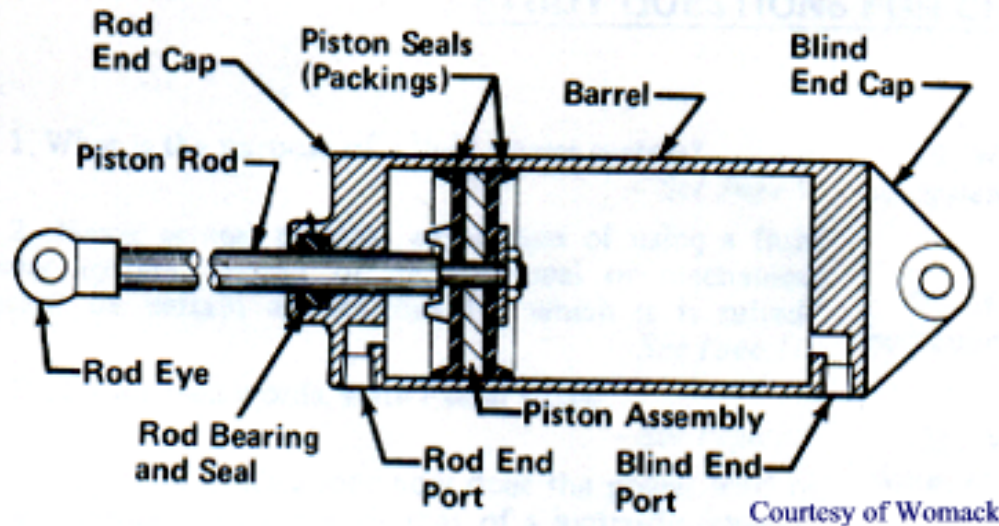


Clevvis

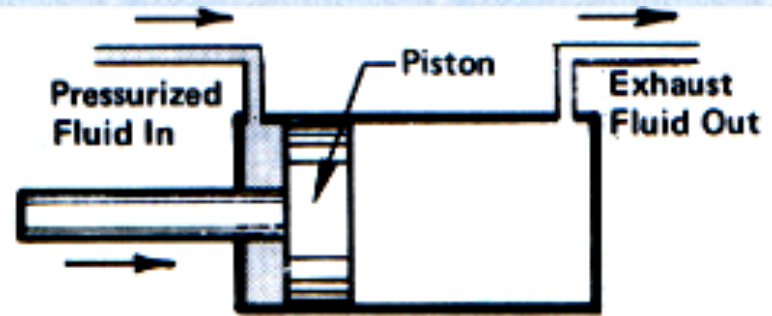


Swivel End Mount

# Inside a Double Acting Actuator

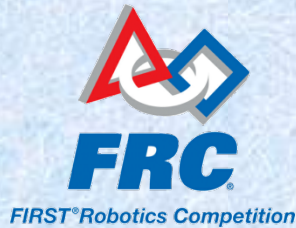


A. Piston Rod Moving Out.



B. Piston Rod Moving In.

Courtesy of Womack



# Cylinder Sizes

*M-Magnet	Bore	Stroke in inches	Mounting
(Optional)	04 = $\frac{3}{4}$ "	0.5, 1, 1.5, 2, 2.5, 3, 4, 5, 6, 8, 10	DP for $\frac{3}{4}$ "
Includes (2)	17 = $1 \frac{1}{2}$ "	0.5, 1, 1.5, 2, 2.5, 3, 4, 5, 6, 7, 8, 9, 10, 11,	DP for $1 \frac{1}{2}$ "
MRS-.087-B	31 = 2"	0.5, 1, 1.5, 2, 2.5, 3, 4, 5, 6, 7, 8, 9, 10, 12, 24	DXP for 2"
position sensors			

Also offer  $1 \frac{1}{16}$ " Cylinders

Bimba Usually Provides Several Free Cylinders

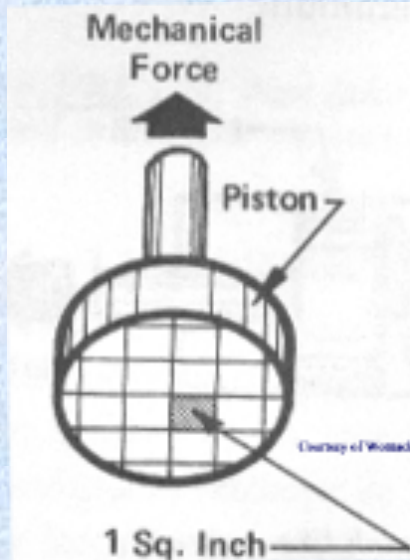


FIRST® Robotics Competition

# Cylinder Forces

	3/4" Bore	3/4" Bore
Pressure	Force Extended	Force Retracted
(pounds/sq. inch)	(pounds)	(pounds)
20	9	8
25	11	10
30	13	12
35	15	14
40	18	16
45	20	18
50	22	20
55	24	22
60	26	24

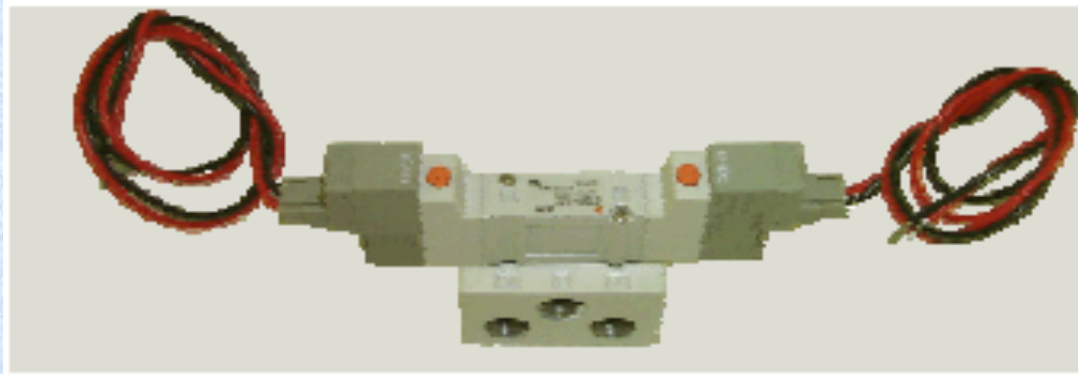
	1-1/2" Bore	1-1/2" Bore
Pressure	Force Extended	Force Retracted
pounds/sq. inch	(pounds)	(pounds)
20	35	32
25	44	40
30	53	48
35	62	57
40	71	65
45	79	73
50	88	81
55	97	89
60	106	97



	2" Bore	2" Bore
Pressure	Force Extended	Force Retracted
pounds/sq. inch	(pounds)	(pounds)
20	63	57
25	79	71
30	94	85
35	110	99
40	126	113
45	141	128
50	157	142
55	173	156
60	188	170

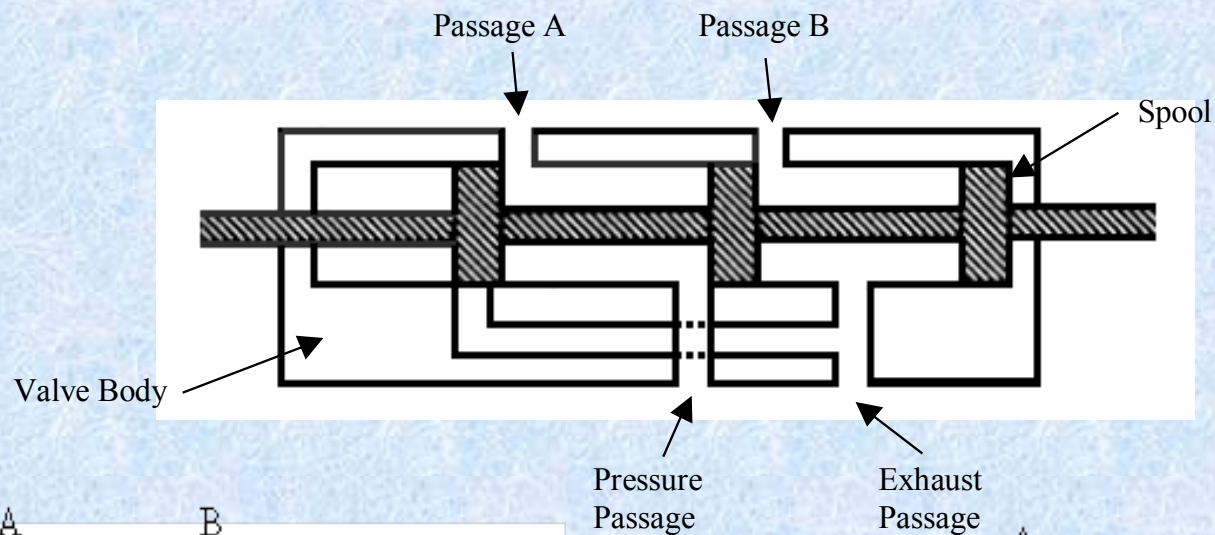


# Valves (Solenoids)

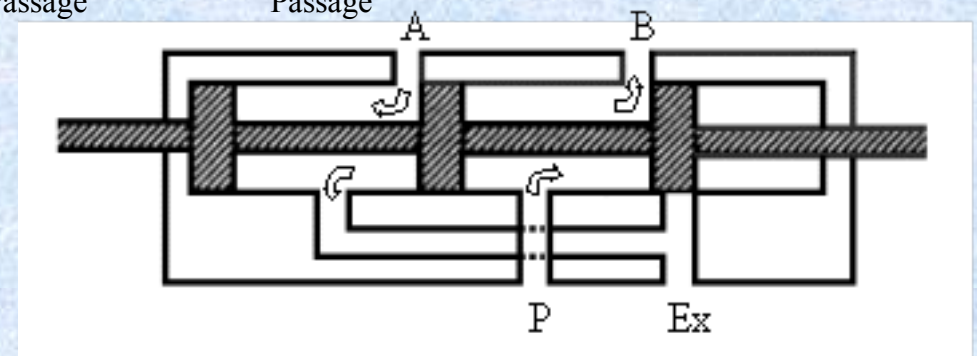
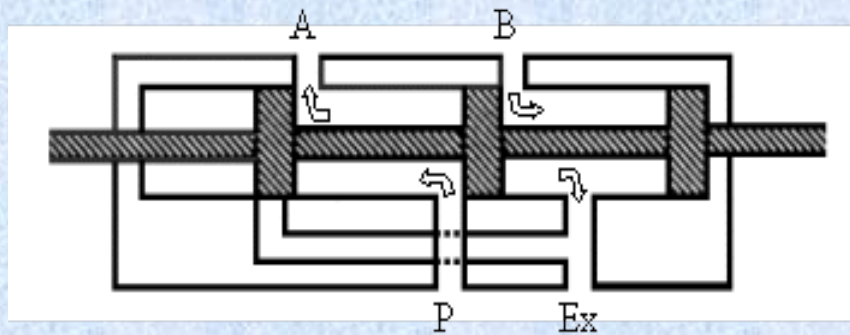


# Inside a Valve

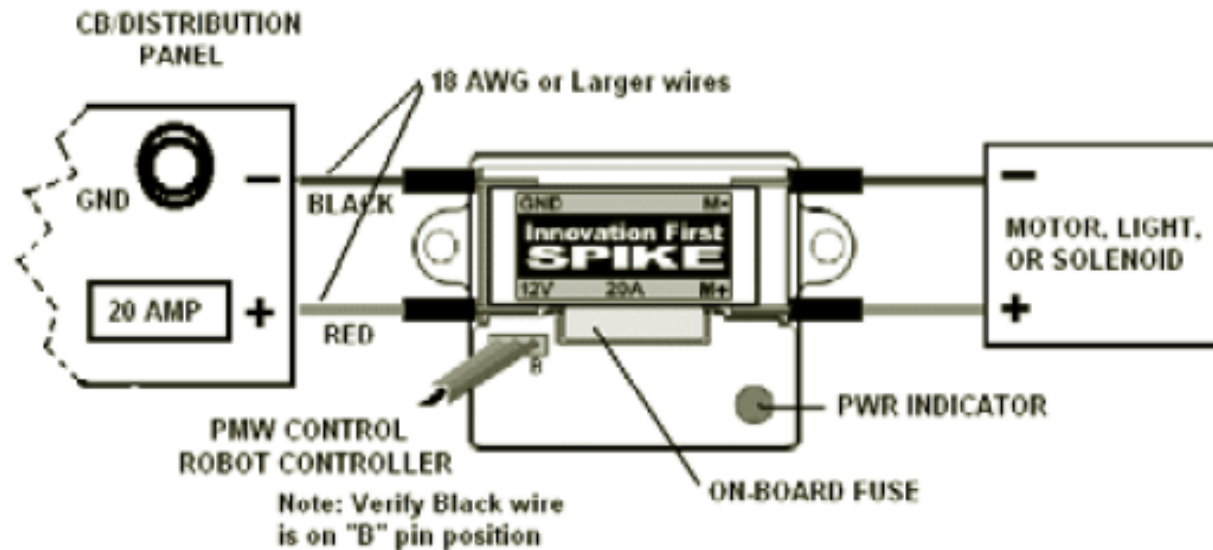
## Single Acting vs Double Acting Valve



Cannot  
Block  
Exhaust



# Spike Control



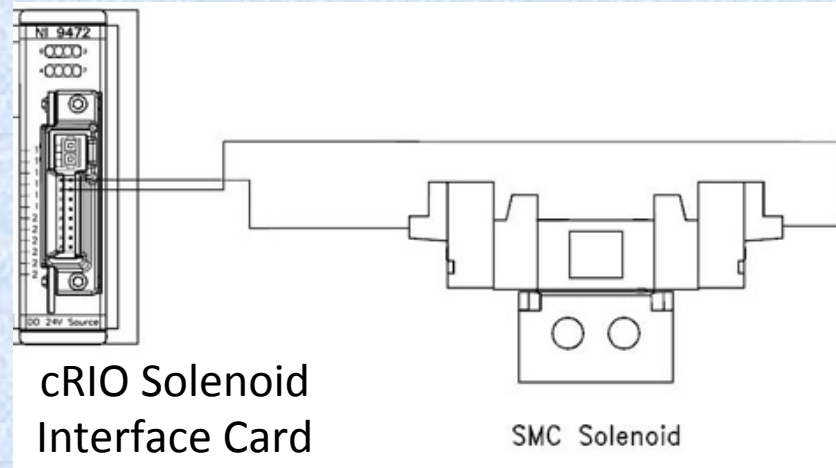
**SPIKE RELAY MODULE TYPICAL CONNECTIONS**

Table 1: Spike **Blue** P-BASIC software control, Spike output, Motor function

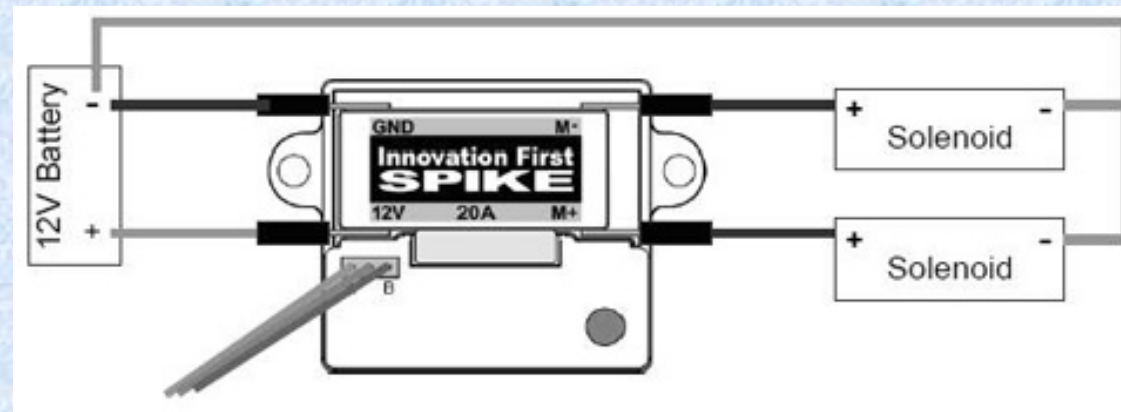
INPUTS		OUTPUTS		Indicator	Motor Function
Fwd	Rev	M+	M-		
0	0	GND	GND	Orange	OFF / Brake Condition (default)
1	0	+12v	GND	Green	Motor rotates in one direction
0	1	GND	+12v	Red	Motor rotates in opposite direction
1	1	+12v	+12v	Off	OFF / Brake Condition

# Powering 12v & 24v Valves

24 volt  
Solenoid

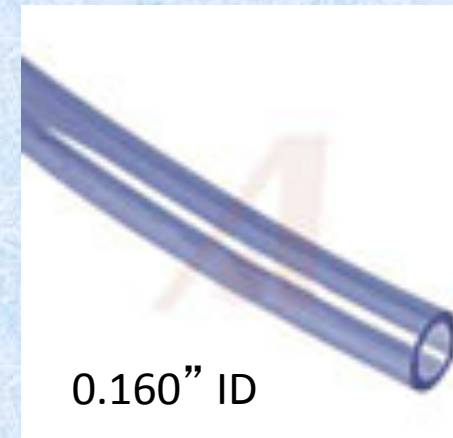


12 volt  
Solenoid





# Plumbing

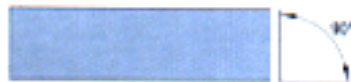




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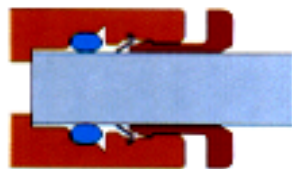
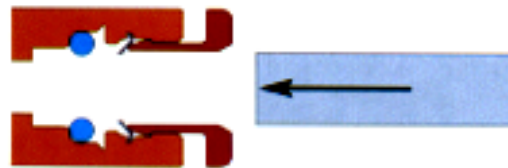
# Pneumatic Tube Insertion

## Method of assembly



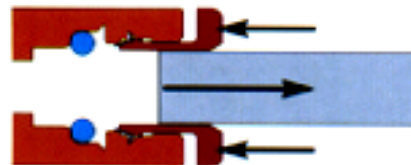
1. Ensure that the end of the tube is cut square and is free from burrs.

2. Push the tube through the release button and grab ring into the fitting.



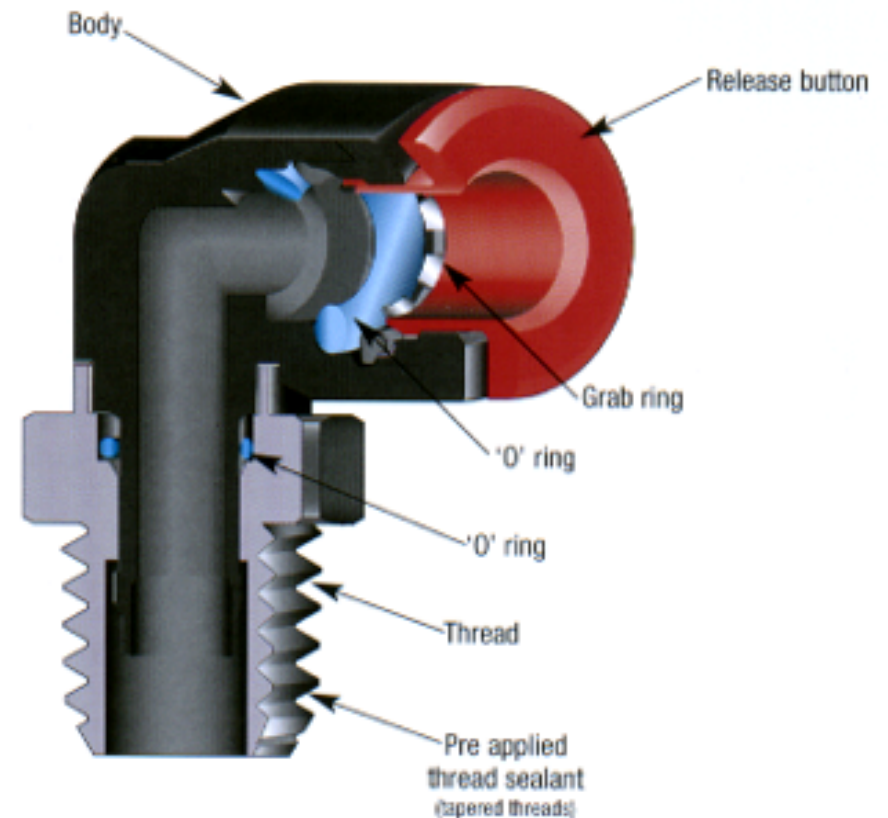
3. Push the tube firmly through the 'O' ring until it bottoms on the tube stop then pull back.

4. To disconnect, push the tube into the fitting, hold down the release button and withdraw the tube.

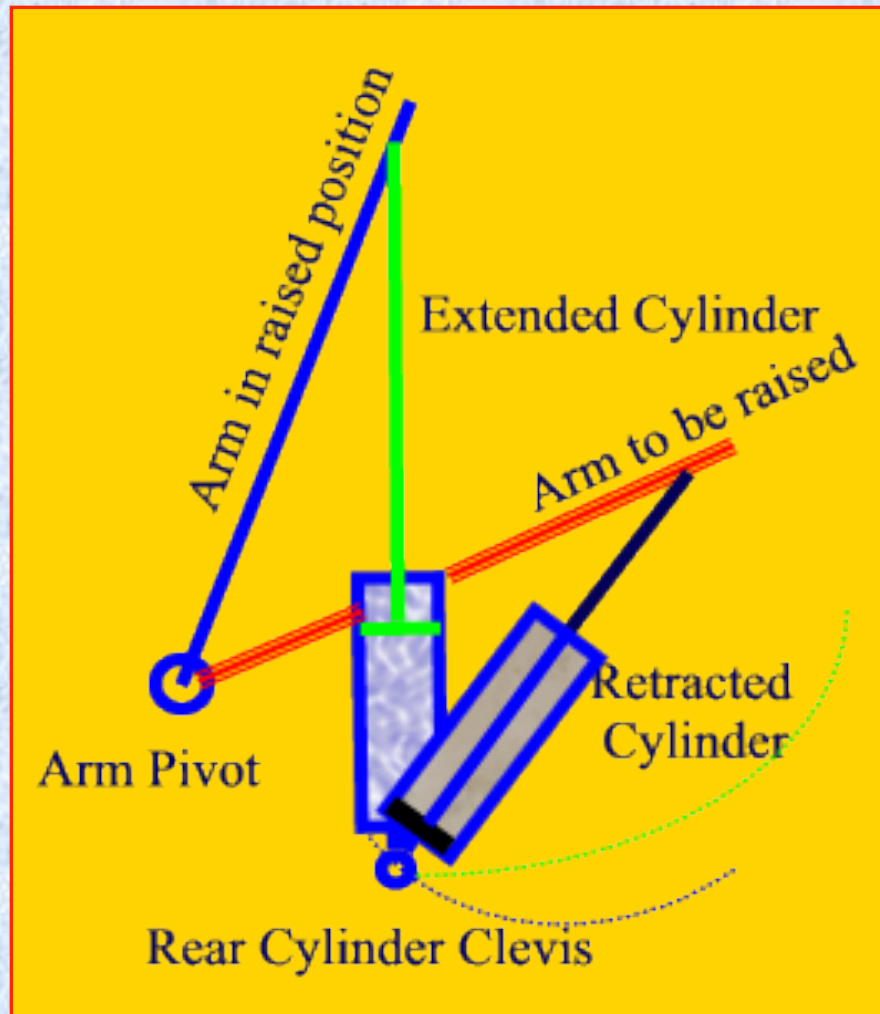


## Typical part

90° Swivel elbow adapter



# Find Mounting Point

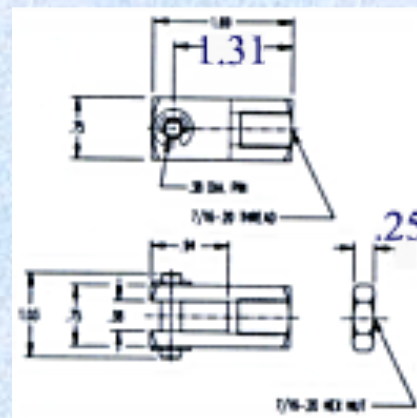
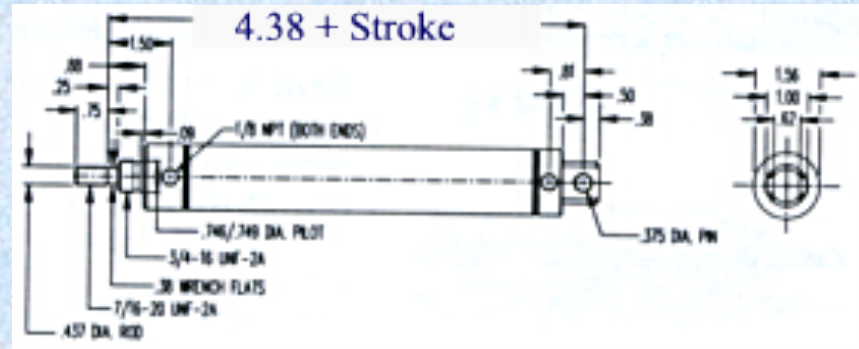


## Example: Arm to be raised by Cylinder

- Determine overall length of retracted cylinder
- Draw an arc from the mounting point on arm
- Determine overall length of extended cylinder
- Draw an arc from the mounting point on arm
- Where arcs intersect is the mounting point
- Check for intermediate interference



# Cylinder Lengths

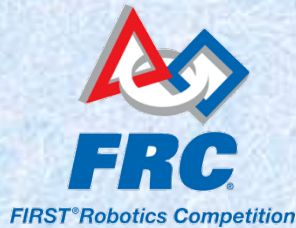


- Base Dimension = 4.38 +
- Stroke Length = ? +
- Locking Nut = .25 +
- Clevis Dimension = 1.31

Retracted Length =  $4.38 + \text{Stroke} + .25 + 1.31 = 5.94 + \text{Stroke}$

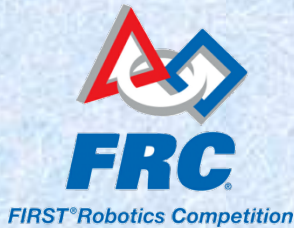
Extended Length =  $5.94 + (2 \times \text{Stroke Length})$





# Why Pneumatics?

- Weight
  - Comparable to other approaches?
- Simple
- Durable
  - Can stall without burning up
- Strong
  - Up to 180 pounds of force
- Adjustable Force
  - Bore size
  - Pressure regulation
- Adjustable Speed
  - Flow control valves
- Adjustable Stroke
  - Many lengths available



# Why Not Pneumatics?

- Weight Overhead for First Actuator
- System is “Springy”
- Reserve Pressure Limited
  - Pressure recovery slow
- Leaks
- Cannot Stop in Mid Stroke