Basic Hydraulic

Basic Component OF Hydraulic system

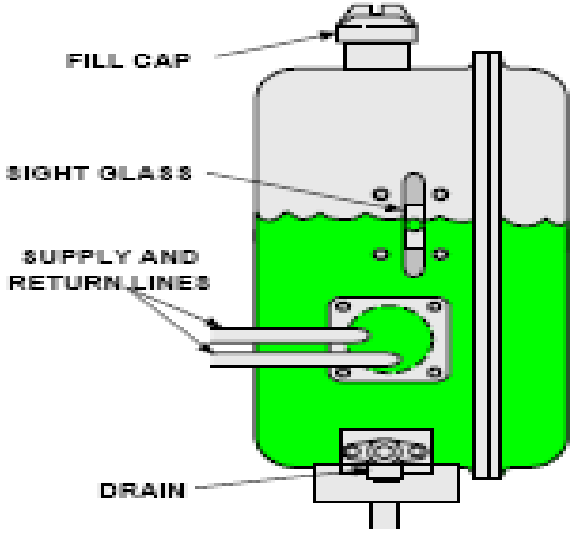
- Hydraulic Tank
- Hydraulic Pumps and Motors
- Pressure Control valves
- Directional Control valves
- Flow control valves
- Cylinders.

Basic Hydraulic

Basic Component OF Hydraulic system

Hydraulic Tank

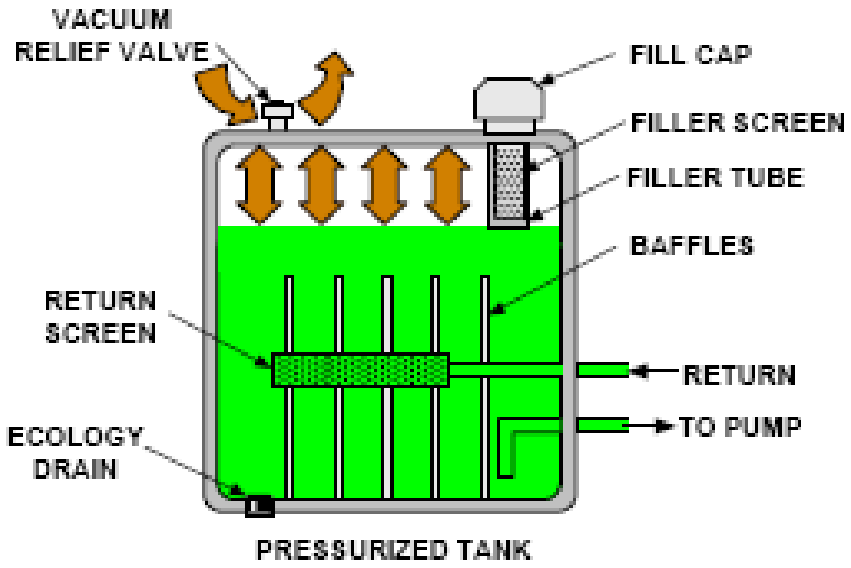
The main function of the hydraulic oil tank is to store oil , remove heat and air from oil

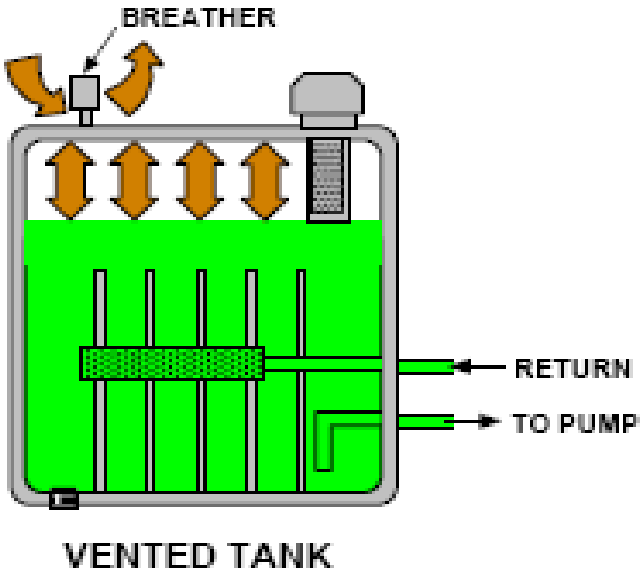


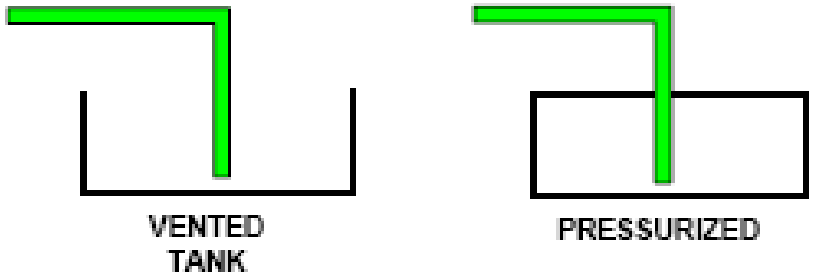
Pressurized Tank

The Two main type of Hydraulic tanks are Pressurized and vented (unpressurized)

Basic Hydraulic







Basic Hydraulic

Basic Component OF Hydraulic system

Hydraulic Pumps

Hydraulic pumps are used to create flow. Pressure is created as a result of system restriction . Various design are used for pumps including :

- Gear pump
- Vane pump
- Gerotor
- Piston Pump

Basic Hydraulic

Basic Component Of Hydraulic system

Hydraulic Pumps and Motors

Positive displacement pumps

have much smaller clearances bet . Component this reduce leakage and provide high efficiency when used in high pressure system

Positive displacement pump have 3 type

1. Gear pump
2. Vane pump
3. Piston pump

Basic Hydraulic

Gear pump

- a gear pump develops flow by carrying fluid bet. The gear teeth and Housing, there are two types of pump :external, internal

Advantage

- Simpler system , Compact design
- Long Life & Low cost

Disadvantage

- Fixed displacement
- Input speed must be increased to get more flow output
- High hp draw

Where use

- Engine oil pumps , transmission pumps
- Low pressure Hyd. systems

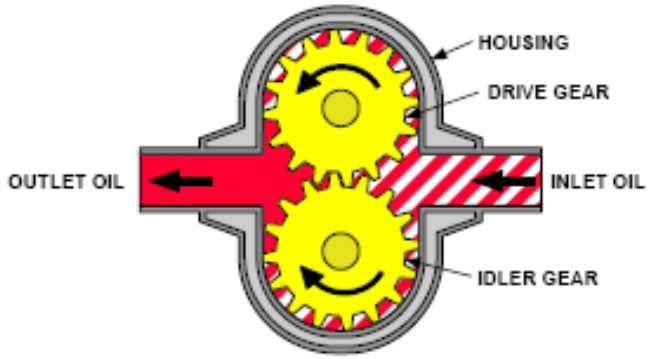
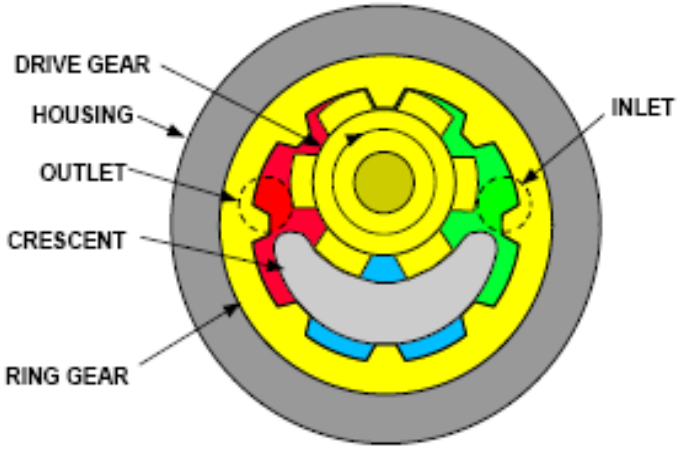
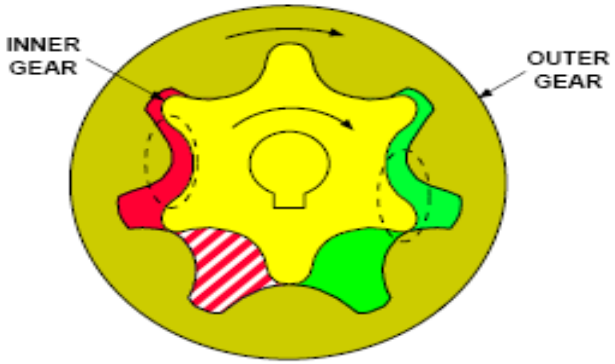


Fig. 3.3.7 Gear Pump Flow

Gear Pump Flow



Basic Hydraulic



Gerotor Pumps

A gerotor pump is similar to an internal pump except that the inner gear sets inside the outer gear, and the outer gear turns slower than the inner gear on some designs. Other designs have a fixed outer gear and the inner gear walks around in the outer gear (Also known as a hand-metering unit).

Advantages:

- Compact design
- Low cost

Disadvantage:

- Fixed displacement
- Input speed must be increased to get more output
- Lower pressure range than other pumps

Where Used:

- Steering systems
- Some engine oil pumps

Basic Hydraulic

Vane pumps

When the rotor rotates around the inside of the cam ring, the vanes slide in and out of the rotor slots to maintain the seal against the cam ring. As the vanes move out of the slotted rotor, the volume between the vanes changes. An increase in the distance between the cam ring and the rotor causes an increase in the volume. The increase in volume creates a slight vacuum that allows the inlet oil to be pushed into the space between the vanes by atmospheric or tank pressure. As the rotor continues to rotate, a decrease in the distance between the ring and the rotor causes a decrease in the volume. The oil is pushed out of that segment of the rotor into the outlet passage of the pump.

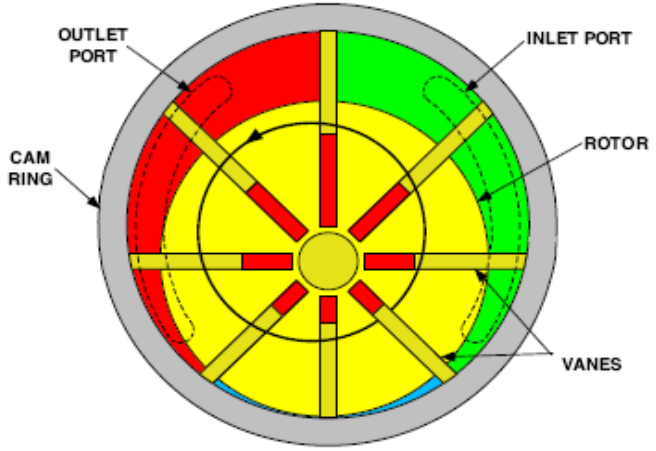


Fig. 3.3.14 Vane Pump Operation

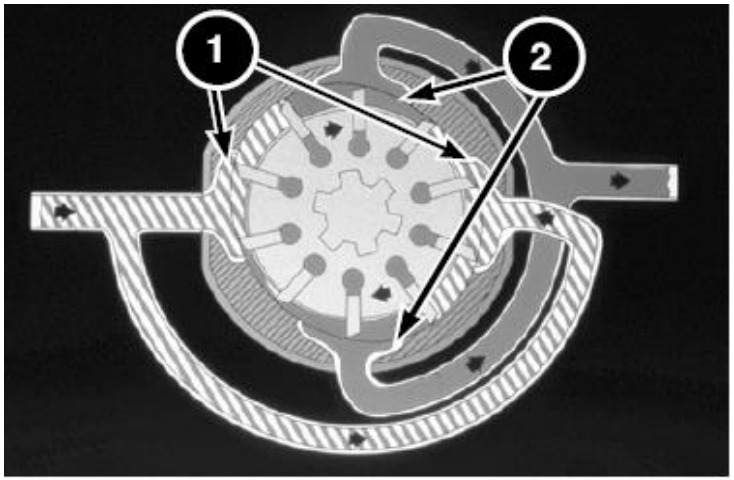


Fig. 3.3.15 Balanced Vane Pump

Balanced Vane Pump

Basic Hydraulic

- **Vane pumps**

Pump movie

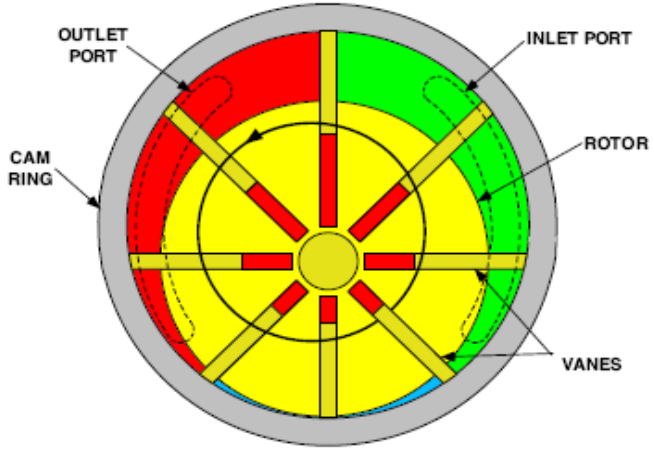


Fig. 3.3.14 Vane Pump Operation

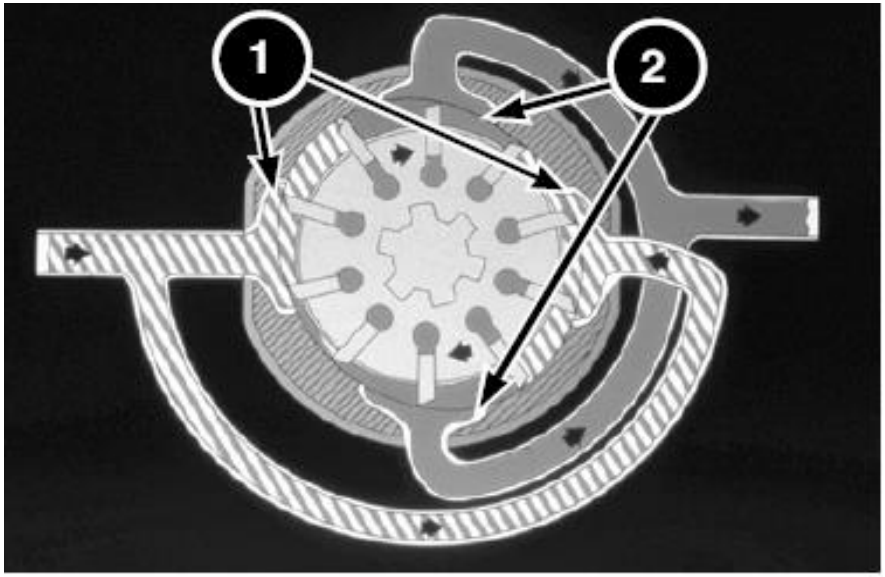


Fig. 3.3.15 Balanced Vane Pump

Balanced Vane Pump

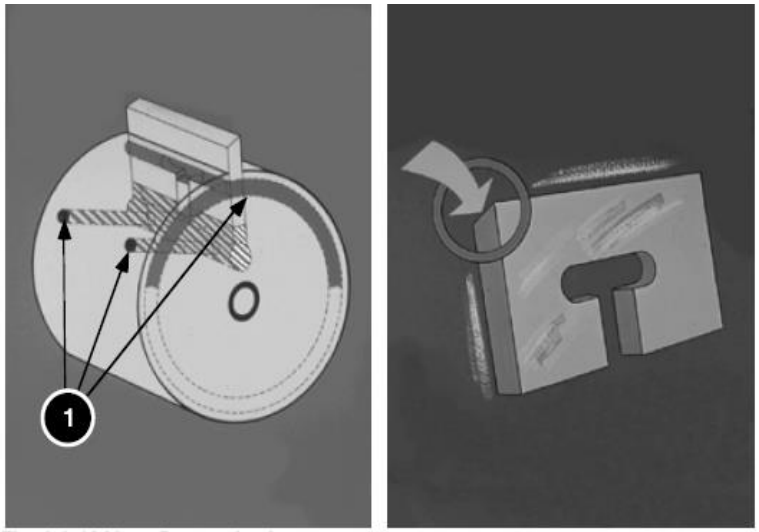


Fig. 3.3.12 Vane Pressurization

Vanes

Basic Hydraulic

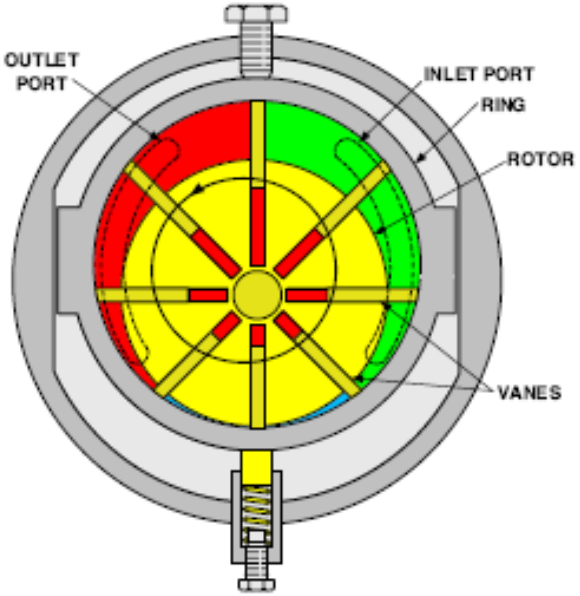


Fig. 3.3.16 Variable Vane Pump

Variable Vane Pump

Variable Vane Pump

Variable output vane pumps are controlled by shifting a round ring back and forth in relation to the rotor centerline. Variable output vane pumps are seldom, if ever, used in mobile hydraulic applications.

Basic Hydraulic

- **Piston Pump**

1. The Head
2. Housing
3. shaft
4. Pistons
5. Port plate
6. Barrel
7. swash plate

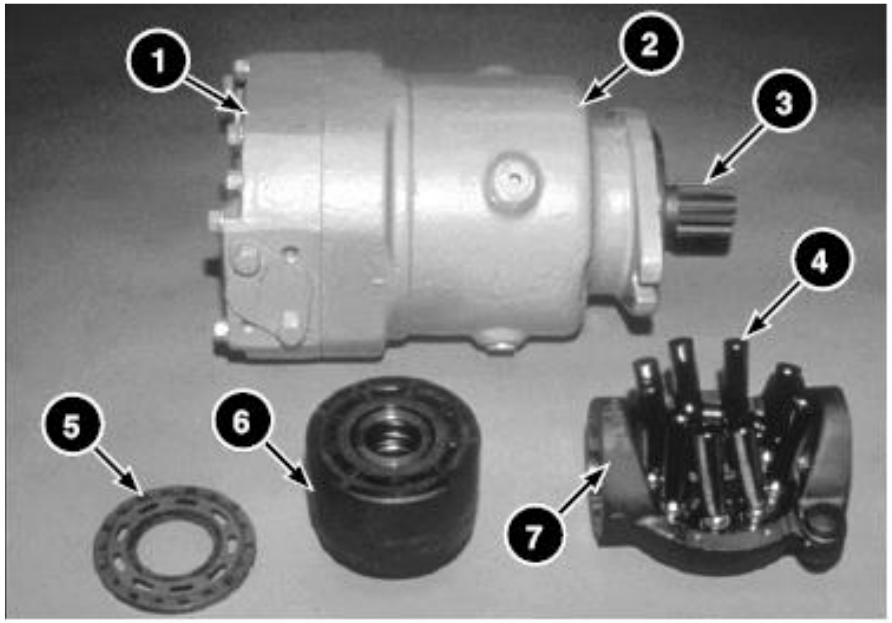
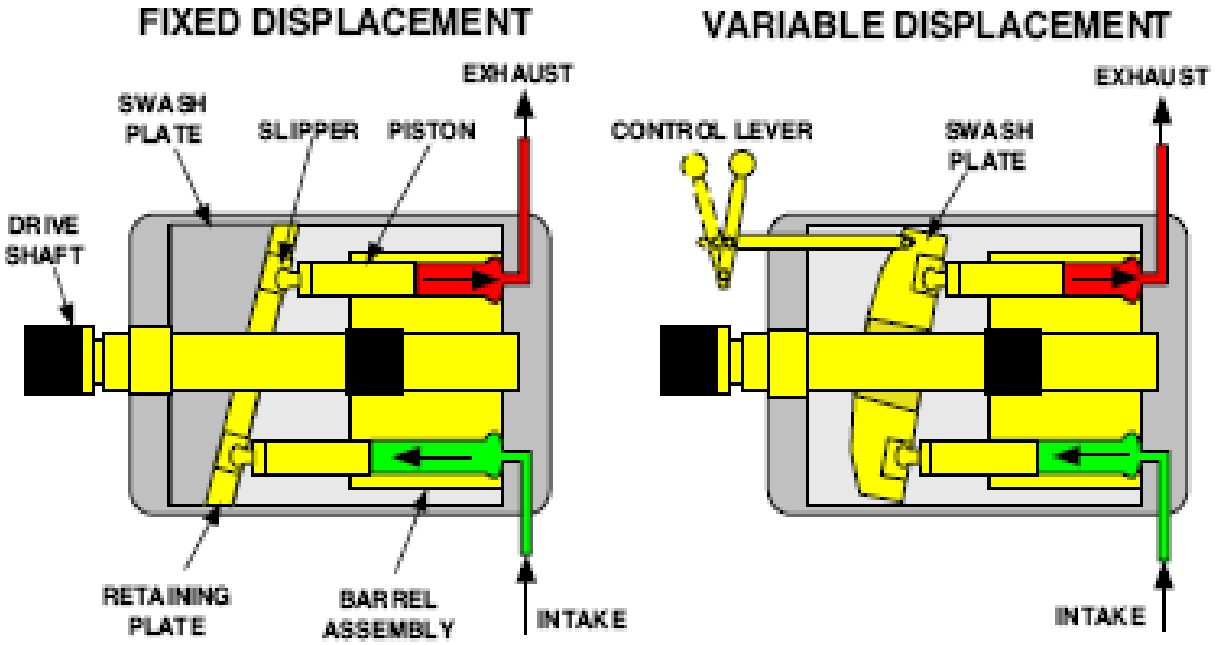


Fig. 3.3.17 Common Parts

Piston Pumps

Most piston pumps and motors have similar or common parts and use the same nomenclature. The pump parts in Figure 3.3.17 are the head (1), the housing (2), the shaft (3), the pistons (4), the port plate (5), the barrel (6) and the swashplate (7).

Basic Hydraulic



In the fixed displacement axial piston pumps, the pistons move backward and forward in a line that is near parallel to the centerline of the shaft.

Basic Hydraulic

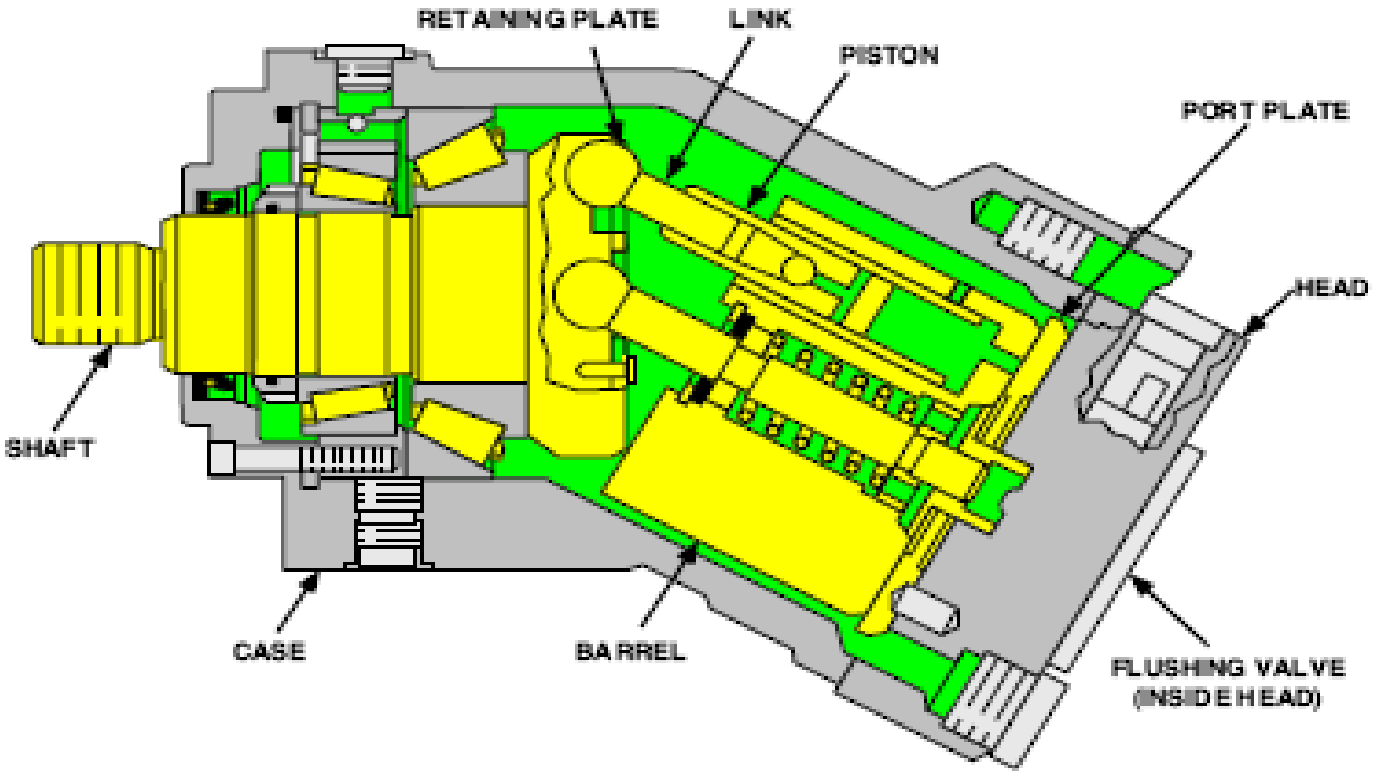


Fig. 3.3.19 Angled Housing Axial Piston Motor

Angled Housing Axial Piston Pump

Basic Hydraulic

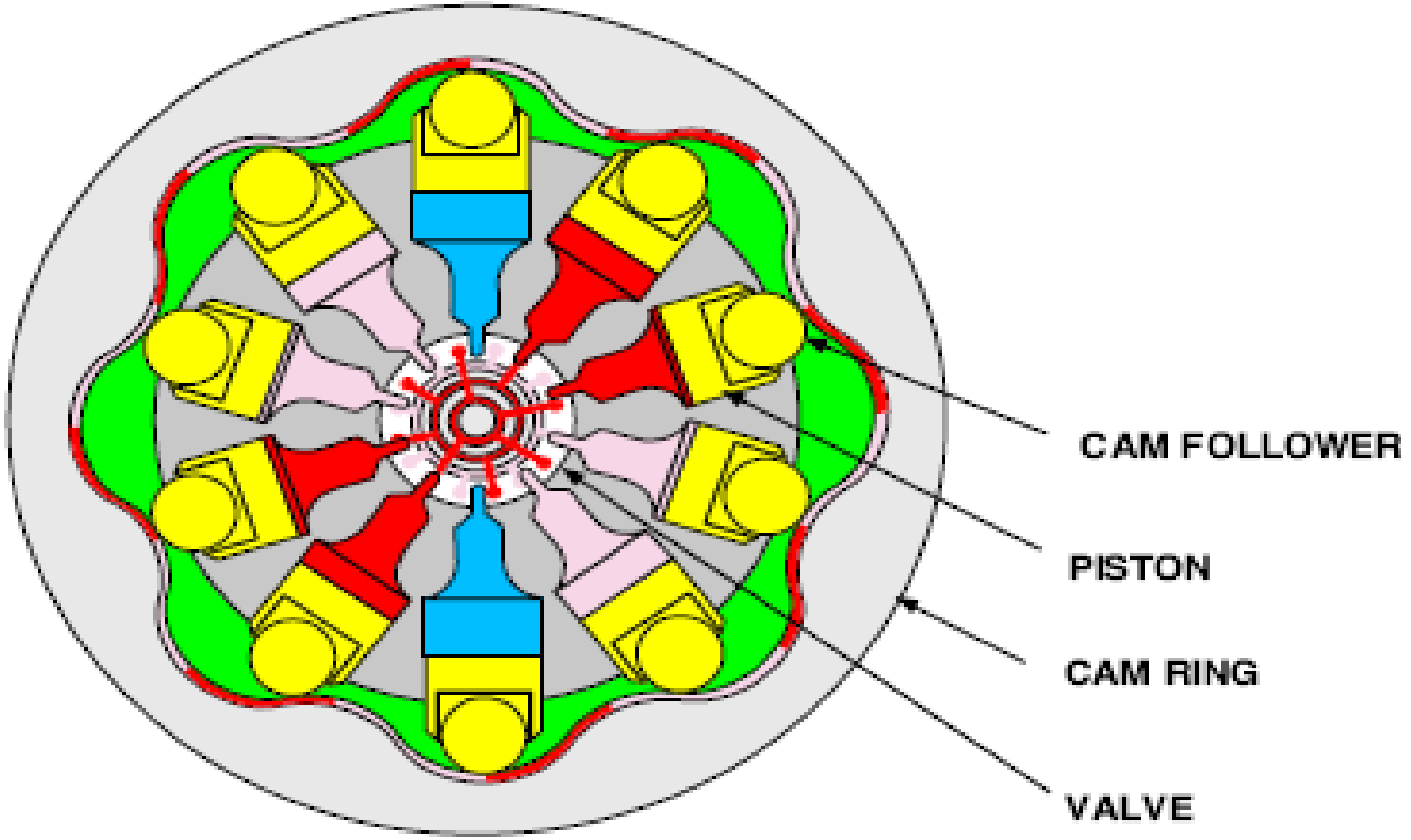


Fig. 3.3.20 Radial Piston Pump

Radial Piston Pump

Basic Hydraulic

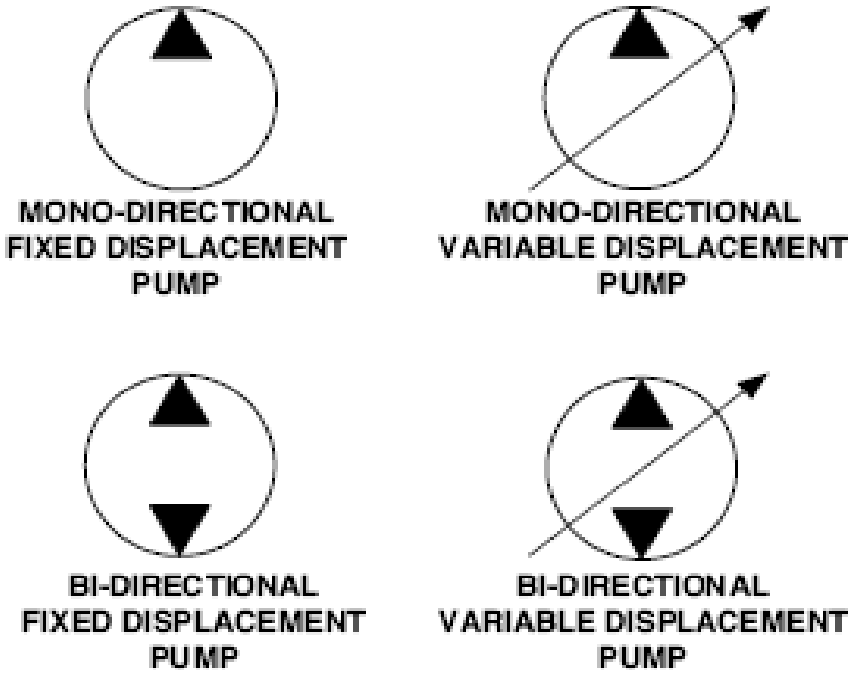


Fig. 3.3.23 Pump ISO Symbols

Pump ISO Symbols

Basic Hydraulic

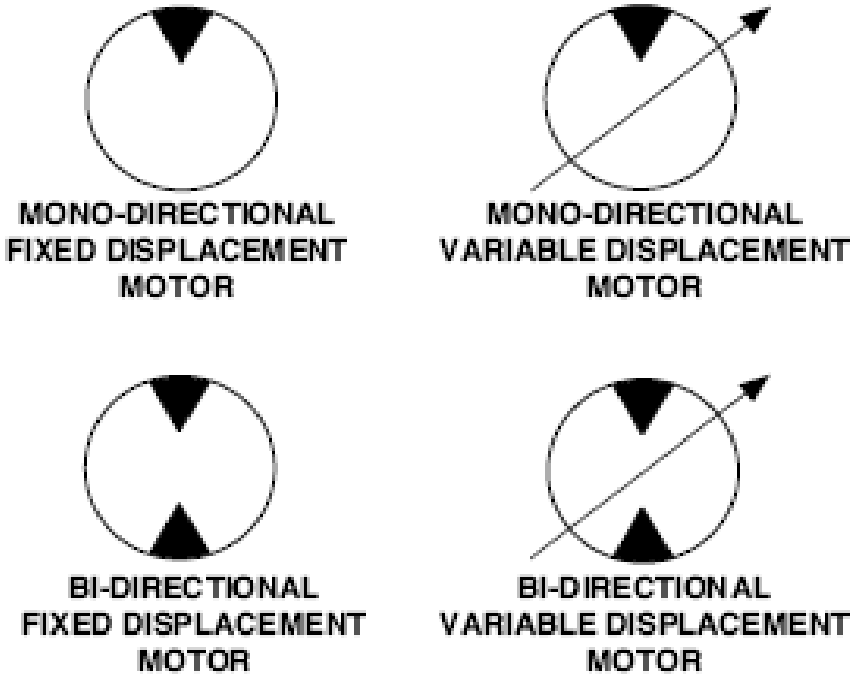


Fig. 3.3.24 Motor ISO Symbols

Motor ISO Symbols

Basic Hydraulic

Basic Component Of Hydraulic system

Pressure control valves

Pressure control valve are used to control pressure in system , the valve function will remain the same although the design change Examples of pressure control valves :

1. Relief valve
2. Sequence valve
3. Pressure reducing valve
4. Pressure differential valve
5. Unloading valve

Basic Hydraulic

- **Relief valve**

The relief valve maintains the pressure within the design limit by opening and allowing excessive oil to flow either to another circuit or back to the tank

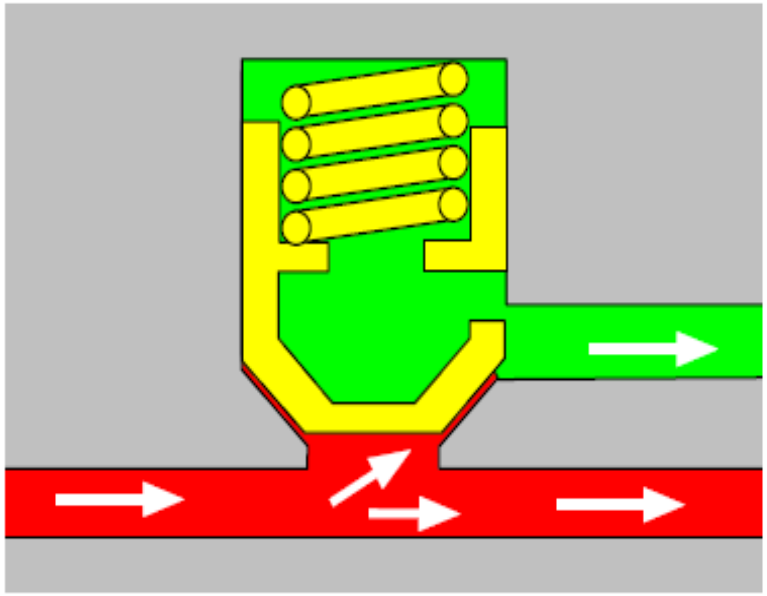


Fig. 3.4.1 Cracking Pressure

Simple Pressure Relief Valve, Cracking Pressure

Basic Hydraulic

- **Pilot operated Relief valve**

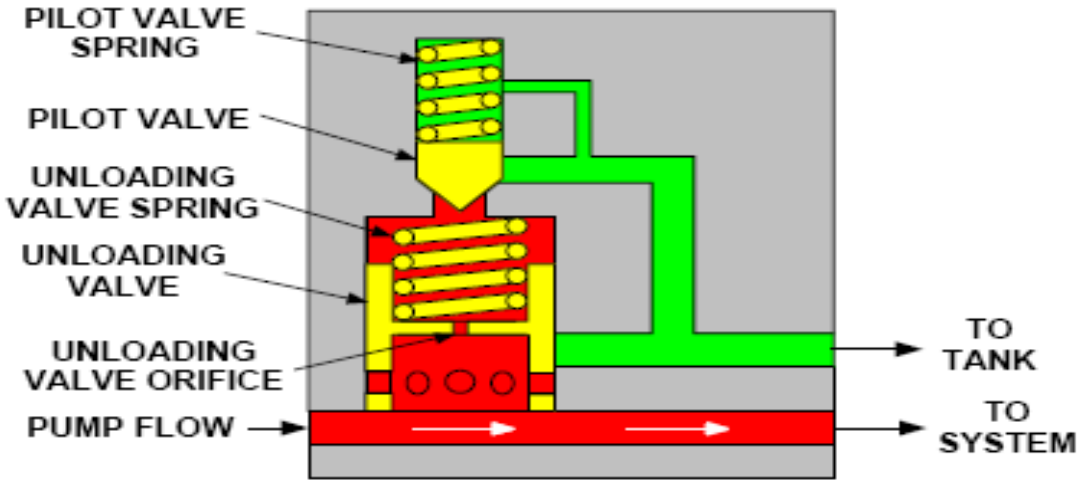


Fig. 3.4.3 System Oil Flow

Pilot Operated Relief Valve, CLOSE Position

In the pilot operated relief valve ,a pilot valve (simple relief valve) is used to control the unloading valve (main valve)

Basic Hydraulic

- **Pilot operated Relief valve**

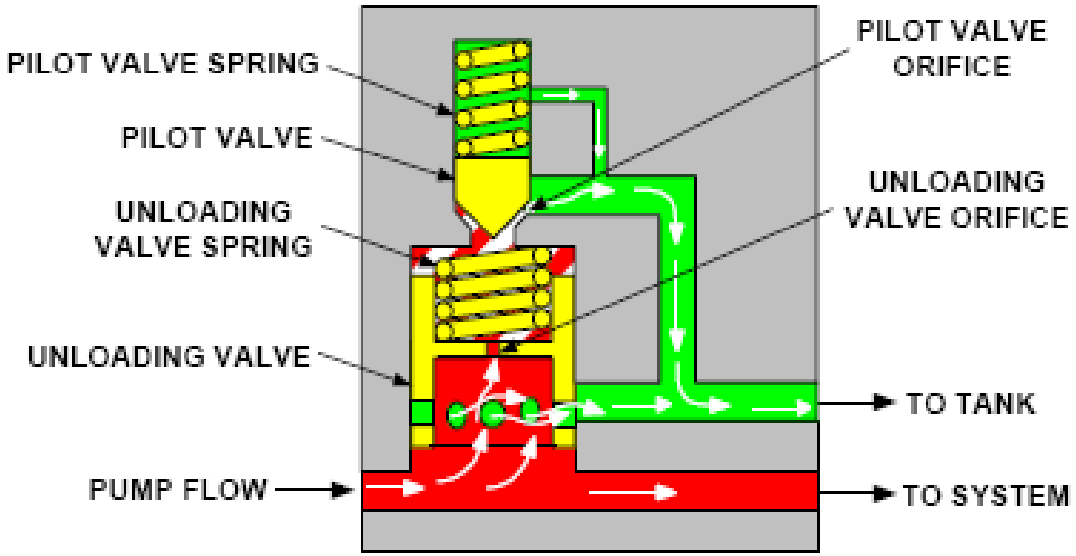


Fig. 3.4.4 Pilot Valve Open

Pilot Operated Relief Valve, OPEN Position

Basic Hydraulic

- **Relief valve**

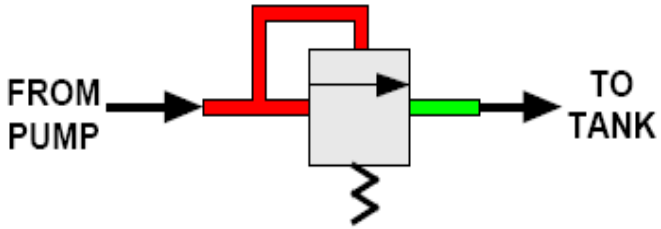


Fig. 3.4.5 Relief Valve ISO Symbol

Relief Valve ISO Symbol CLOSED

The above relief valve ISO symbol shows a single valve envelope in the CLOSED position. The system pressure is sensed through the pilot line at the top of the envelope and works to move the valve (arrow) against the spring. During normal operations, the pump flow is blocked at the closed valve.

Basic Hydraulic

- **Relief valve**

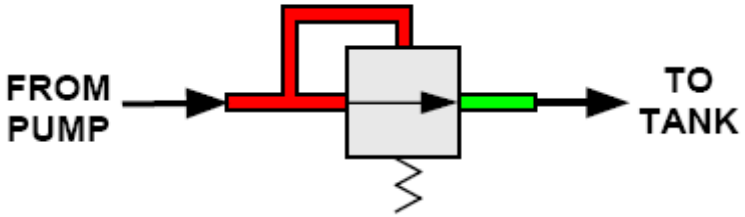


Fig. 3.4.6 Relief Valve ISO Symbol Open to Flow

Relief Valve ISO Symbol OPEN

When the force of the system oil pressure overcomes the spring force, the arrow moves down (valve opens) and connects the oil line from the pump with the oil line to the tank. The pump oil flows through the valve to the tank.

Basic Hydraulic

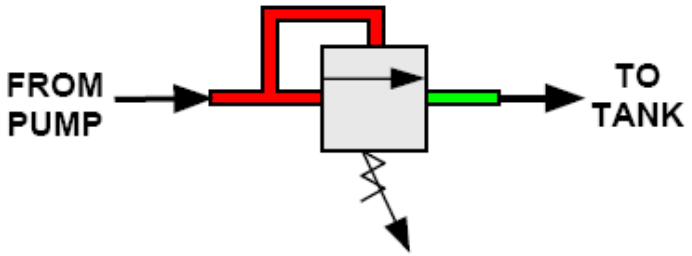


Fig. 3.4.7 Variable Relief Valve

Variable Relief Valve ISO Symbol

The variable relief valve is a single envelope valve with an arrow through the spring. The arrow shows that the spring tension can be varied.

Basic Hydraulic

- **Sequence valve**

  - The sequence valve is simply a pilot operating relief valve in series with second circuit
  - The sequence valve is used when two circuits are supplied by one pump and one circuit has priority over the other

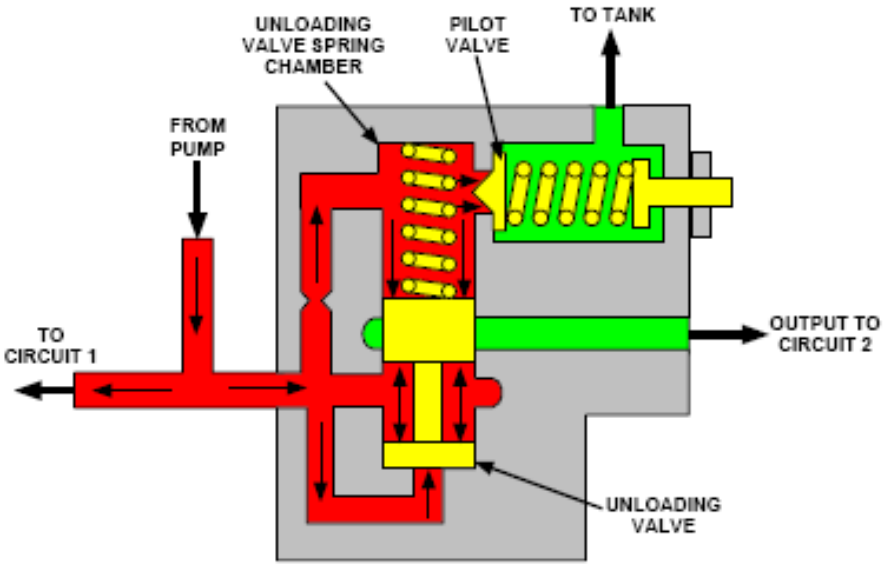
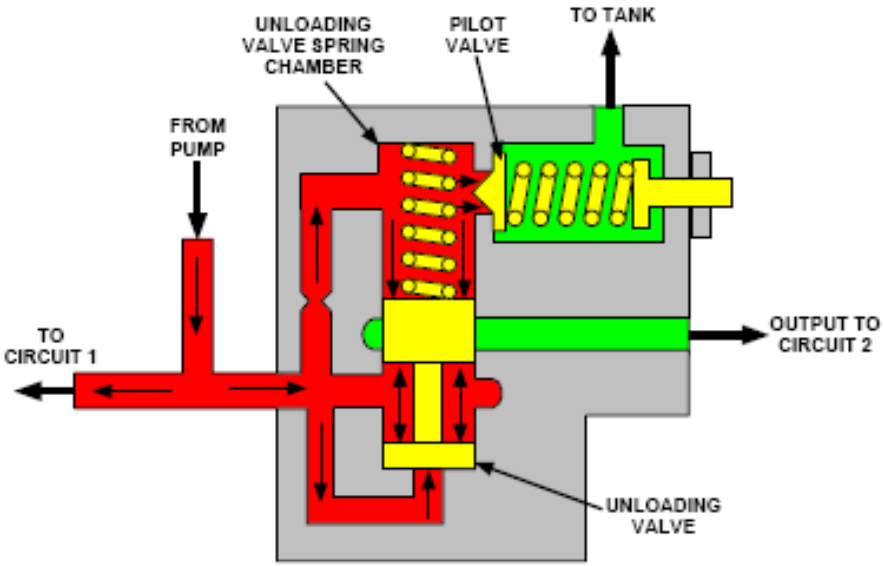


Fig. 3.4.8 Sequence Valve CLOSED

Sequence Valve, CLOSE Position

Basic Hydraulic

- **Sequence valve**



When the pressure in the unloading valve spring chamber exceeds the setting of the pilot valve spring, the pilot valve opens. The open pilot valve allows the oil in the unloading valve spring chamber to flow to the tank. This allows the pressure to decrease in the unloading valve spring chamber. The force of the higher system oil pressure moves the unloading valve against the unloading valve spring force and opens the passage to circuit 2. Pump oil flows through the sequence valve to circuit 2. The sequence valve remains open until the pressure in circuit 1 decreases to less than the pressure setting of the sequence valve.

Basic Hydraulic

- **Sequence valve**

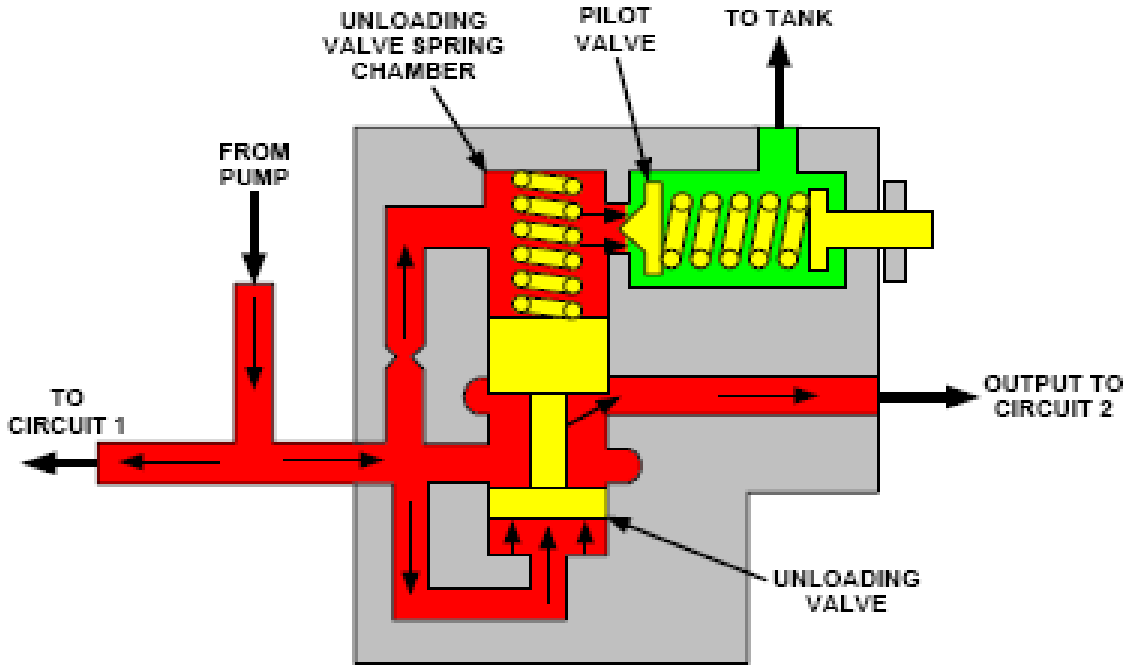


Fig. 3.4.9 Sequence Valve OPEN

Sequence Valve, OPEN Position

Basic Hydraulic

- **Sequence valve**

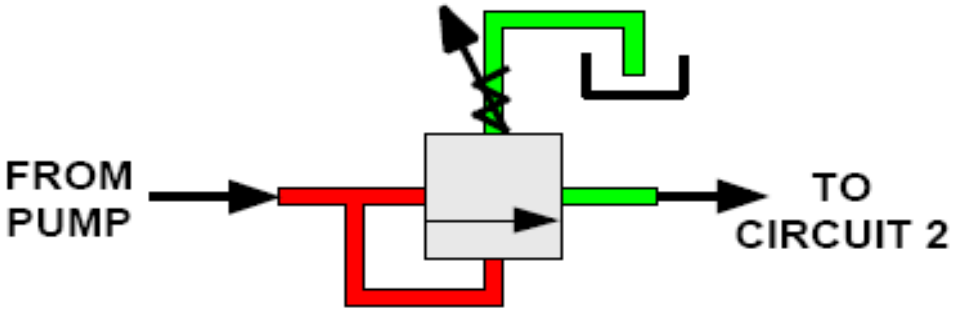


Fig. 3.4.10 Sequence Valve ISO SYMBOL

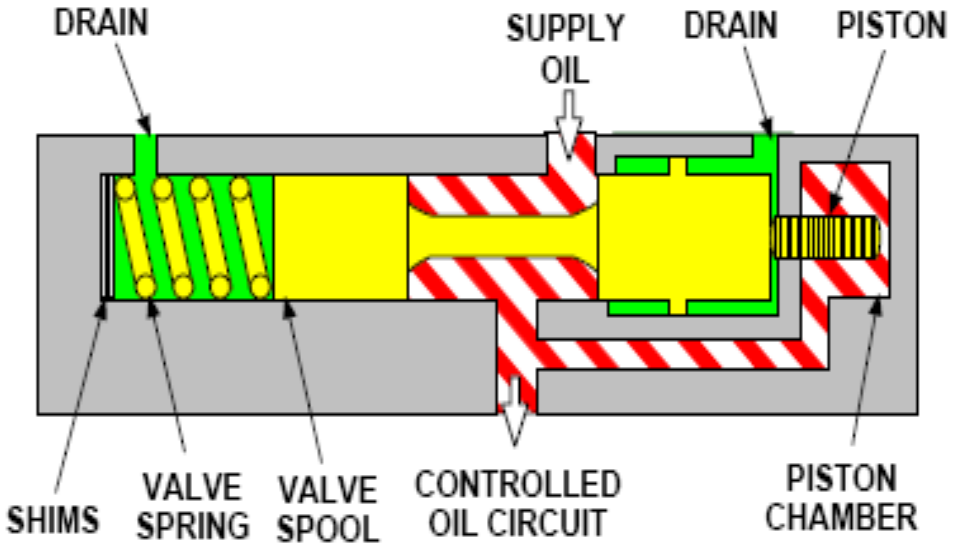
Sequence Valve ISO Symbol

The operation of the sequence valve is the same as the operation of the relief valve.

In the relief valve, the spring chamber is normally drained internally to outlet passage. In the sequence valve, the outlet passage connects to the second circuit. Because the second circuit is under pressure when the sequence valve opens, the pilot valve spring chamber must be externally drained to the tank.

Basic Hydraulic

- **Pressure reducing valve**



- The pressure reducing valve allow two circuit of different pressures to be supplied by the same pump
- The max. supply oil pressures is controlled by the system relief valve
- The pressure control valve control the max. pressure in the controlled oil circuit

Basic Hydraulic

- **Pressure reducing valve**

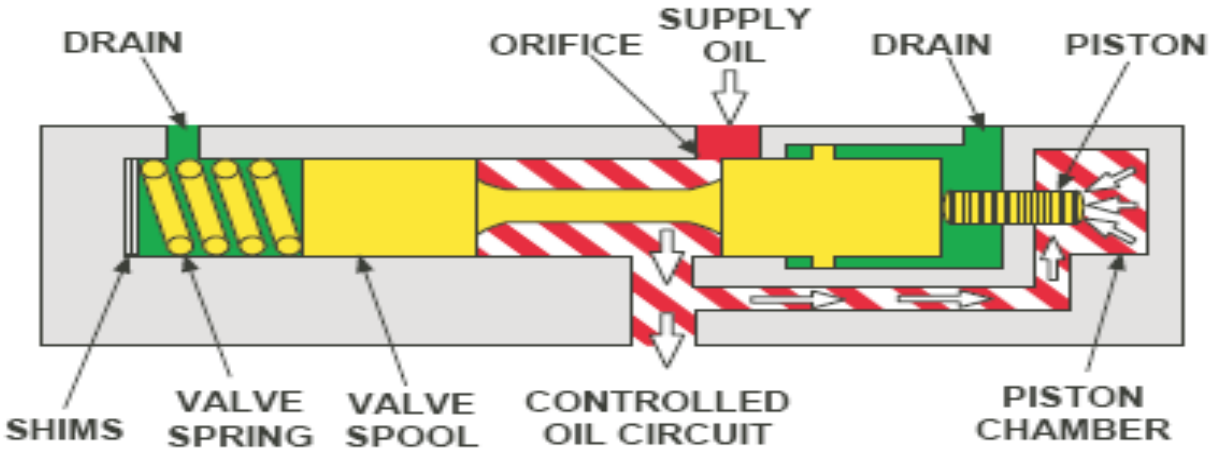


Fig. 3.4.12 Normal Operating Condition

Normal Operating Condition

Basic Hydraulic

- **Pressure reducing valve**

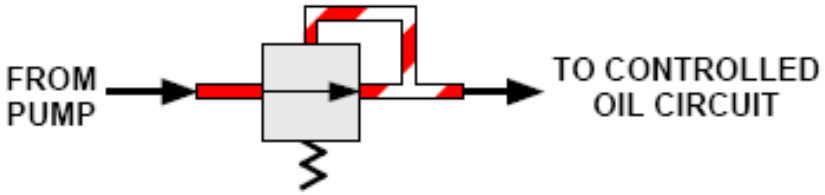


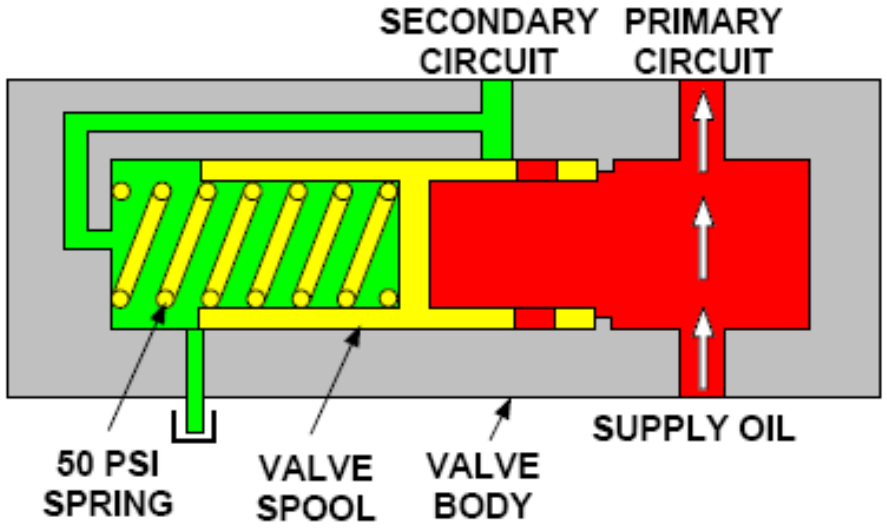
Fig. 3.4.13 Pressure Reducing Valve ISO Symbol

Pressure Reducing Valve ISO Symbol

Basic Hydraulic

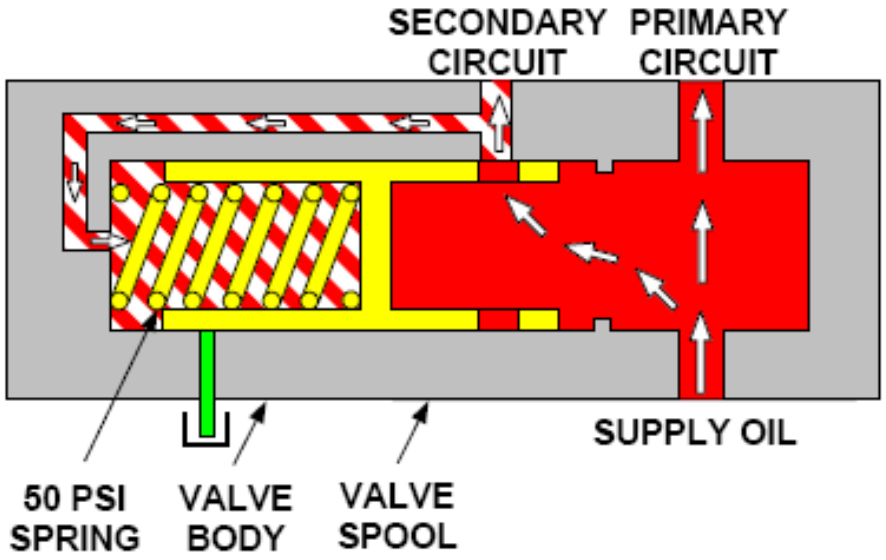
- **Pressure Differential valve**

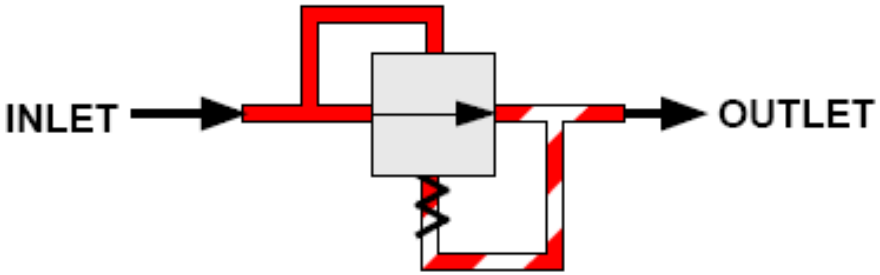
The pressure differential valve maintains a specified difference in pressure between two circuits.



Basic Hydraulic

- **Pressure Differential valve**





Basic Hydraulic

Basic Component Of Hydraulic system

Direction control valves

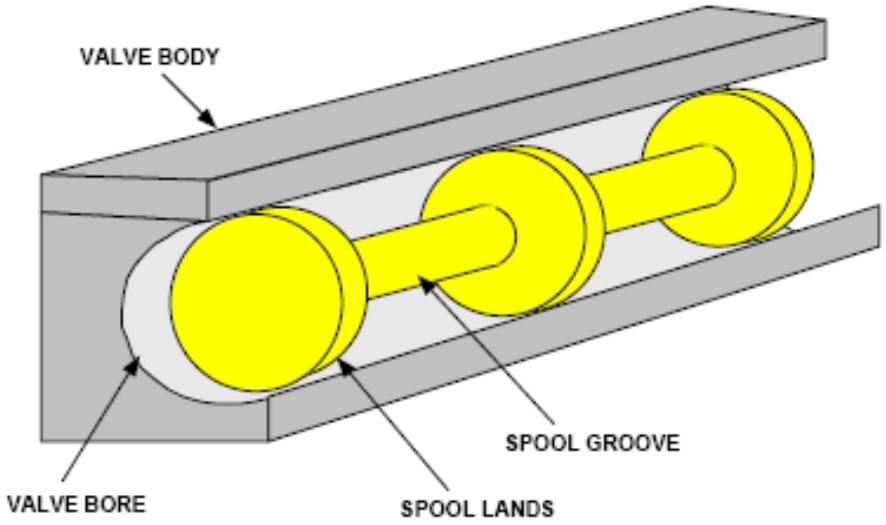
Directional control valve are used to direct oil into separate circuits of a hyd. System , the max. flow capacity and the pressure drop through the valve are the first consideration .

Direction control valve interfaced with manual, hydraulics , pneumatic and electric control , these factors are mostly determined during the initial system design.

Basic Hydraulic

Direction control valves

Directional control valve are used to direct oil into separate circuits of a hyd. System



Basic Hydraulic

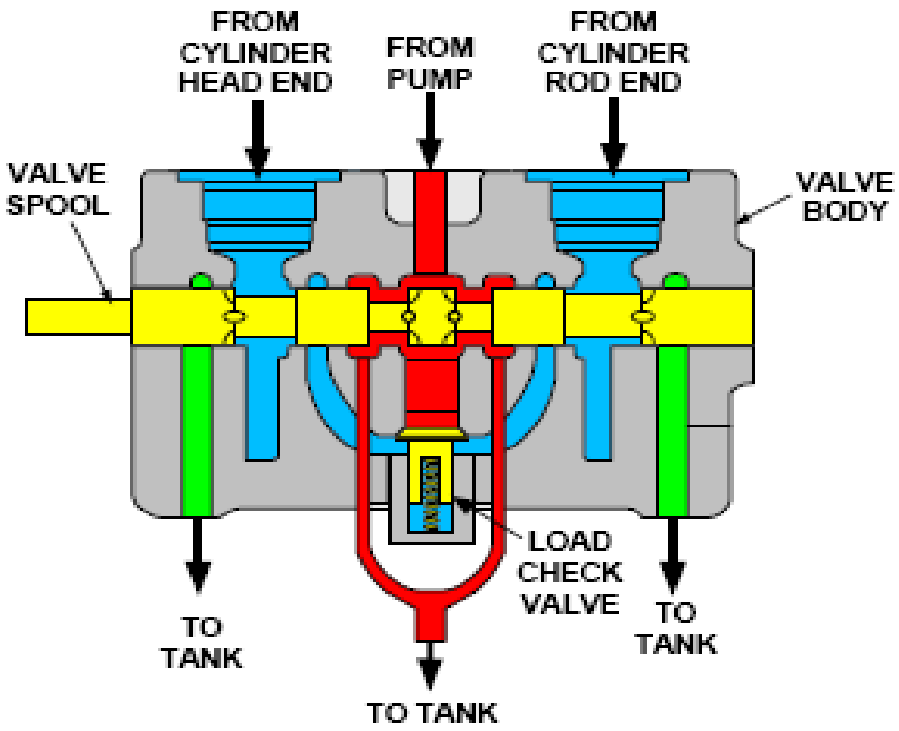


Fig. 3.5.2 Directional Control Valve in HOLD

Open Center Directional Control Valve in HOLD Position

Basic Hydraulic

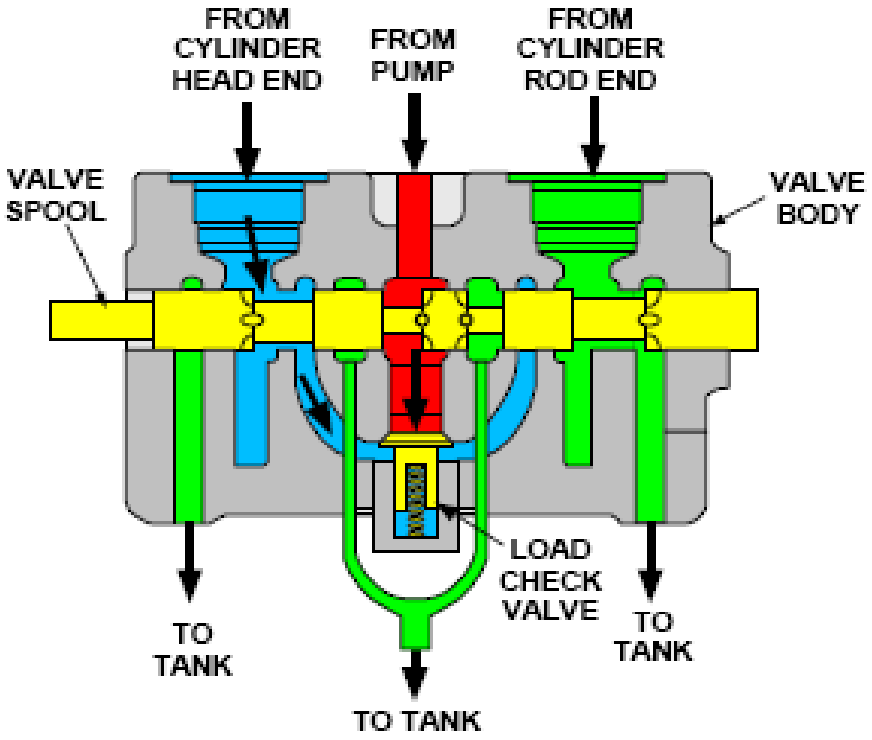
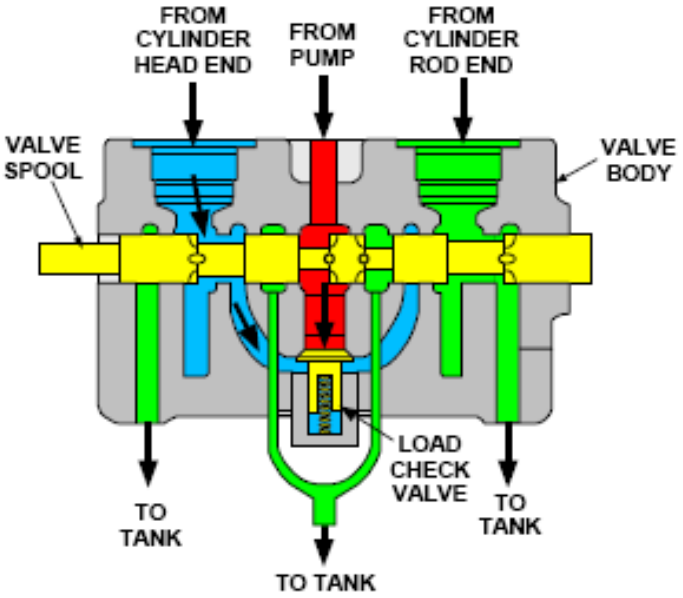
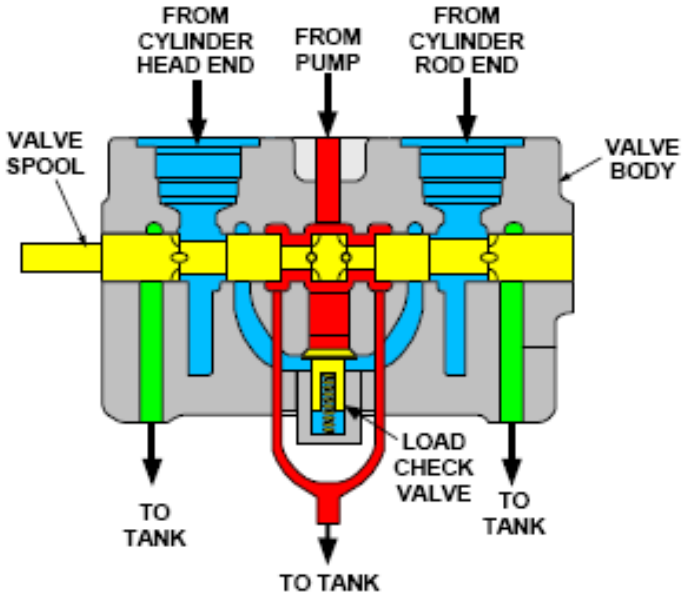


Fig. 3.5.3 Directional Control Valve RAISED

Open Center Directional Control Valve in RAISE Position

Basic Hydraulic





Basic Hydraulic

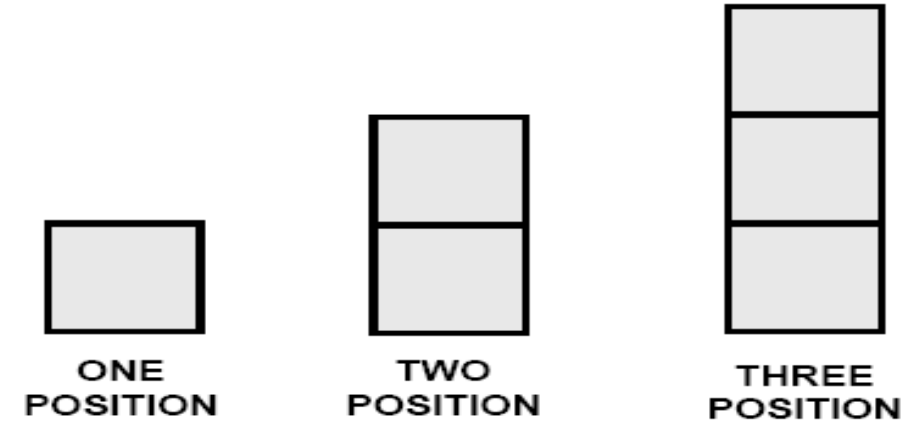
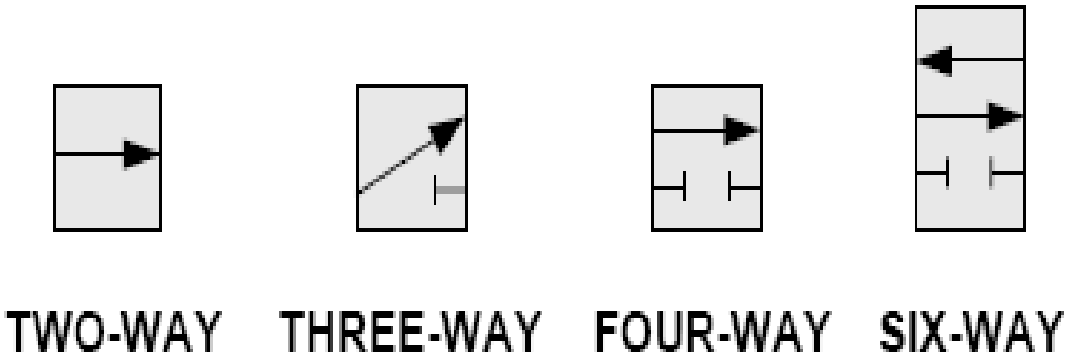


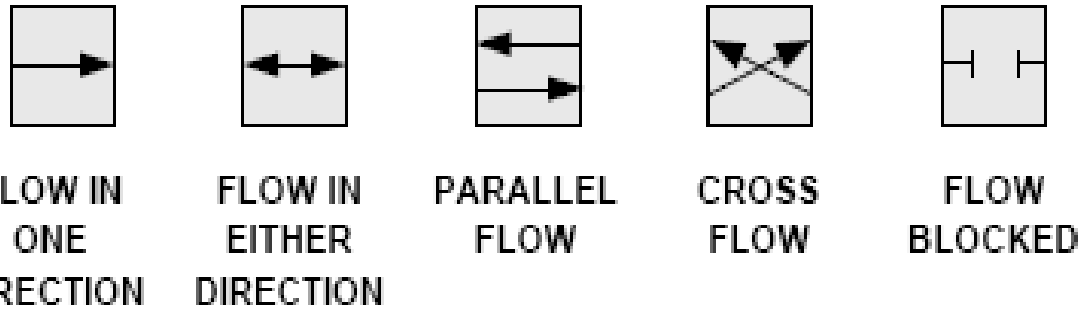
Fig. 3.5.5 ISO Symbols

Directional Control Valve ISO Symbols



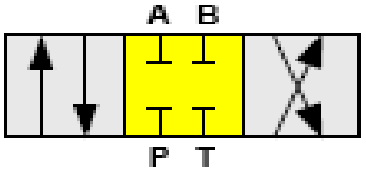
Basic Hydraulic

- **Flow path**

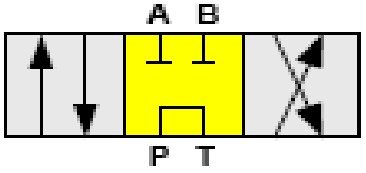


- **Three position valve**

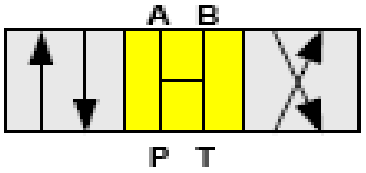
CLOSED CENTER



TANDEM CENTER (CATERPILLAR OPEN CENTER)



OPEN CENTER



Basic Hydraulic

- **Three Position , Six way , open center , Manual controlled valve**

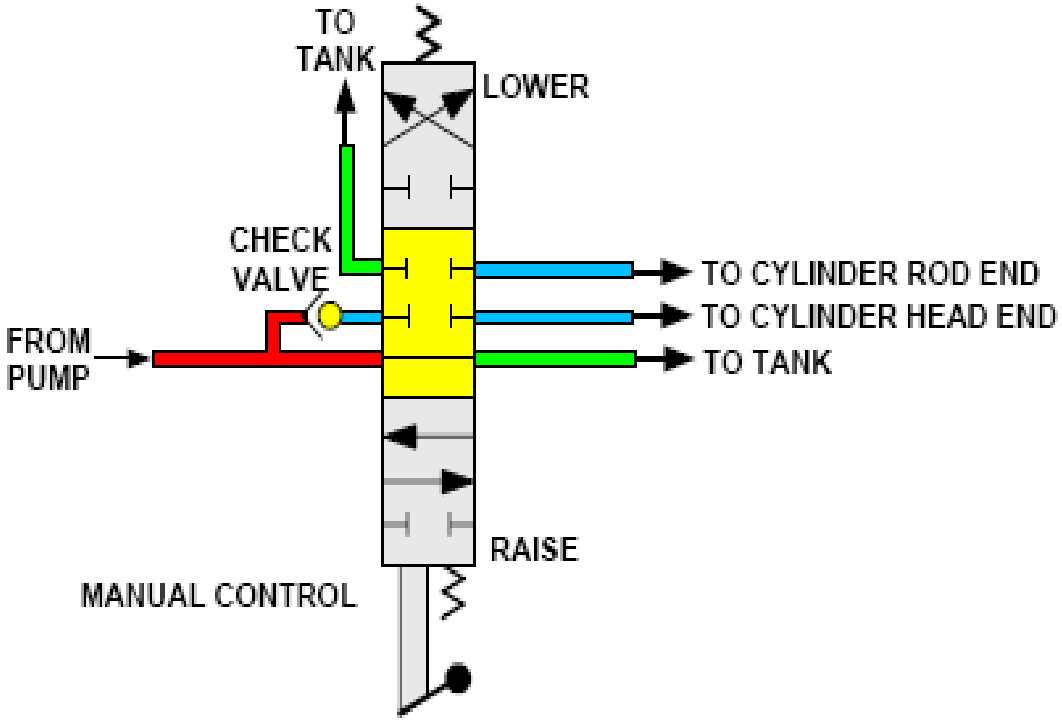
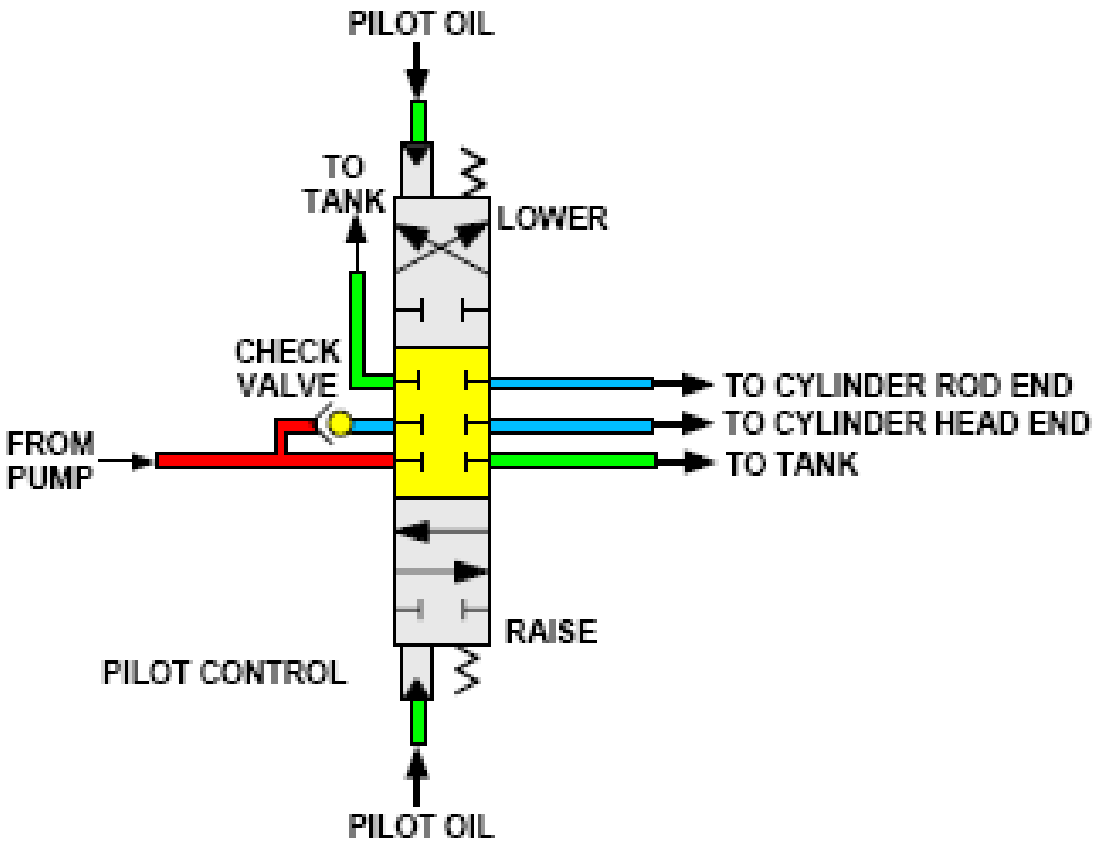


Fig. 3.5.9 Six Way Valve

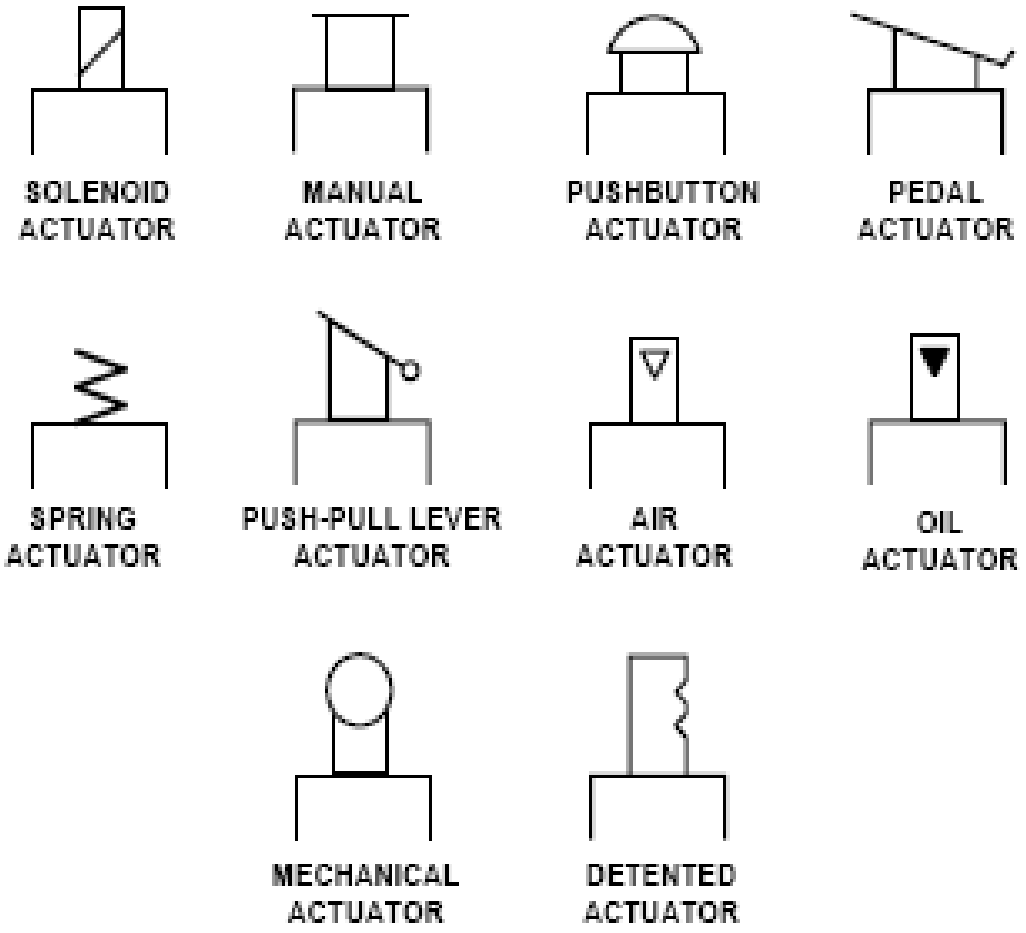
Basic Hydraulic

- **Three Position , Six way , open center , Pilot controlled valve**



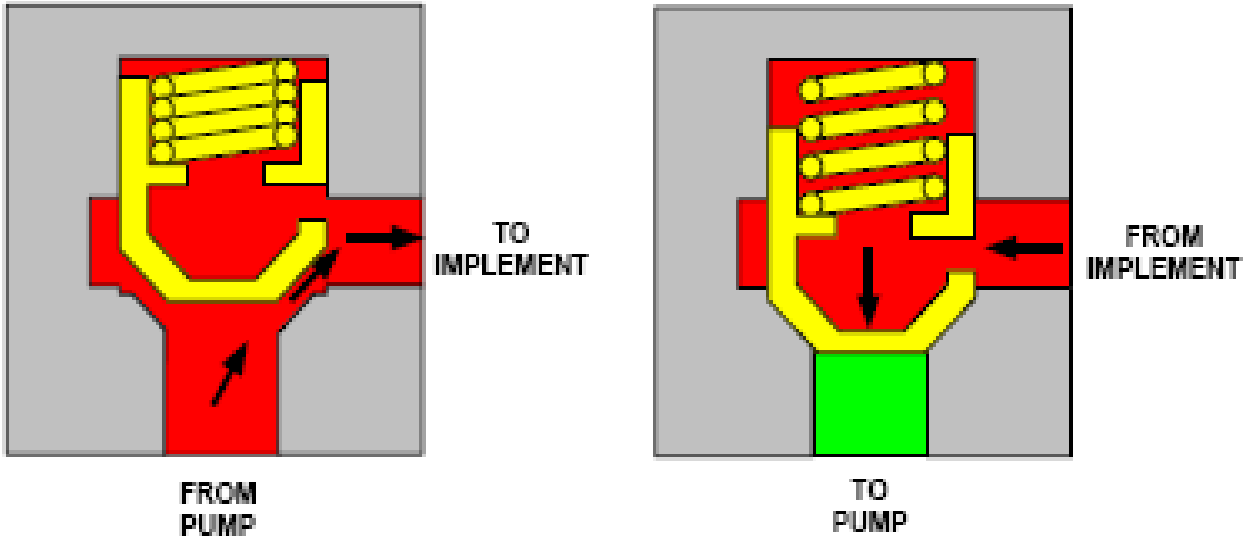
Basic Hydraulic

- **Directional control valve Actuator**



Basic Hydraulic

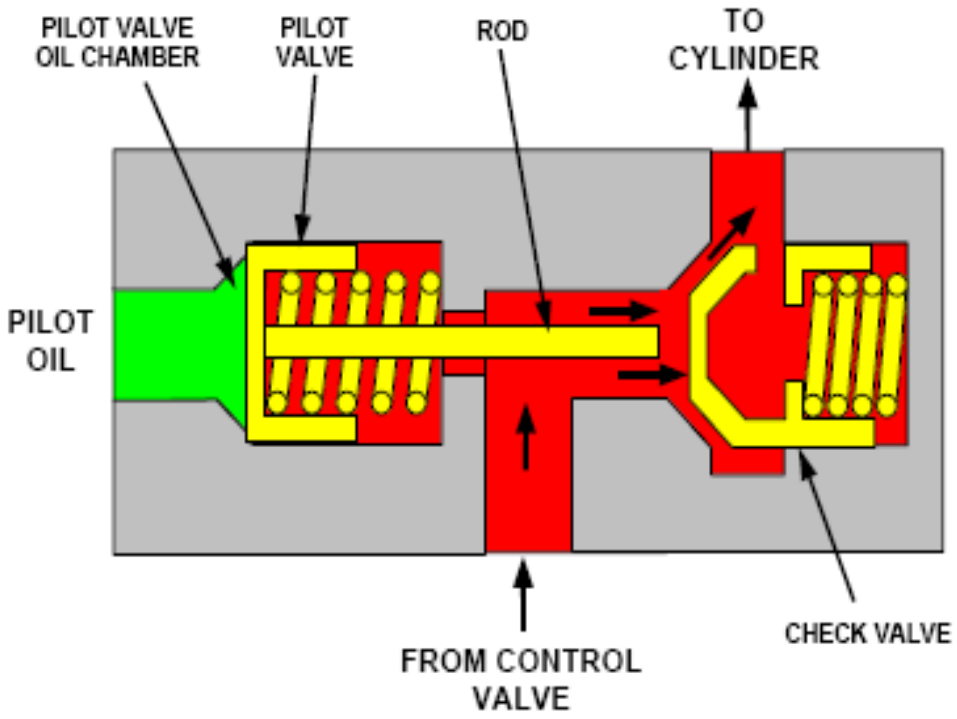
- **Check valve**



The purpose of a check valve is to readily permit oil flow in one direction, but prevent (check) oil flow in the opposite direction. The check valve is sometimes called a "one way" check valve.

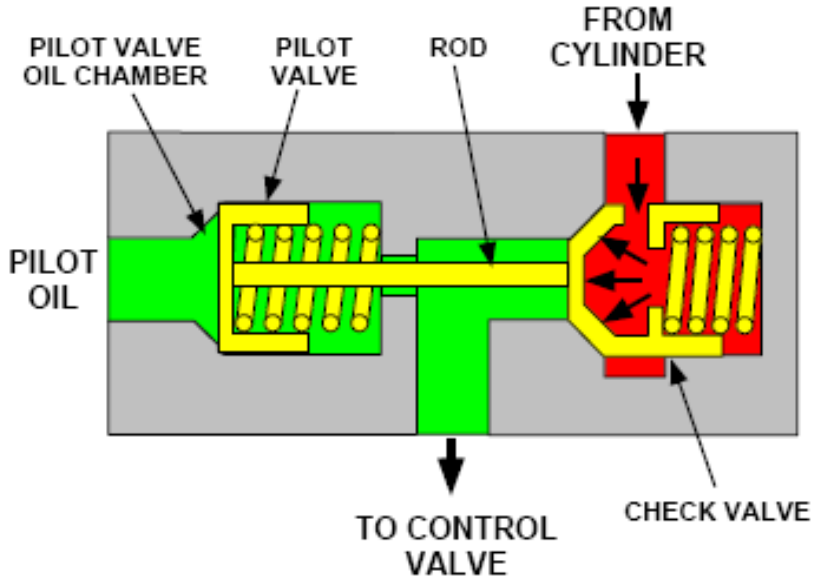
Pilot Operated Check Valve

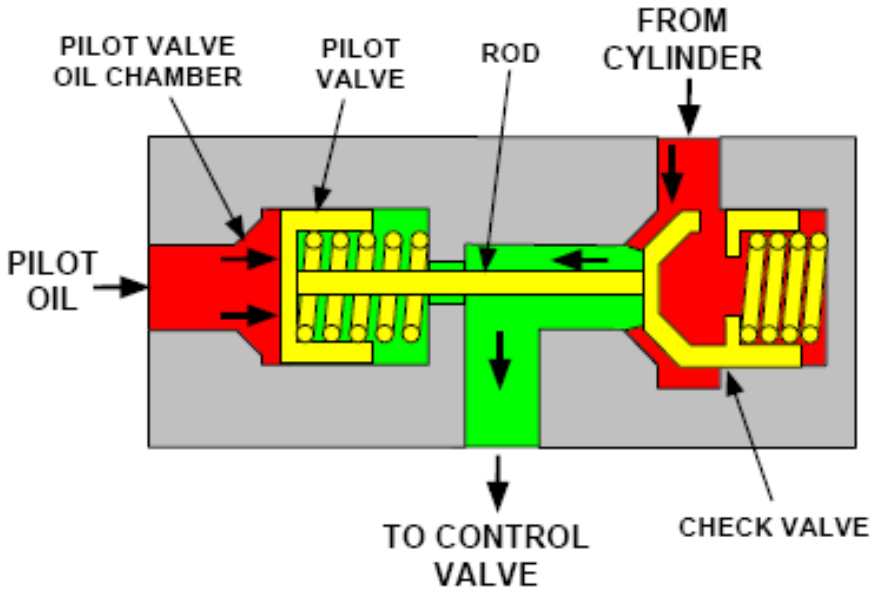
The pilot operated check valve differs from the simple check valve in that the pilot operated check valve allows oil flow through the valve in the reverse direction.



Basic Hydraulic

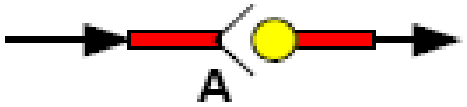
Flow Blocked



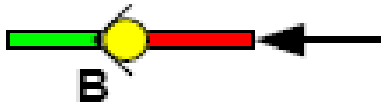


Reverse Flow

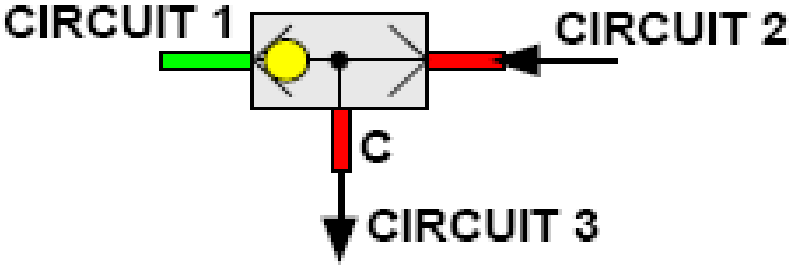
Basic Hydraulic



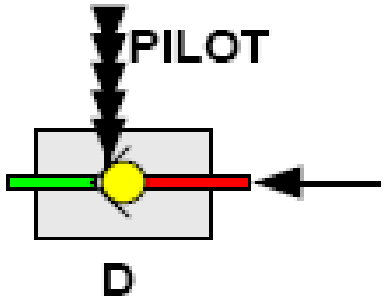
CHECK VALVE (OPEN)



CHECK VALVE (CLOSED)



SHUTTLE VALVE
(RESOLVER VALVE)



PILOT OPERATED
CHECK VALVE

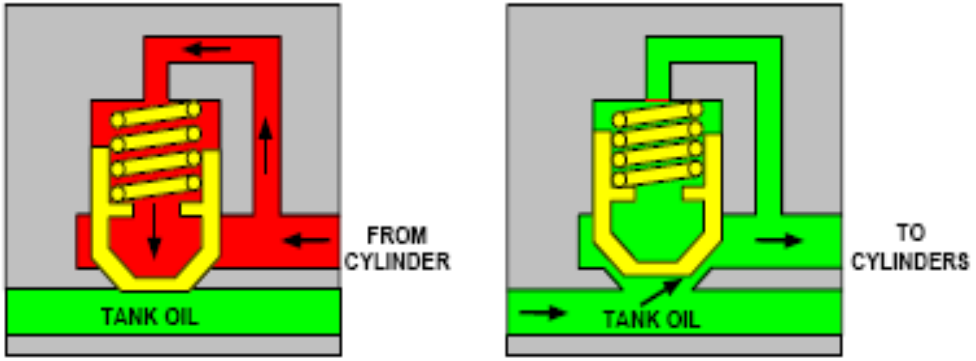
Fig. 3.5.17 Check Valve ISO Symbols

Check Valve ISO Symbols

Basic Hydraulic

Make-up Valve

The make-up valve is used to prevent cavitation.

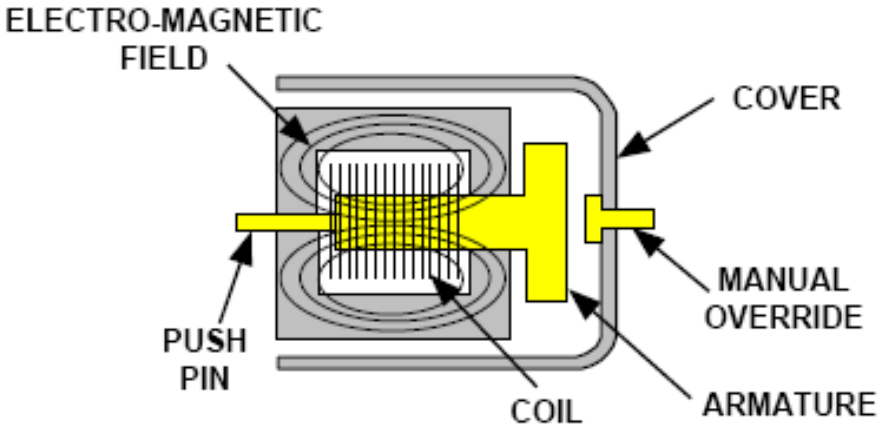


SOLENOID ACTUATED CONTROL VALVES

Solenoid Actuator

In a solenoid actuator, an electro-magnetic field moves an armature which moves a push pin. The push pin moves the valve spool.

The two most popular solenoid actuators are the air gap and the wet armature.



Air Gap Solenoid

Basic Hydraulic

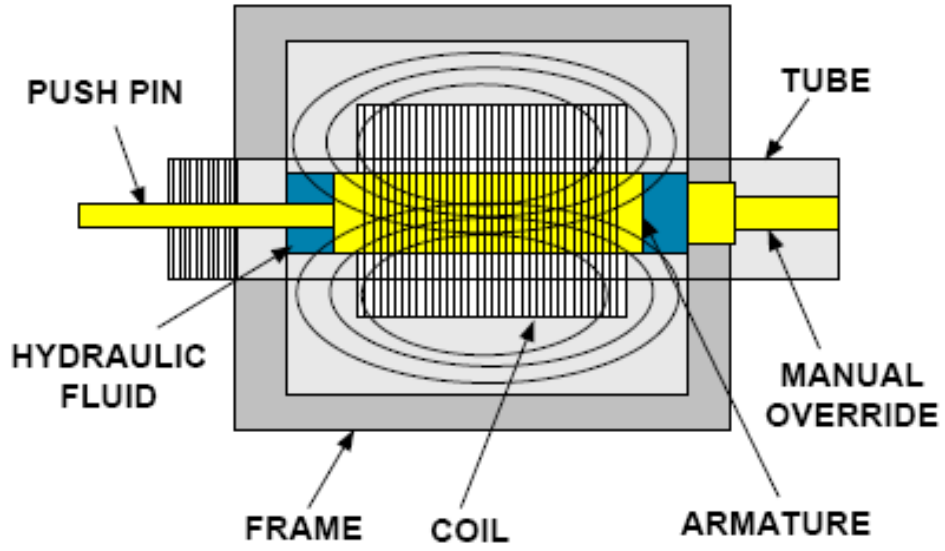


Fig. 3.5.20 Wet Armature Solenoid

Wet Armature Solenoid

Basic Hydraulic

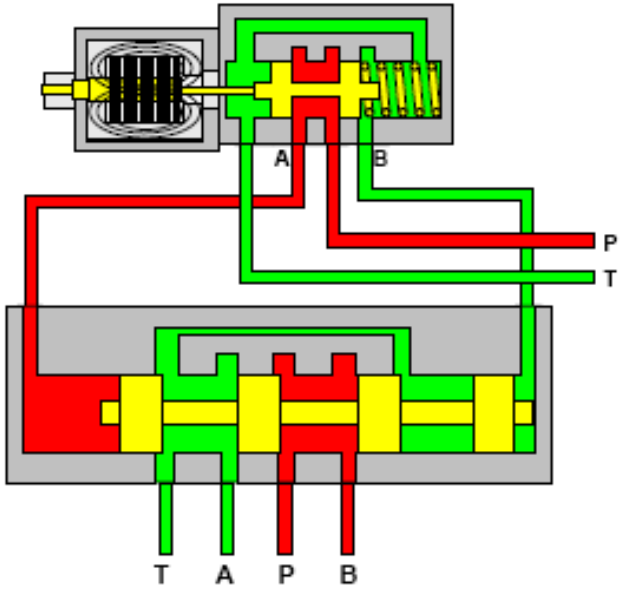


Fig. 3.5.21 Two Position 4-Way Directional Control Valve

Solenoid Controlled, Spring Offset, Pilot Operated, Two Position, 4-way Directional Control Valve

Basic Hydraulic

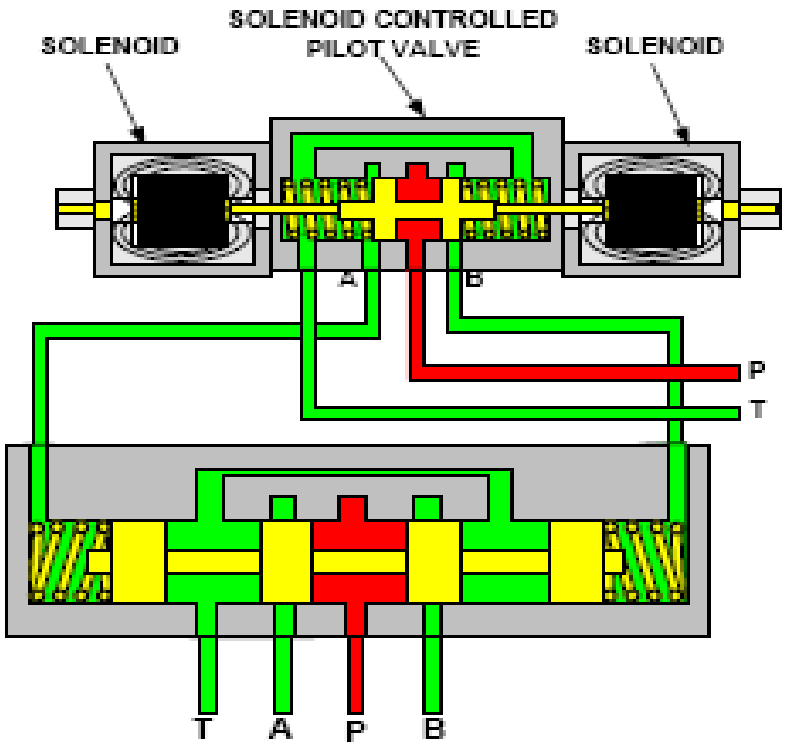


Fig. 3.5.22 Three Position 4-way Directional Control Valve

Solenoid Controlled, Pilot Operated, Three Position, 4-way Directional Control Valve

Basic Hydraulic

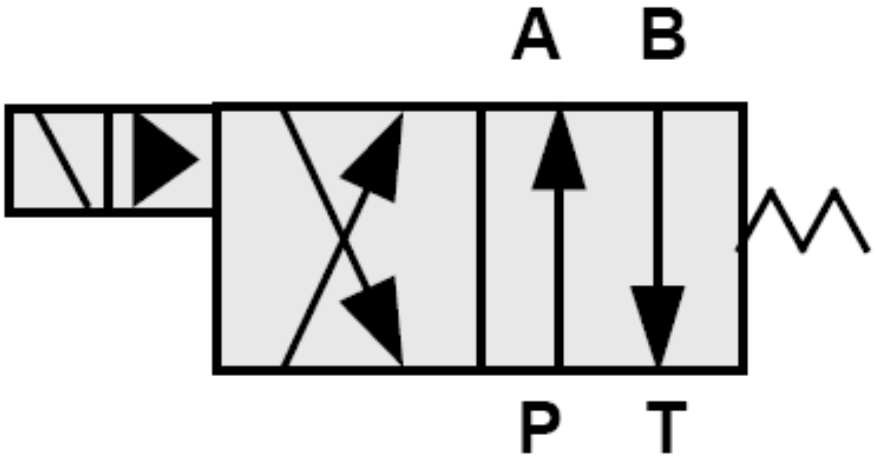


Fig. 3.5.23 Two Position, 4-way Pilot Valve

Spring Offset, Solenoid Controlled, Two Position, 4-Way Pilot Valve

Basic Hydraulic

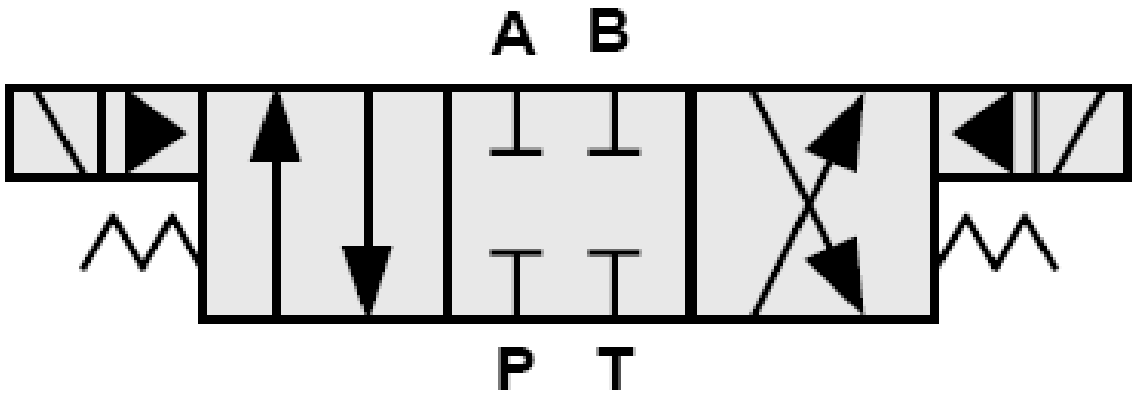


Fig. 3.5.24 Three Position, 4-way Control Valve

Solenoid Controlled Pilot Operated, Spring Centered, Three Position, 4-Way, Closed-Centered Control Valve

Basic Hydraulic

- Flow Control Valves

Flow control consists of controlling the volume of oil flow in or out of a circuit. Controlling flow in a hydraulic circuit can be accomplished in several ways.

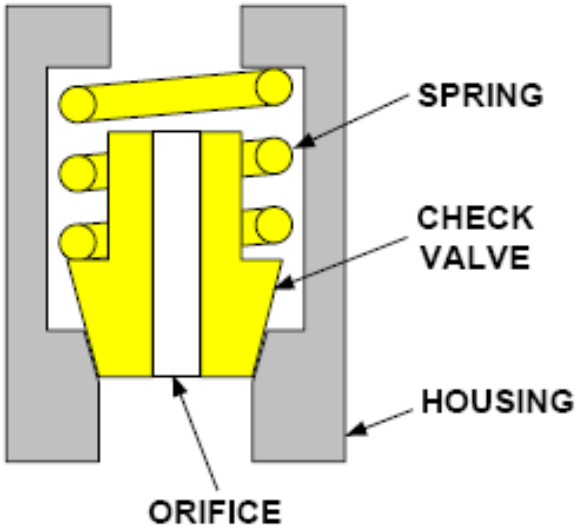


Fig. 3.6.1 Check Valve With Fixed Orifice

Check Valve With A Fixed Orifice

Basic Hydraulic

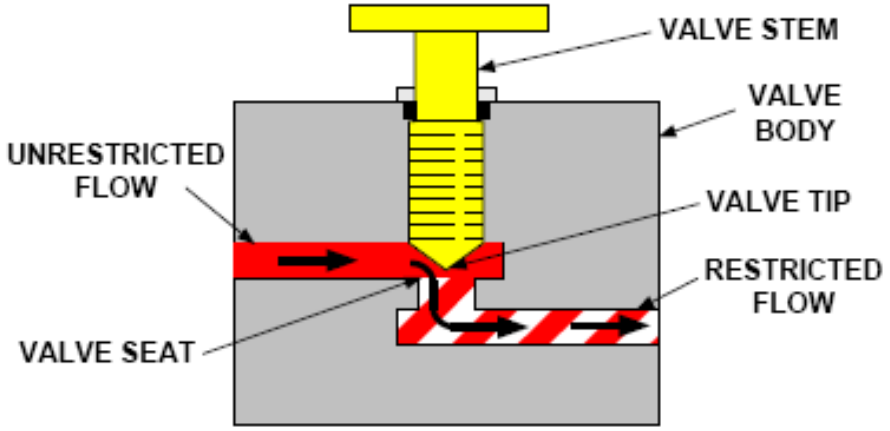


Fig. 3.6.2 Variable Orifice

Variable Orifice

Basic Hydraulic

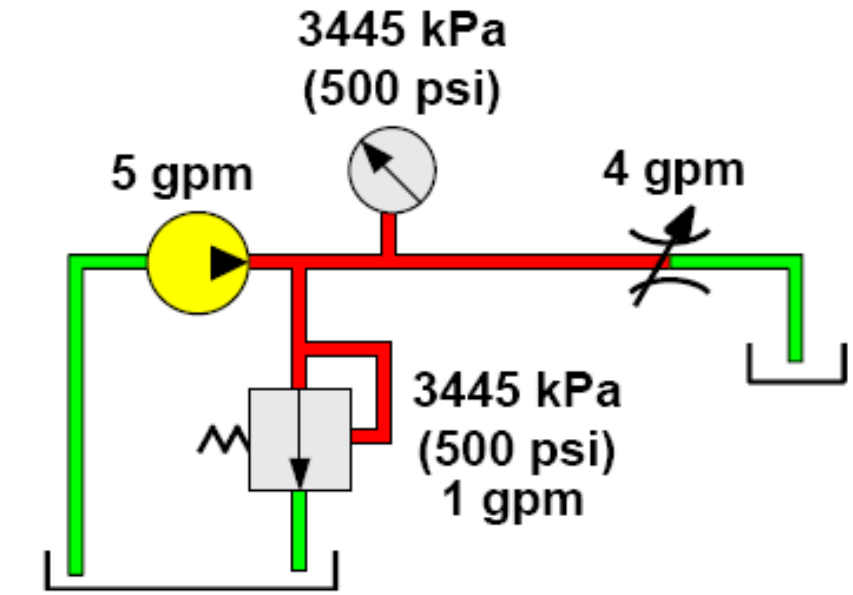


Fig. 3.6.3 Variable Orifice 4 gpm

Basic Hydraulic

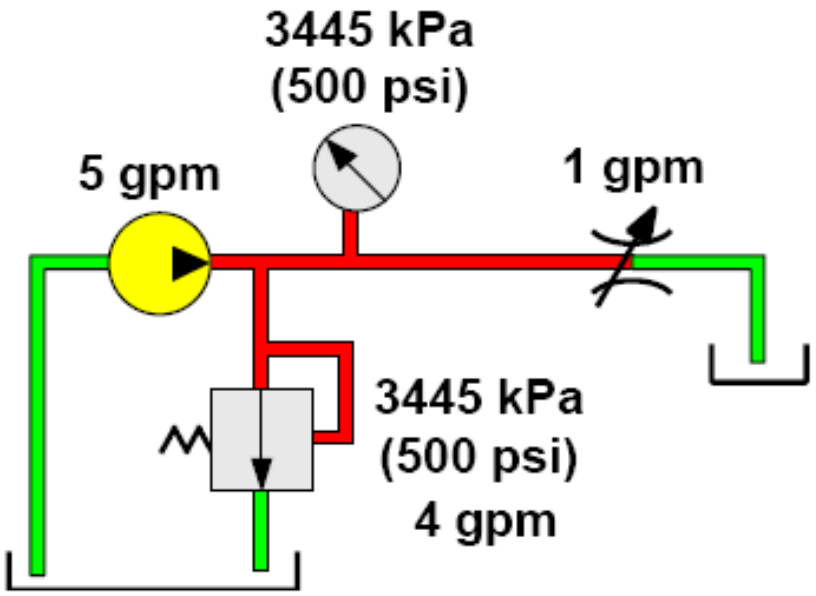


Fig. 3.6.4 Variable Orifice 1 gpm

Basic Hydraulic

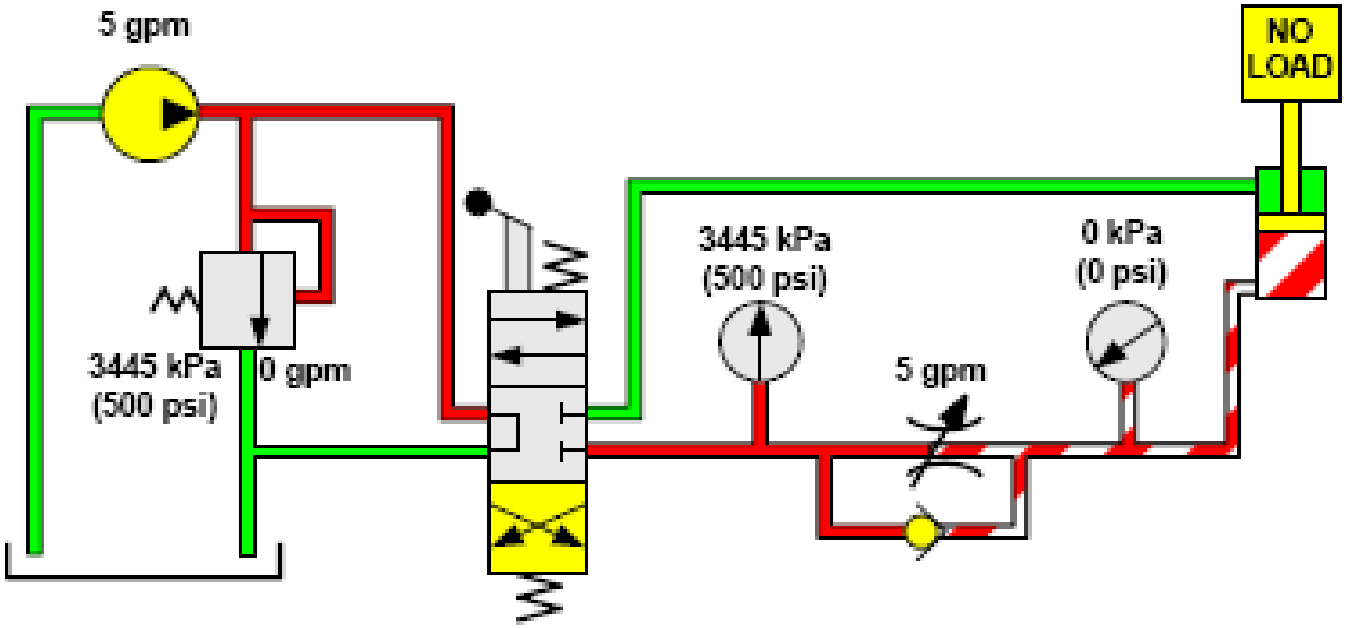


Fig. 3.6.6 Non-Compensated Flow Control Valve Schematic

Non-Compensated Flow Control Valve

Basic Hydraulic

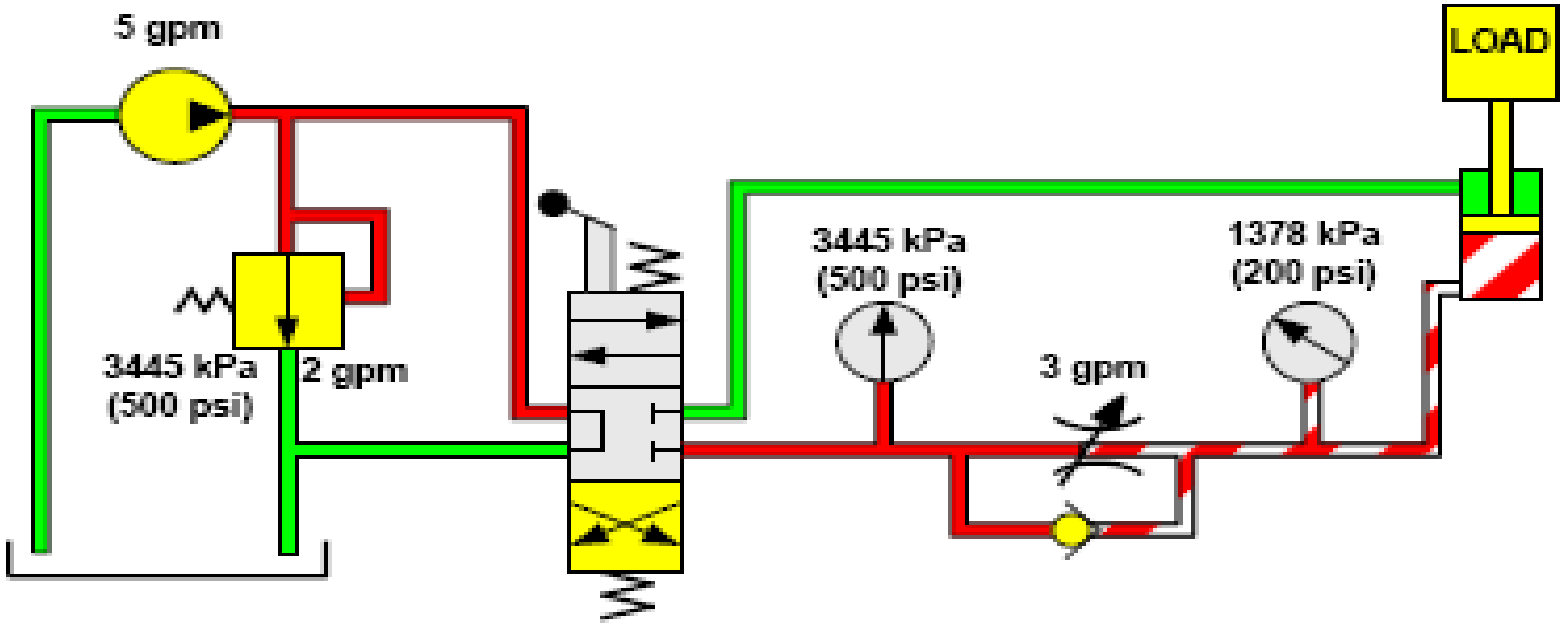


Fig. 3.6.7 Load and Pressure Increases

Load Increase

Basic Hydraulic

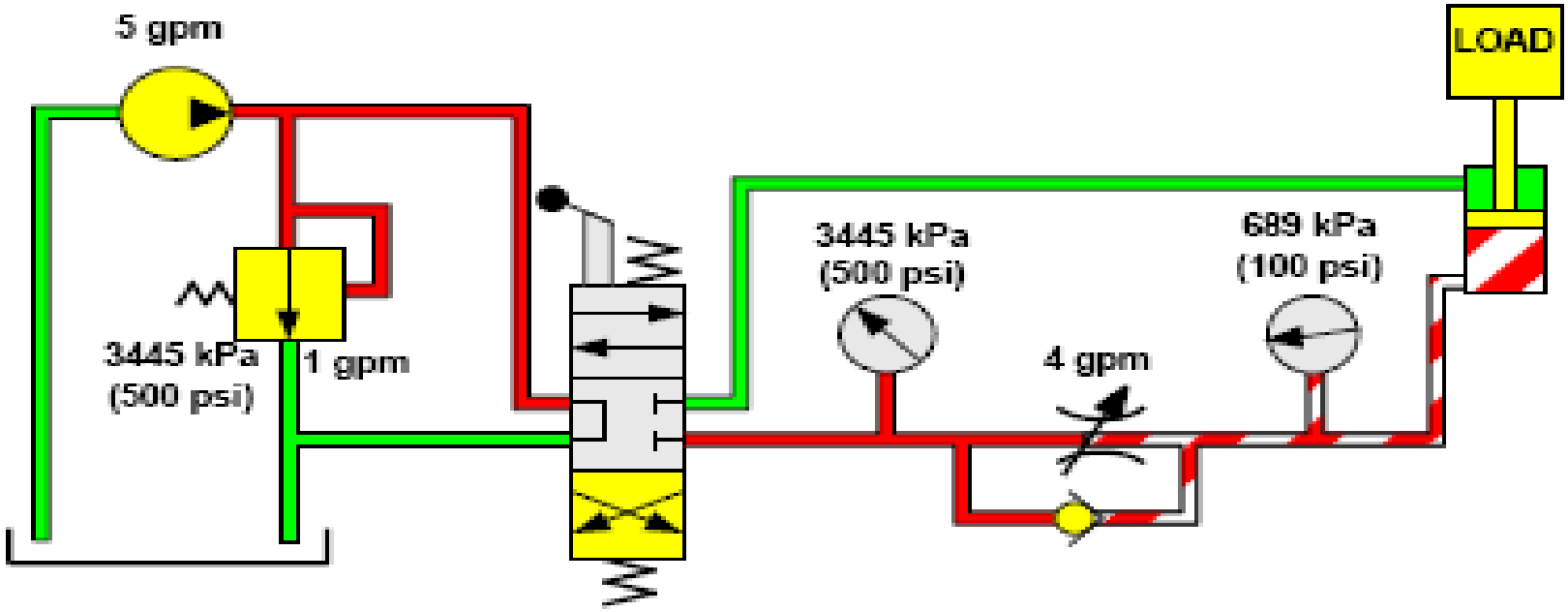


Fig. 3.6.8 Load and Pressure Decreases

Load Decrease

Basic Hydraulic

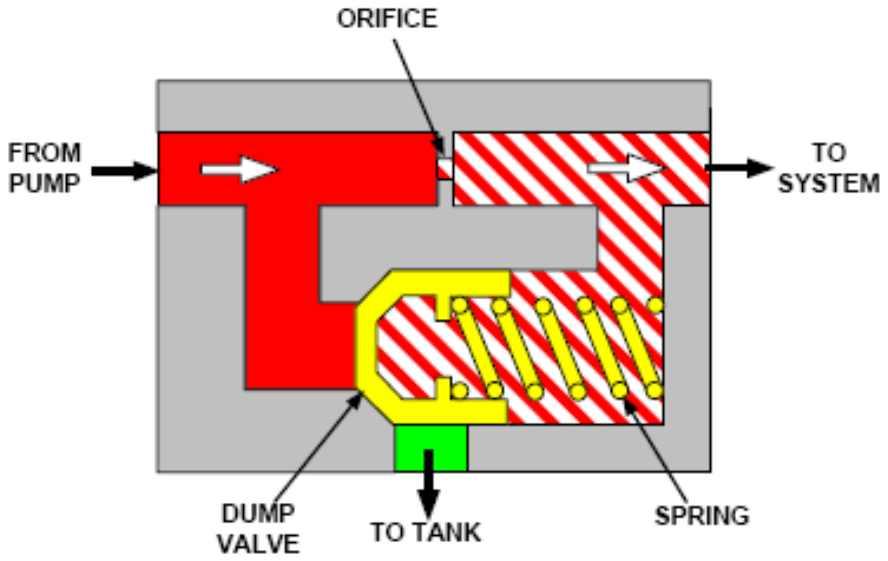


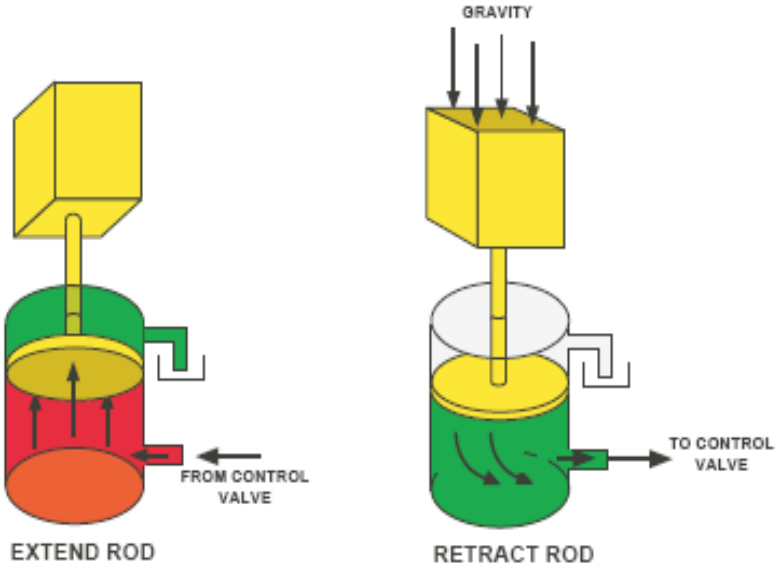
Fig. 3.6.9 By-pass Pressure Compensated Flow Control Valve

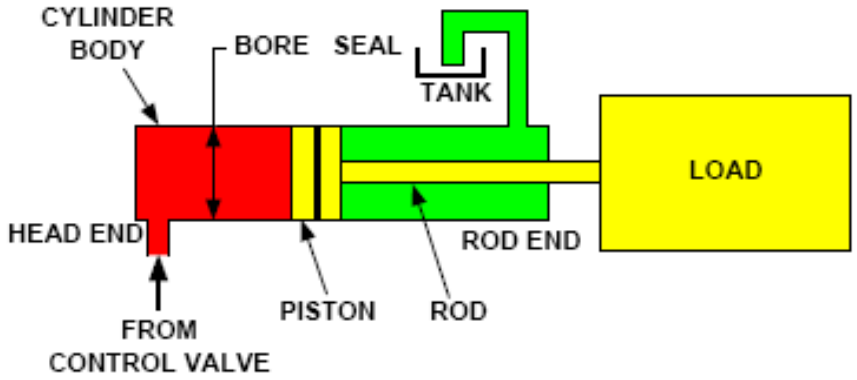
By-pass Pressure Compensated Flow Control Valve

Basic Hydraulic

- Cylinders

Cylinders are basically linear actuators. Their outputs are straight line motion or force. The most common types are single acting cylinders and double acting cylinders.





Single Acting Cylinders

Basic Hydraulic

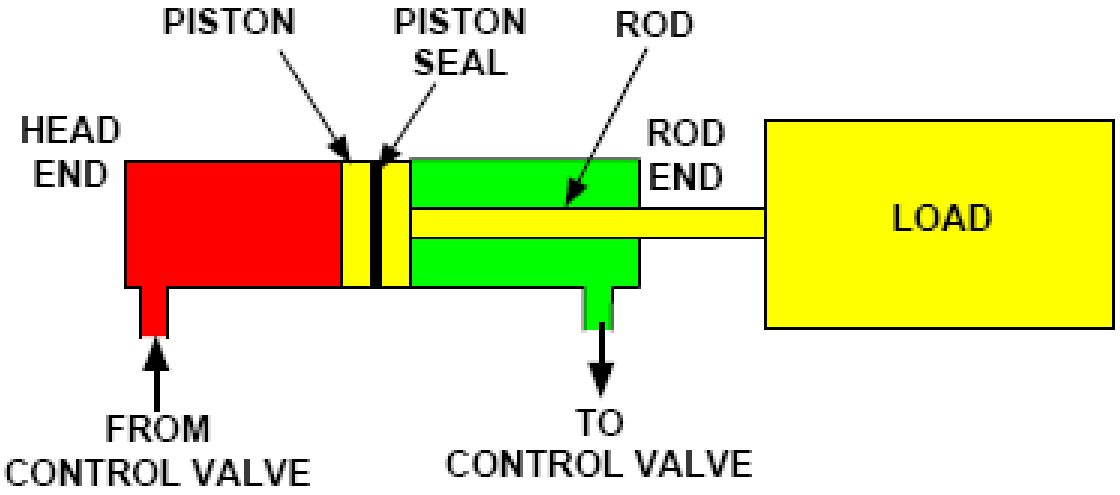


Fig. 3.7.3 Double Acting Cylinders

Double Acting Cylinders

Basic Hydraulic

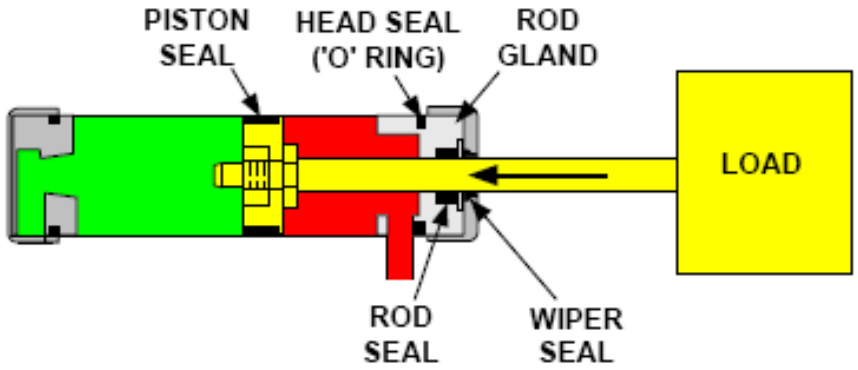


Fig. 3.7.5 Seals