

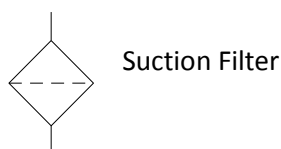
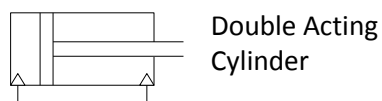
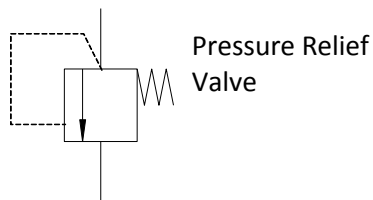
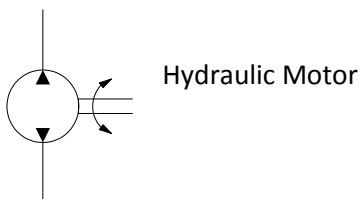
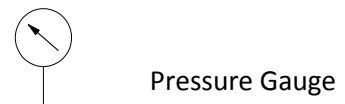
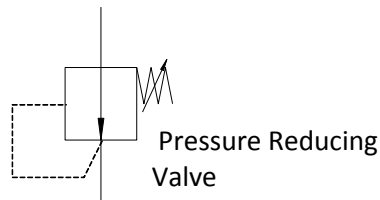
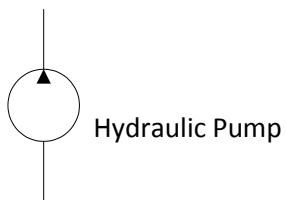
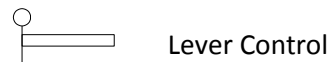
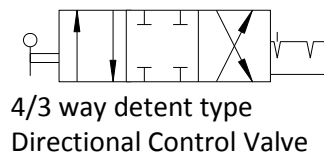
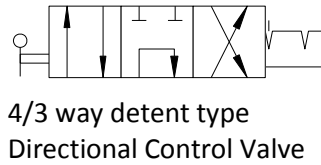
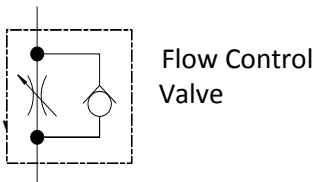
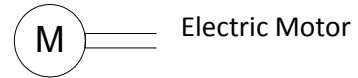
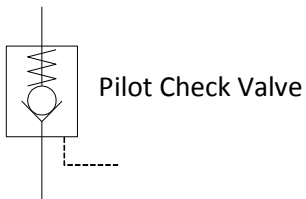
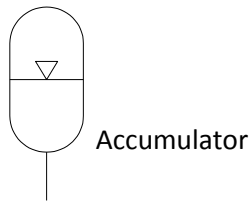
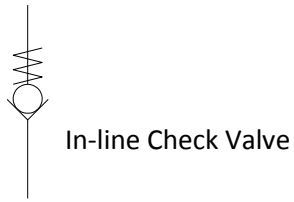
Hydraulic Experiment Workbook



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Introduction of Hydraulic Symbol



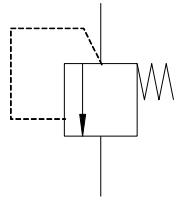
Basic Circuit Testing & Understanding of Hydraulic Components

1.0 Pressure Relief Valve

1.1 What is the function of pressure relief in hydraulic system?

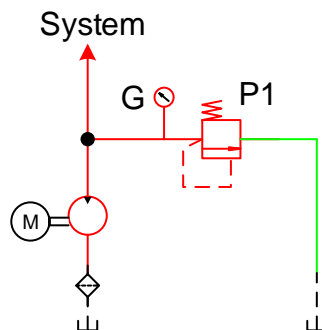
Answer: Pressure relief valve is normally closed type whose function is to limit the pressure to a specified maximum value by diverting pump flow back to the tank.

1.2 Please draw out the symbol of pressure relief valve.



1.3 Please draw the simple hydraulic pressure relief valve circuit for further understanding.

Pressure Relief Circuit

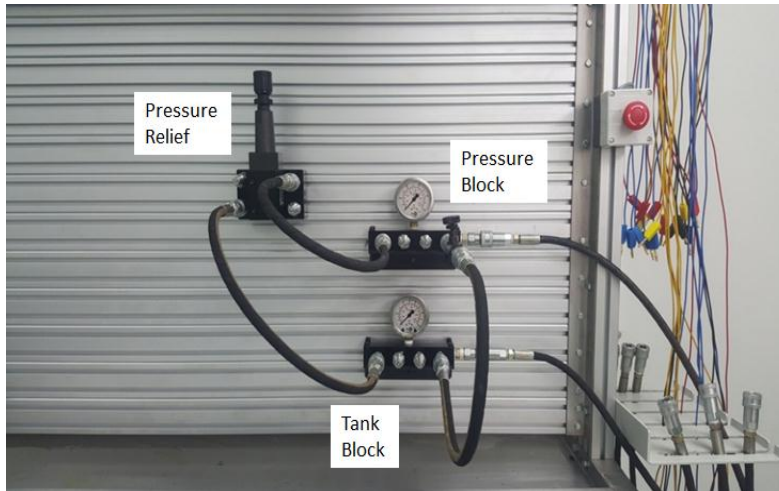


1.4 Kindly construct the practical step of hydraulic pressure relief set up and experiment from existing components.

Instruction:

- 1) Take out 5 way P-block and 5 way T-block then fix onto working panel;
- 2) Connect a hose from power unit P-line to 5 way P block and do the same for T-line to 5 way T block;
- 3) Take out Pressure Relief Valve (P1) and fix onto working panel;
- 4) Connect a hose from P-line 5 way block to P1 pressure line;
- 5) Connect a hose from P1 T-line to 5 way T block;
- 6) Regulate the P1 counter clockwise to minimum level
- 7) Turn on the power unit and slowly regulate the pressure adjustment knob and observe the needle movement of pressure gauge G
- 8) Clockwise to increase pressure value (do not exceed 70kgf for safety testing)
- 9) Counter clockwise to reduce pressure value.

Below photo is for reference of pressure relief set up

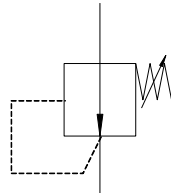


2.0 Pressure Reducing Valve

2.1 What is the function of pressure reducing valve in hydraulic system?

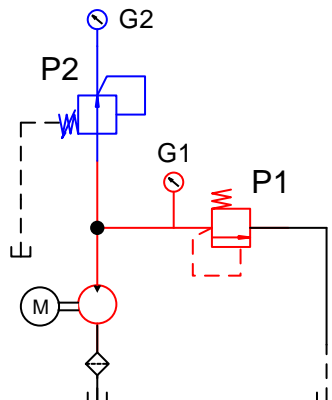
Answer: Pressure reducing valve is a normally open type valve whose functions to maintain reduced pressure in specified location of hydraulic system. It is actuated by downstream pressure and tend to close as this pressure reaches the valve setting value.

2.2 Please draw out the symbol of pressure reducing valve.



2.3 Please draw the simple circuit of hydraulic pressure reducing valve for further understanding.

Pressure Reducing Circuit

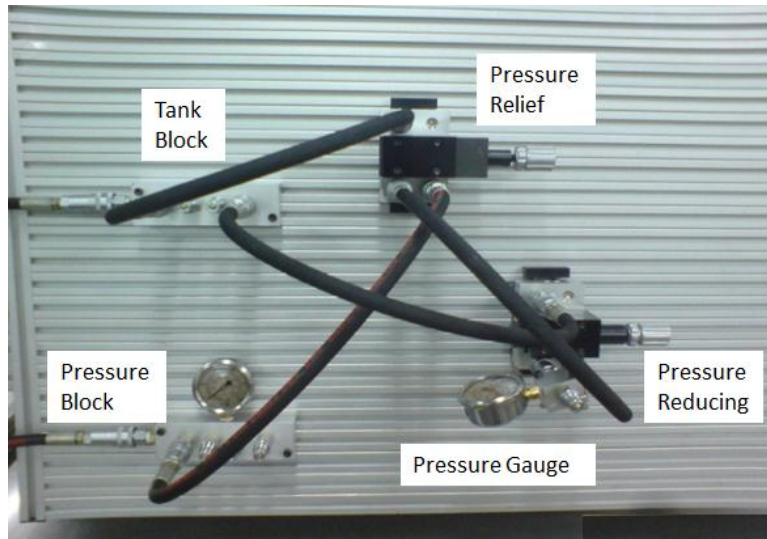


2.4 Kindly construct the practical step of hydraulic pressure reducing set up and experiment from existing components.

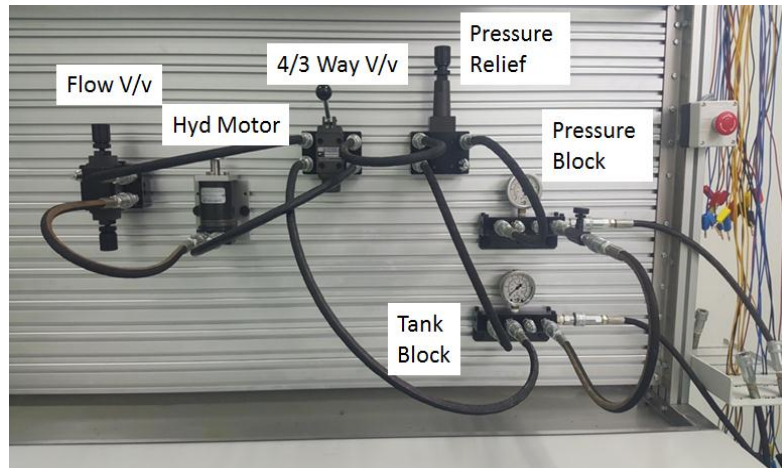
Instruction:

- 1) Take out 5 way P-block and 5 way T-block then fix onto working panel;
- 2) Connect a hose from power unit P-line to 5 way P block and do the same for T-line to 5 way T block;
- 3) Take out Pressure Relief Valve (P1) and Pressure Reducing Valve (P2) fix onto working panel;
- 4) Connect a hose from P-line 5 way block to P-line of P1; A-line to P2 P-line;
- 5) Both valve T-line connect to 5 way T block
- 6) P2 A-line connect a Gauge block
- 7) Regulate the P1 & P2 counter clockwise to minimum level
- 8) Turn on the power unit and slowly regulate the pressure adjustment knob and observe the needle movement of pressure gauge
- 9) Clockwise P1 to increase pressure value and set at specified value G1(do not exceed 70kgf for safety testing)
- 10) Counter clockwise P2 to reduce pressure value
- 11) Observe the pressure value of G2

Below photo is for reference of pressure reducing set up



Below photo is for reference of flow control valve set up

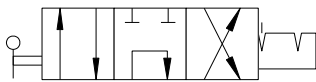


4.0 4/3 way Directional Control Valve

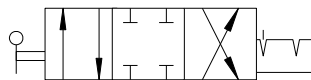
4.1 What is the function of Directional Control Valve in hydraulic system?

Answer: Directional Control valve is used to control the directional of flow in a hydraulic circuit regardless of its design.

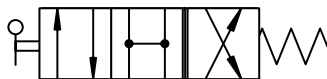
4.2 Please draw out the symbol of 5 different design of directional control valve and its function.



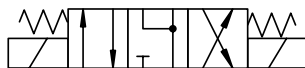
4/3 way tandem center hand lever detent type



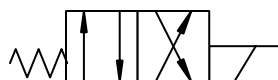
4/3 way close center hand lever detent type



4/3 way open center hand lever spring return

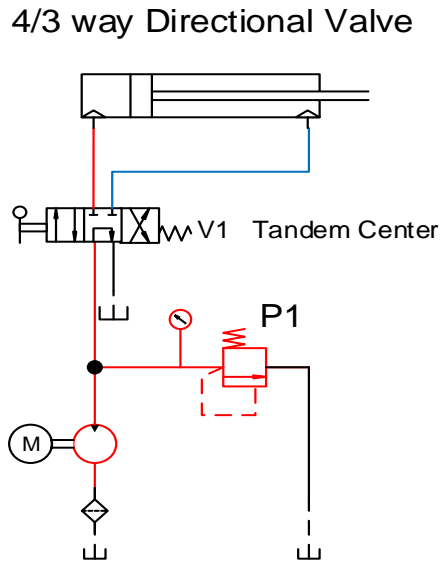


4/3 way pressure close; AB open to Tank solenoid control



4/2 way single solenoid control

4.3 Please draw the simple 4/3 way directional valve circuit for further understanding.

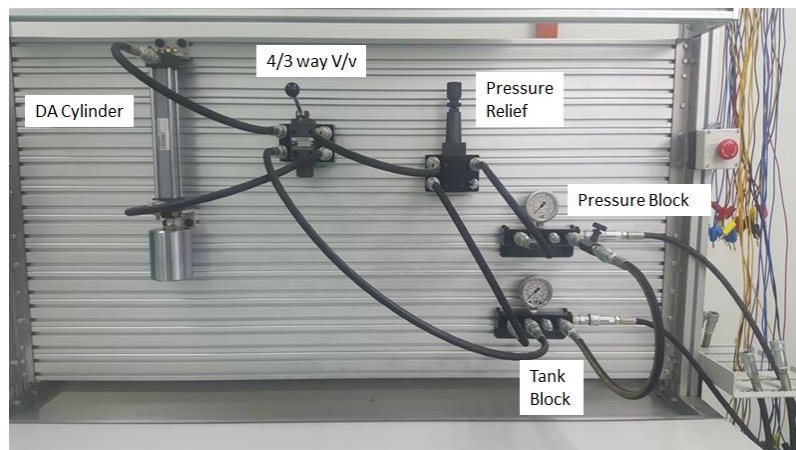


4.4 Kindly construct the practical step of directional control valve set up and experiment from existing components.

Instruction:

- 1) Take out 5 way P-block, 5 way T-block, P1, Directional Control Valve V1 (Tandem) and Hydraulic Cylinder and fix onto working panel;
- 2) Connect a hose from power unit P-line to 5 way P block and do the same for T-line to 5 way T block;
- 3) P1 P-line connect to Tandem Valve P-line; A-line & B-line of V1 Tandem Valve connect to hydraulic cylinder ports;
- 4) When hand lever in center position, oil re-circulating back to tank
- 5) Push lever to left and observe the hydraulic cylinder will extending
- 6) Push lever to right and observe the hydraulic cylinder will retracting

Below photo is for reference of directional control valve set up

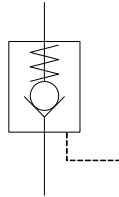


5.0 Pilot Check Valve

5.1 What is the function of Pilot Check Valve in hydraulic system?

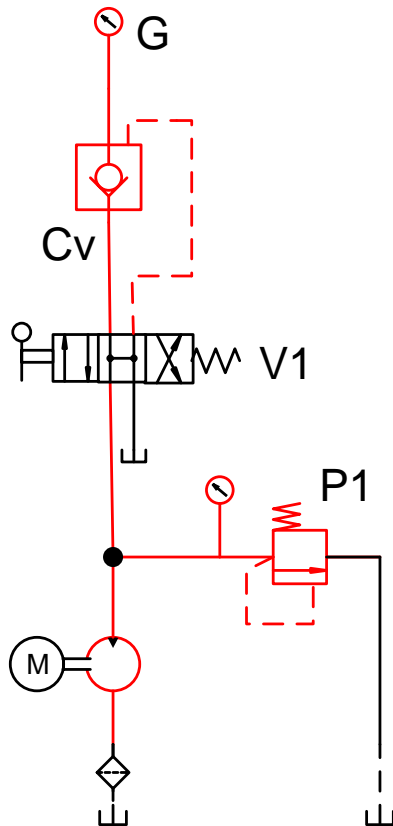
Answer: The purpose of pilot check valve is to permit free flow in one direction and prevent any flow in the opposite direction in hydraulic circuit only if pilot pressure is applied at the pilot pressure port of the valve.

5.2 Please draw out the symbol of the design of pilot check valve.

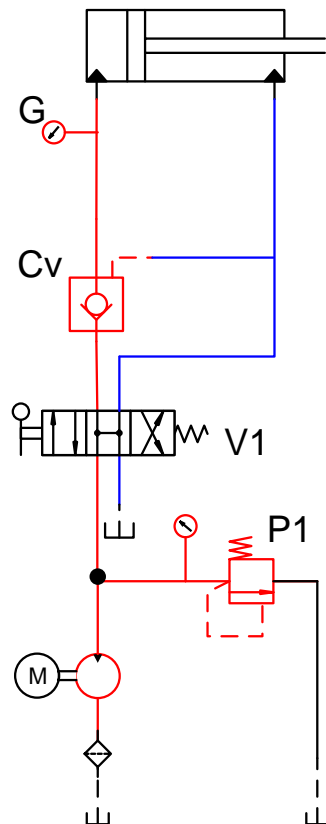


5.3 Please draw the simple hydraulic Pilot Check Valve circuit for further understanding

Pilot Check Circuit



Pilot Check Circuit
Connected to Actuator

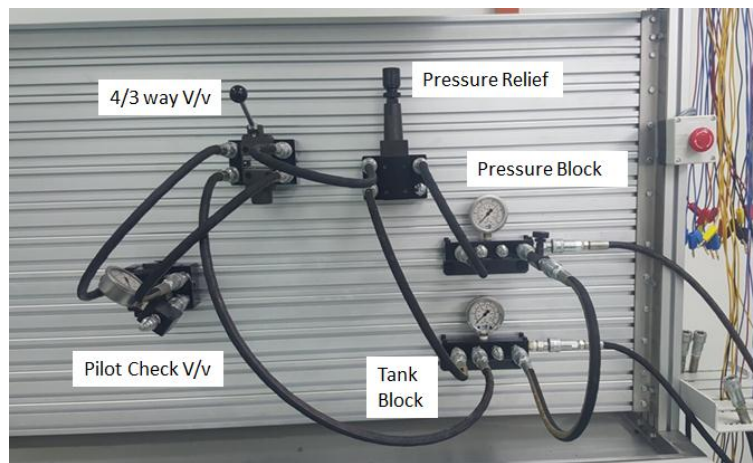


5.4 Kindly construct the practical step of Pilot Check Valve set up and experiment from existing components.

Instruction:

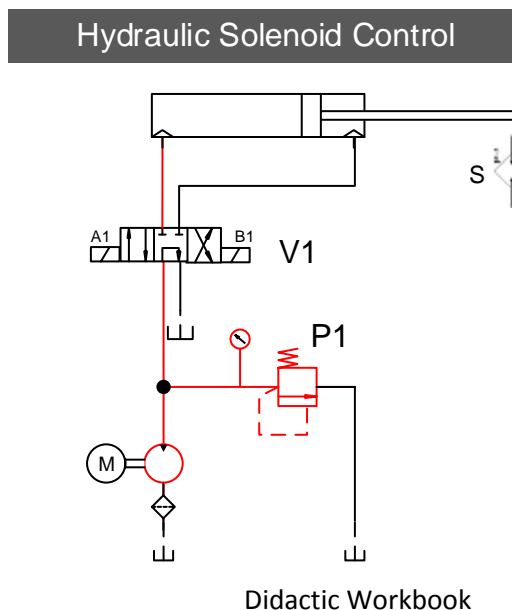
- 1) Take out 5 way P-block, 5 way T-block, P1, Pilot Check Valve(Cv), Gauge block, V1 and fix onto working panel;
- 2) Connect a hose from power unit P-line to 5 way P block and do the same for T-line to 5 way T block;
- 3) V1 A-line connect to Cv P-line; A-line of Cv connect to Gauge block;
- 4) V1 B-line connect to X port of C2;
- 5) Push lever to the right till G build up set pressure;
- 6) Push lever to the left G will drop to zero pressure.

Below photo is for reference of Pilot Check Valve set up



6.0 Solenoid Operation Control of Hydraulic Actuator

6.1 Please draw the hydraulic circuit of solenoid operation control?



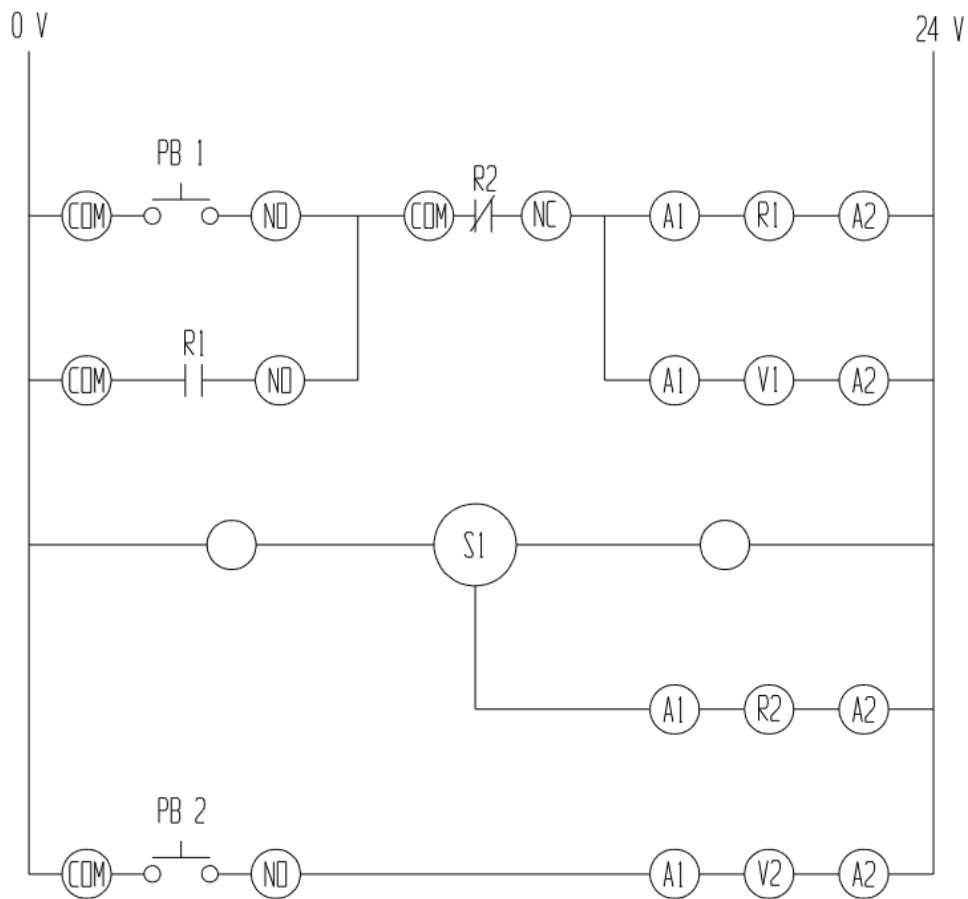
6.2 Kindly construct the practical step of hydraulic solenoid control process set up and experiment from existing components.

Instruction:

- 1) Take out 5 way P-block, 5 way T-block, P1 Relieve Valve, V1 4/3 way, limit switches, DA Cylinder and fix onto working panel;
- 2) Connect a hose from power unit P-line to 5 way P block and do the same for T-line to 5 way T block;
- 3) V1 AB-line connect to Double Acting Cylinder;
- 4) Valve coil and electrical limit switch connect to electrical control module
- 5) Push button (Green) as Start button to energize A1;
- 6) Cylinder extending
- 7) Extending limit switch detected will de-energize A1
- 8) Push Button (Red) as Stop Button to energize B1
- 9) Cylinder start retracting once (Red) push button continue pressed

7.3 Electrical test lead wiring connection for Solenoid Control of hydraulic process

Electrical Diagram



Useful Mechanical/Hydraulic/Conversion Formulas

Work

$$W = F \times D$$

F = force in lbs

D = Distance in inches or feet

Unit are expressed in (in-lbs) or (ft lbs)

Force

$$F = Ma$$

F = force in lbs

$$M = \text{mass in} = \frac{\text{weight (lbs)}}{32.2 \text{ ft/sec}^2}$$

Acceleration

$$A = \frac{V}{T}$$

a = acceleration ft/sec²

V = velocity ft/sec

T = time in seconds

$$g = 32.2 \text{ ft/sec}^2$$

Torque

$$T = F \times r$$

T = torque in lb in

F = force in lbs

r = radius in inches

Flow Rate

$$\text{GPM} = \frac{A \times V}{231} \text{ for Cylinder}$$

$$\text{GPM} = \frac{D \times \text{RPM}}{231} \text{ for Motor}$$

Required Pressure

Cylinder

$$\text{PSI} = \frac{F}{A} \text{ or } F = \text{PSI} \times A$$

Motor

$$\text{PSI} = \frac{2\pi T}{D}$$

T = torque in (lb in)

D = displacement (in³/rev)

Hydraulic Horsepower

$$\text{HP} = \frac{\text{GPM} \times \text{PSI}}{1714}$$

Volume

$$1 \text{ gallon} = 231 \text{ in}^3$$

$$1 \text{ gallon} = 3.785 \text{ liters}$$

$$1 \text{ liters} = 61.02 \text{ in}^3$$

Pressure

$$1 \text{ bar} = 14.5 \text{ psi}$$

$$1 \text{ atmosphere} = 14.7 \text{ psi}$$

$$1 \text{ kg/cm}^2 = 14.2 \text{ psi}$$

$$1 \text{ bar} = 100 \text{ kpa}$$

$$1 \text{ psi} = 6.89 \text{ kpa}$$

Speed

$$1 \text{ ft/sec} = 0.3048 \text{ M/sec}$$

Length

$$1 \text{ inch} = 25.4 \text{ mm}$$

$$1 \text{ meter} = 39.37 \text{ inches}$$

$$1 \text{ micron} = 0.000039 \text{ inches}$$

Force

$$1 \text{ N (newton)} = 0.2248 \text{ lbs}$$