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कौशल भारत-कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

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IESC
Infrastructure Equipment Skill Council

Participant Handbook

Sector
Infrastructure Equipment

Sub-Sector
Equipment Maintenance

Occupation
Mechanic

Reference ID: **IES/Q1104, Version 2.0**
NSQF Level 3

Junior Mechanic (Hydraulic)

Edition, September 2022

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"Skilling is building a better India. If we have to move India towards development then Skill Development should be our mission."

Shri Narendra Modi
Prime Minister of India

Acknowledgements

About this Book

This program is aimed at training candidates for the job of a "Junior Mechanic Hydraulic", in the "Infrastructure Equipment" Sector/Industry and aims at developing skills amongst the learner.

To address the future sector demand, this Participant Handbook is designed to enable training for the specific Qualification Pack (QP). Each National Occupational (NOS) is covered across Unit(s).

Key Learning Objectives for the specific NOS mark the beginning of the Unit(s) for that NOS. The symbols used in this book are described below.

Symbols Used

Key Learning Outcomes

Steps

Tips

Notes

Unit Objectives

Table of Contents

Employability & Entrepreneurship Skills

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1. Introduction

Unit 1.1 – About the Program

Unit 1.2 – About the Hydraulic Systems

Key Learning Outcomes

At the end of this module, you will be able to:

1. Familiarize with one another
2. Outline the program expectations
3. Familiarize the role of Junior Crane Operator
4. Identify different parts of the crane along with their uses
5. List the primary controls of the crane and their uses

UNIT 1.1: About the Program

Unit Objectives

At the end of this unit, you will be able to:

1. Understand training curriculum design.
2. Get to know each one in the training program.
3. List out the expectations from the training.

1.1.1 Overview of the Book

The training curriculum will help you to:

1. **Assist in carrying out repairs and maintenance of equipment's hydraulic assemblies and sub-assemblies.** Basic working of hydraulic assemblies & systems, identification and use of hand tools and equipment, techniques for removal of defective components and fitment after rectification.

2. **Maintain the workshop area, tools and machinery to support operations.** Maintenance of workshop area, tools and equipment, various cleaning agents and their use, safety precautions & measures.

3. **Comply with workshop health and safety guidelines.** Health, safety and environment policies; personal protective equipment, fire-fighting equipment, basic first aid for common injuries at work shop.

Activity

Knowing Each Other

1. List out two names of fellow participants whom you have met and interacted with.

2. List out two names of those from the same place/district/state.

3. List out two names among the participants whose hobbies are the same as yours.

Expectation Mapping

1. My expectations from the training programme are:

UNIT 1.2: About the Hydraulic Systems

Unit Objectives

At the end of this unit, you will be able to:

1. Understand history of Hydraulics.
2. Understand the basic features and use of Hydraulics system.
3. List out various parts of Hydraulics system and their use.
4. Understand different principles of Hydraulics system and their use and function.
5. Understand different types of circuit of Hydraulics system and their use and function.

1.2.1 Brief Description of Hydraulics

Hydraulics

"The engineering science of liquid (fluid) flow and pressure"

Flow

"The movement of fluid"

Pressure

"Resistance to flow" (Force per unit area)

WHY – HYDRAULICS?

Hydraulics system is used to "Transfer Energy", because of its following advantages:

1. Variable speed
2. Reversible
3. Over load protection
4. Small package (Power to weight ratio)
5. Can be stalled (w/o any damage to the system)
6. Control is Simpler, Precise & Accurate.

HOW PUMP WORKS

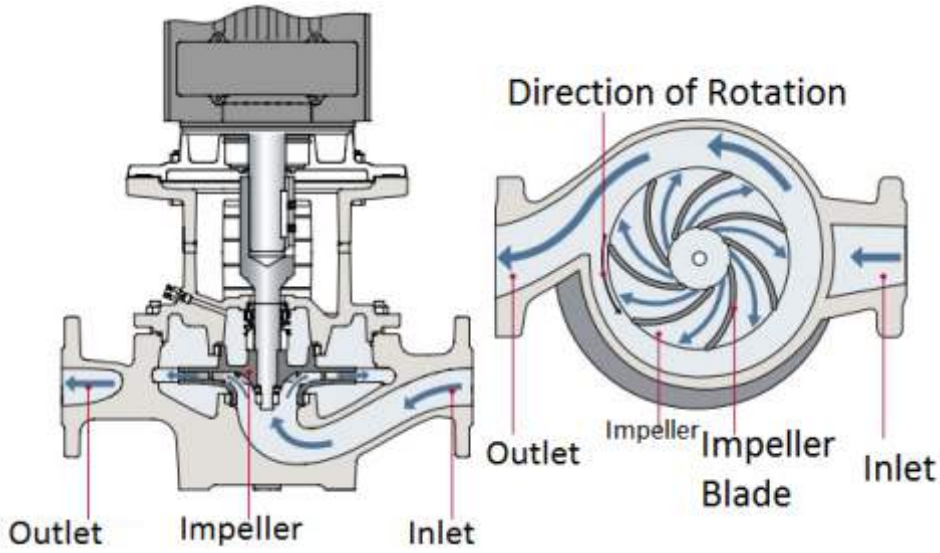


Fig. 1.2.1. How Pump Works

An increase in the fluid pressure from the pump inlet to its outlet is created when the pump is in operation. This pressure difference drives the fluid through the system or plant.

1.2.2 Pascal's Law

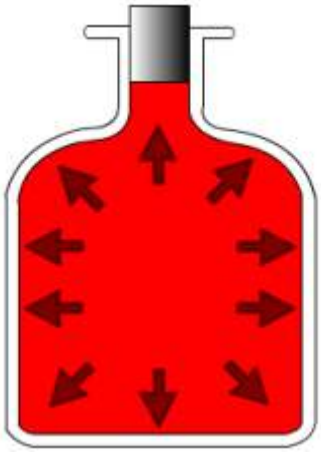


Fig. 1.2.2. Pascal's Law

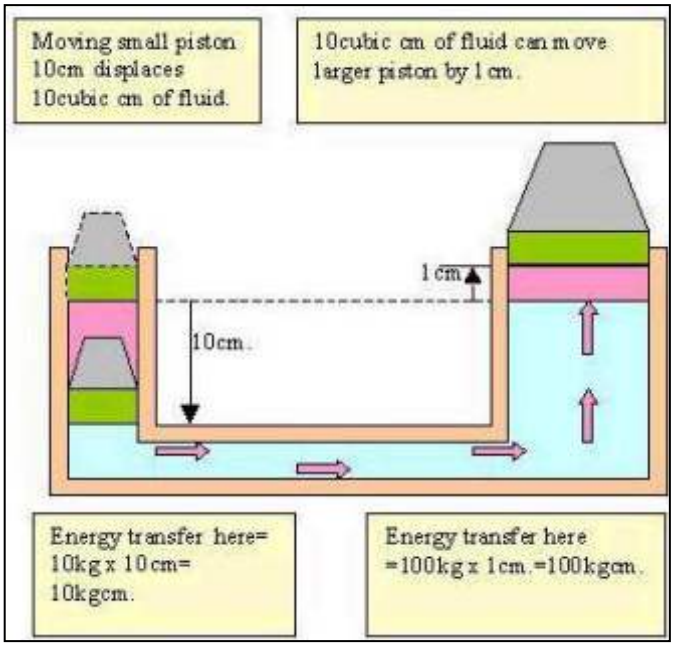
Pressure applied on a confined liquid transmitted in an undiminished in all directions, and acts with equal force on equal areas.

1.2.3 Comparison-Transfer of Energy

Weight: 10 Kg

Area: 10 cm sq

Pressure: 1 Bar



Weight: 100 Kg

Area: 100 cm sq

Pressure: 1 Bar

Fig. 1.2.3. Transfer Of Energy

1.2.4 Hydraulic Symbols

Below mentioned are major symbols used in hydraulic circuits;

Line working	
Pilot or Signal line	
Connector	
Hydraulic Tank	
Line passing	
Flow restriction - Fixed	
Flow Restriction - Variable	
Pressure gauge	

Table 1.2.4 (a). Hydraulic Symbols

Temperature gauge	
Uni directional - fixed displacement pump	
Bi-directional - fixed displacement pump	
Uni directional – variable displacement pump	
Bi-directional – variable displacement pump	
Uni directional - fixed displacement Motor	

Table 1.2.4 (b). Hydraulic Symbols

1.2.4 Hydraulic Symbols Contd.

Bi directional - fixed displacement motor	
Uni-directional - variable motor	
Bi-directional – variable displacement motor	
Single acting hydraulic cylinder	
Double acting hydraulic cylinder	

Table 1.2.4 (c) Hydraulic Symbols

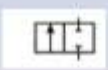
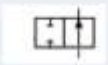
Double ended piston rod	
Cylinder with cushion	
Cylinder with cushion - Adjustable	
Directional control valve – 2 position, 2 way , Normally close	
Directional control valve – 2 position, 2 way , Normally open	

Table 1.2.4 (d) Hydraulic Symbols

1.2.4 Hydraulic Symbols Contd.

2 position 4 way normally open	
Directional control valve – 3 position, 4 way , closed position	
Manual control - lever	

Table 1.2.4 (e) Hydraulic Symbols

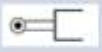
Manual control - pedal	
Mechanical control - plunger	
Mechanical control - Spring	
Mechanical control - roller	
Electrical Control - Solenoid	

Table 1.2.4 (f) Hydraulic Symbols

1.2.4 Hydraulic Symbols Contd.

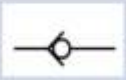
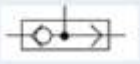
Pilot control - Hydraulic	
Check Valve	
Check Valve – Pilot to close	
Check Valve – Pilot to open	
Shuttle valve	

Table 1.2.4 (g) Hydraulic Symbols

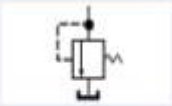
Pressure Control Valve	
Filter	
Filter with by-pass valve	
Shut –off valve	
Heat exchanger - Oil cooler	

Table 1.2.4 (h) Hydraulic Symbols

1.2.5 Principles of Hydraulics

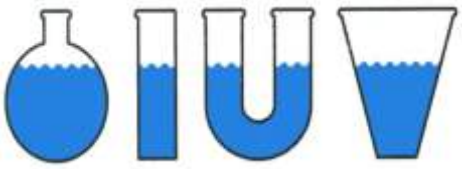


Fig. 1.2.5 (a) Fluids' Shape in their Container

Fluids have no shape of their own. They can move freely, so they do not have a definite shape and take a shape of their container.

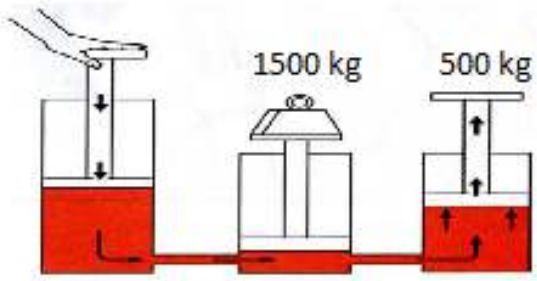


Fig. 1.2.5 (b) Path of the Hydraulic Oil

Fluid will always take the path of least resistance. If two cylinders of equal size are connected to a single supply line, they will produce the same force. If one of the cylinders is trying to lift 500 kg and the other cylinder is trying to lift 1500 kg, fluid will flow into the cylinder that is lifting 500 kg.

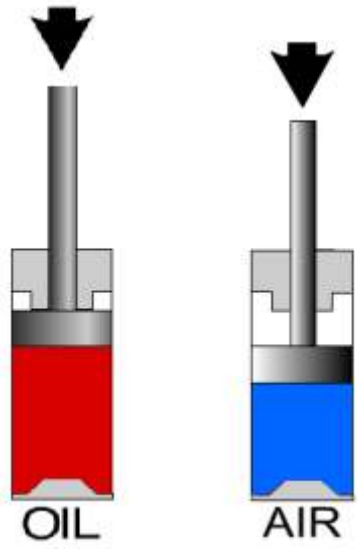


Fig. 1.2.5 (c) Incompressible Hydraulic Fluids

Fluids are practically incompressible, but air (gases) can be compressed. For example: In two cylinders; one with oil and another with air. When load (pressure) is applied on both, the cylinder with oil will not be compressed, but the cylinder with air will be compressed. So, hydraulic fluids are incompressible.

1.2.5 Principles of Hydraulics Contd.

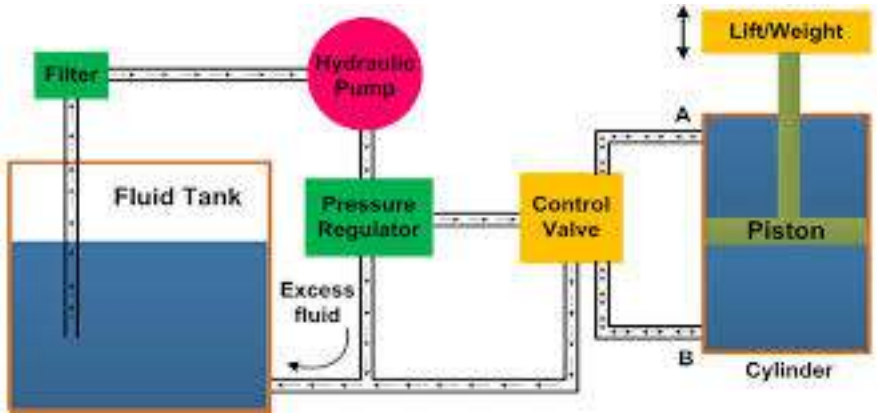


Fig. 1.2.5 (d) Pressure Flow of Hydraulics

Pressure and flow are the key ingredients to a hydraulic system. Pressure along with size of the cylinders will influence the system usage. Pumps will only create pressure if there is resistance to the moving fluid. So in the hydraulic system, the more pressure the system produces, the more force the cylinders can create. Control valve controls the flow of hydraulic fluid.

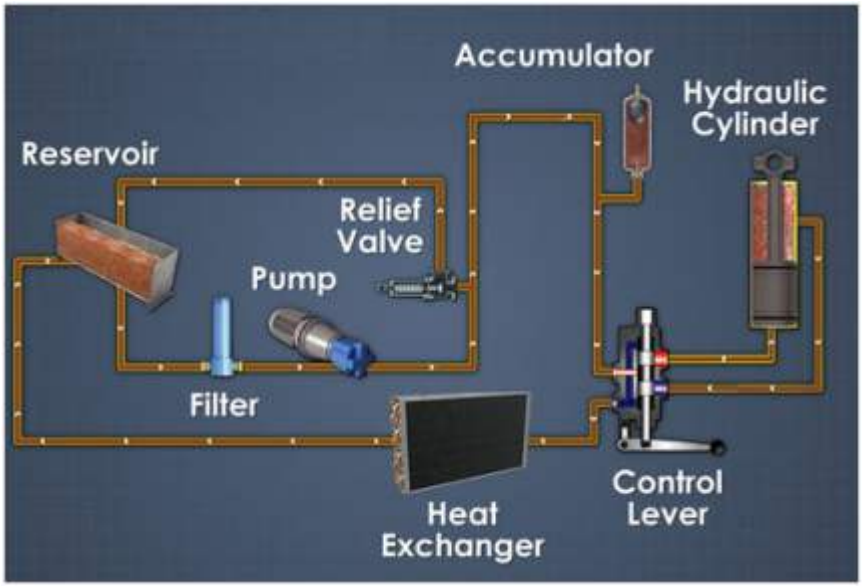


Fig. 1.2.5 (e) Heat Exchanger of Hydraulics

Flow of the hydraulic oil produces pressure. This pressure must be used for doing work. If the pressure is not used to do work, it will be converted into heat. Hydraulic fluid under pressure takes the path of least resistance. When fluid moves from an area of high pressure to an area of low pressure (pressure drop) without performing useful work, heat is generated. Excess heat in hydraulics will cause the system failure, so heat exchanges will be installed to handle this excess heat.

1.2.5 Principles of Hydraulics Contd.

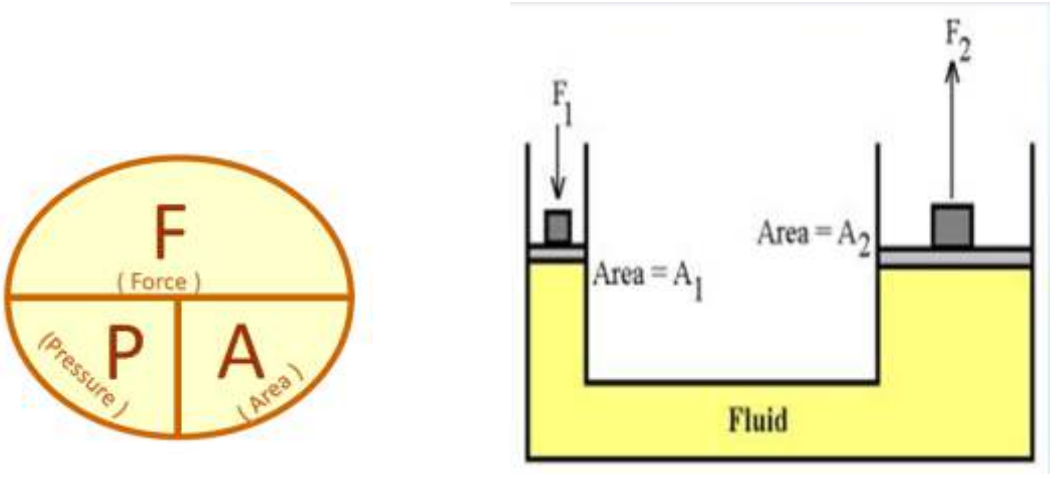


Fig. 1.2.5 (f) Pressure in Hydraulics

Pressure depends on force on a cylinder or size of a cylinder. In a hydraulic system, fluid is confined to two chambers. Each chamber has a piston that is free to move. When some force is applied on F1 on a piston with area A1 and that will exert a pressure in the fluid that transmits to the other piston, exerting F2 on area A2.

1.2.6 Basic Components of Hydraulics

In a hydraulic system, many components are necessary for the operation and control of the system. For each component in a system, several designs are available.

Basic components of hydraulic system:

1. Hydraulic fluid
2. Filters
3. Pumps
4. Valves
5. Actuator
6. Reservoir
7. Accumulator

1. **Hydraulic Fluid**: This is the medium by which power is transferred in hydraulic machinery. Common hydraulic fluids are based on mineral oil or water.

Fig. 1.2.6 (a) Hydraulic Fluid

Properties of hydraulic fluid:

- Good lubrication
- Ideal viscosity
- Chemical stability
- Compatibility with system components
- Highly incompressible
- Fire resistance
- Good heat-transfer capability
- Low density
- Foam resistance
- No toxicity (nontoxic)

2. Filters: Malfunctioning of hydraulic systems may be due to clogging and internal wear. With the contaminated hydraulic fluids, hydraulic systems get damaged and will fail to provide optimal performance. Therefore, they require filtration to remove contaminants from the working fluids.

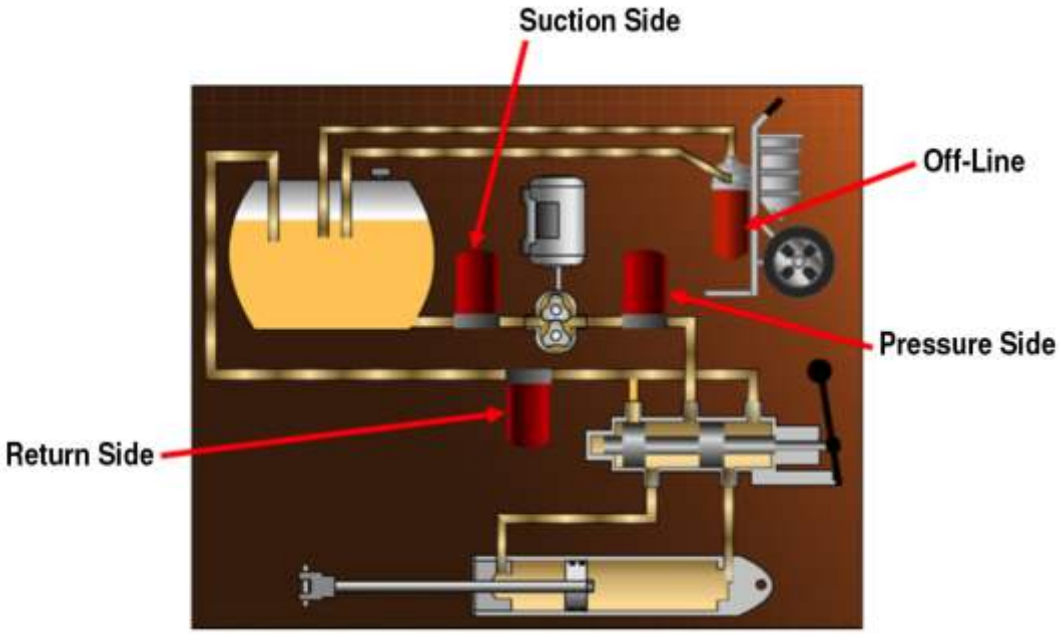


Fig. 1.2.6 (b) Hydraulic Filters

1.2.6 Basic Components of Hydraulics Contd.

Suction-side Filters: These filters protect the pump from contaminants in hydraulic fluid. Generally, they are deployed before the hydraulic pump. Suction-side filters are equipped with wire screen, a higher micron-rating filtering system.

Pressure-side Filters: Located downstream from the hydraulic pump, these filters are designed to clean the fluid as it exits the pump to protect more sensitive system components such as control valves and actuators from contaminants generated from the pump. The typical filtering media used in these filters is capable of removing a high percentage of the smaller particles of contaminant.

Return-side Filters: Located between the control valve and the fluid reservoir, these filters are designed to capture wear debris from the hydraulic systems working components before returning the fluid back to the reservoir. The media used in these filters is designed to remove common size wear particles that may be generated by these system components.

Off-line Filters: They are generally deployed outside of the hydraulic system, to filter the fluid before it enters the system. They work completely independent from the hydraulic system. These filters suck the fluid from the tank, filter the fluid and return it to the hydraulic tank.

In-tank Breather Filters: Located on the reservoir, this filter may be used to prevent moisture and contaminants from entering the reservoir.

Fig. 1.2.6 (c) In-tank Breather Filter

1.2.6 Basic Components of Hydraulics Contd.

3. Pumps: A hydraulic pump is a mechanical source of power that converts mechanical power into hydraulic energy (hydrostatic energy i.e. flow, pressure).

Types of hydraulic pumps:

A. Gear pumps
B. Rotary-vane pumps
C. Screw pumps
D. Piston pumps
E. Peristaltic pumps

A. Gear Pumps: A gear pump uses the meshing of gears to pump fluid by displacement. They are one of the most common types of pumps for hydraulic fluid power applications. Gear pumps are of two types; external and internal gear pumps.

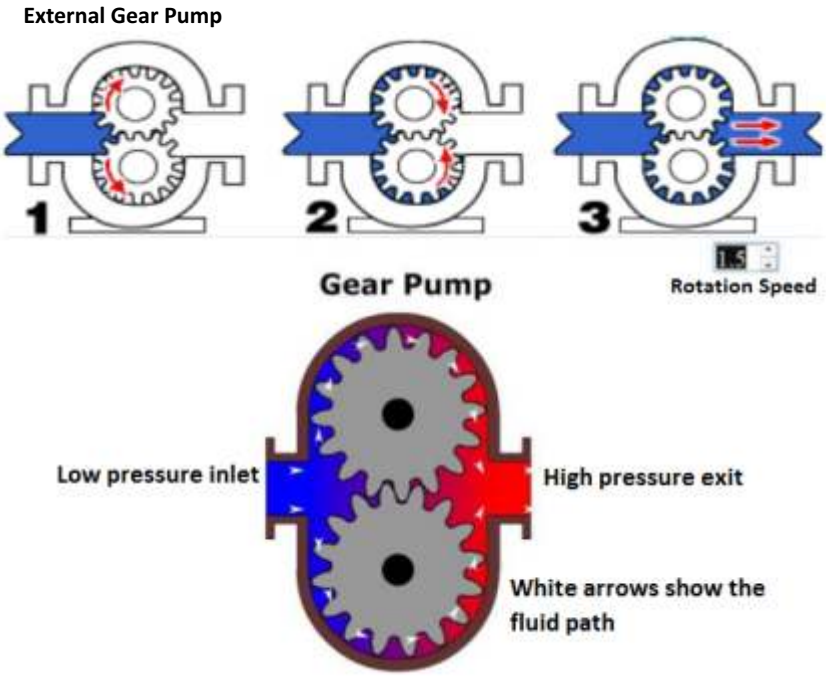


Fig. 1.2.6 (d) Working of External Gear Pump

1. As the gears come out of mesh, they create expanding volume on the inlet side of the pump. Liquid flows into the cavity and will get trapped by the gear teeth as they rotate.
2. Liquid travels around the interior of the casing in the pockets between the teeth and the casing. It does not pass between the gears.
3. Finally, the meshing of the gears forces liquid through the outlet port under pressure.

1.2.6 Basic Components of Hydraulics Contd.

Internal Gear Pump

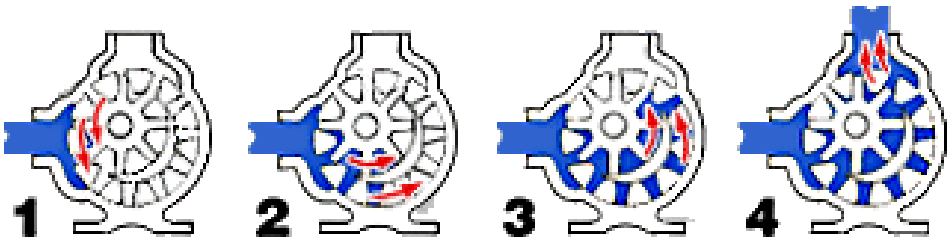


Fig. 1.2.6 (e) Working of Internal Gear Pump

1. Liquid enters the suction port between the rotor (large exterior gear) and idler (small interior gear) teeth. The arrows indicate the direction of the pump and liquid.
2. Liquid travels through the pump between the teeth of the "gear-within-a-gear" principle. The crescent shape divides the liquid and acts as a seal between the suction and discharge ports.
3. The pump head is now nearly flooded, just prior to forcing the liquid out of the discharge port. Intermeshing gears of the idler and rotor form locked pockets for the liquid which assures volume control.
4. Rotor and idler teeth mesh completely to form a seal equidistant from the discharge and suction ports. This seal forces the liquid out of the discharge port.

B. **Rotary-vane Pumps**:

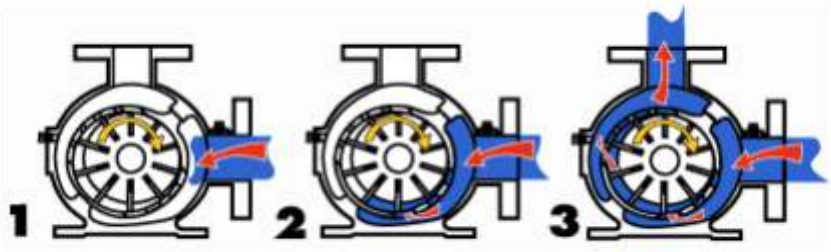


Fig. 1.2.6 (g) Working of Rotary-vane Pump

1. A slotted rotor is eccentrically supported in a cycloidal cam. The rotor is located close to the wall of the cam so a crescent-shaped cavity is formed. The rotor is sealed into the cam by two side plates. Vanes or blades fit within the slots of the impeller. As the rotor rotates (yellow arrow) and fluid enters the pump, centrifugal force, hydraulic pressure, and pushrods push the vanes to the walls of the housing. The tight seal among the vanes, rotor, cam, and side plate is the key to the good suction characteristics common to the vane pumping principle.
2. The housing and cam force fluid into the pumping chamber through holes in the cam (small red arrow on the bottom of the pump). Fluid enters the pockets created by the vanes, rotor, cam, and side plate.
3. As the rotor continues around, the vanes sweep the fluid to the opposite side of the crescent where it is squeezed through discharge holes of the cam as the vane approaches the point of the crescent (small red arrow on the side of the pump). Fluid then exits the discharge port.

1.2.6 Basic Components of Hydraulics Contd.

C. Screw Pumps: Screw pumps carry fluid in the spaces between the screw threads. The fluid is displaced axially as the screws mesh. There are two types of screw pumps; single screw pumps and multiple screw pumps.

Single screw pumps are commonly called progressive cavity pumps. They have a rotor with external threads and a stator with internal threads. The rotor threads are eccentric to the axis of rotation.

Fig. 1.2.6 (h) Single-screw Pump

Multiple screw pumps have multiple external screw threads. These pumps may be timed or untimed.

Fig. 1.2.6 (i) Multiple-screw Pump

D. Piston Pumps: In piston pumps, high-pressure seal reciprocates with the piston. Piston pumps can be used to move liquids or compress gases. They can operate over a wide range of pressures. High pressure operation can be achieved without a strong effect on flow rate. Piston pumps can also deal with viscous media and media containing solid particles. This pump type functions through a piston cup, oscillation mechanism where down-strokes cause pressure differentials, filling of pump chambers, where up-stroke forces the pump fluid out for use. Piston pumps are often used in scenarios requiring high, consistent pressure and in water irrigation or delivery systems.

Piston pumps are of two types:

- Axial piston pumps
- Radial piston pumps

1.2.6 Basic Components of Hydraulics Contd.

Axial Piston Pumps: An axial piston pump has a number of pistons in a circular array within a cylinder block. It can be used as a stand-alone pump, a hydraulic motor or an automotive air conditioning compressor. Axial piston pumps are of two types:

- Inline axial piston pumps
- Bent-axis axial piston pumps

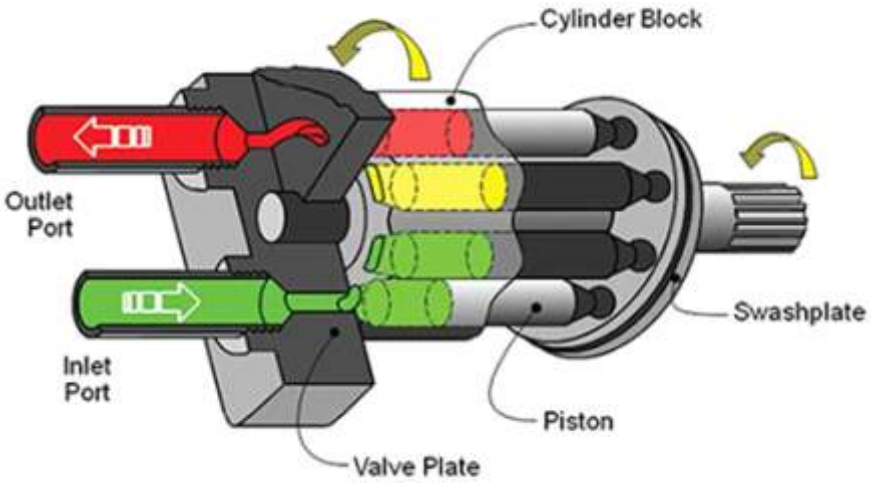


Fig. 1.2.6 (j) Inline Axial Piston Pump

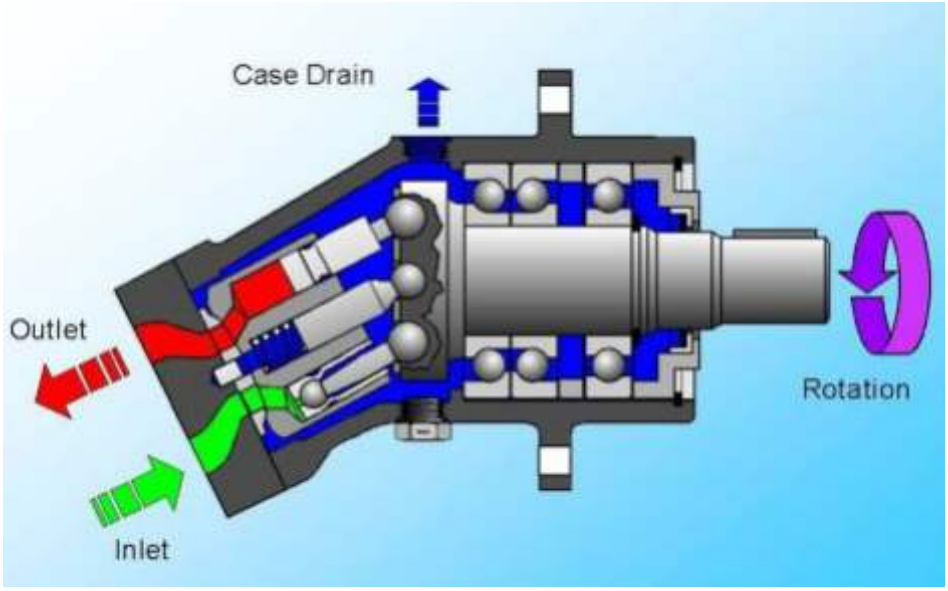


Fig. 1.2.6 (k) Bent-axis Axial Piston Pump

1.2.6 Basic Components of Hydraulics Contd.

Radial Piston Pumps: A radial piston pump is a form of hydraulic pump. The working pistons extend in a radial direction symmetrically around the drive shaft, in contrast to the axial piston pump.

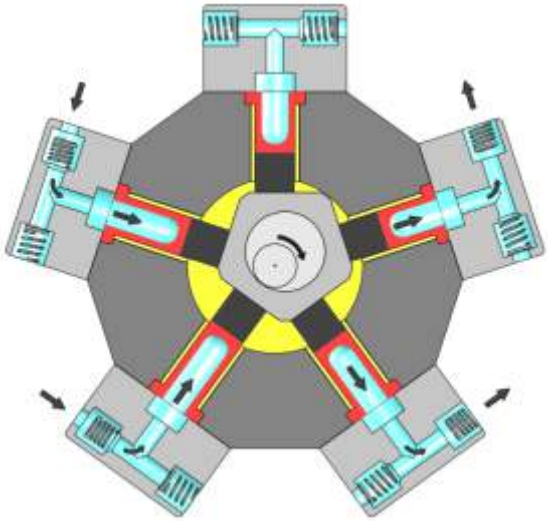


Fig. 1.2.6 (l) Radial Piston Pump

Radial piston pumps contain pistons arranged like wheel spokes around a cylindrical block. A drive shaft rotates this cylindrical block which pushes or slings the pistons, causing compression and expansion. The eccentricity between the piston housing and cylinder block centerlines determines the piston stroke. These pumps have a low noise level, very high loads at the lowest speeds, and high efficiency.

E. Peristaltic Pump:

Fig. 1.2.6 (m) Peristaltic Pump

1. The peristaltic pump is based on alternating compression and relaxation of the hose or tube drawing the contents into the hose or tube, operating in a similar way to our throat and intestines.

2. A rotating shoe or roller passes along the length of the hose or tube totally compressing it and creating a seal between suction & discharge side of the pump, eliminating product slip.

3. Upon restitution of the hose or tube a strong vacuum is formed drawing product into the pump.

4. The medium to be pumped does not come into contact with any moving parts and is totally contained within a robust, heavy-duty hose or a precision extruded tube.

5. This pumping action makes the pump suitable for accurate dosing applications and has a pressure rating up to 16 bar (hose) and 2 bar (tube).

6. The high pressure hose has inner layer of 2-6 reinforcement layers and an outer layer, which allow higher working pressures and generate higher suction lifts than non re-enforced tubing.

1.2.6 Basic Components of Hydraulics Contd.

4. Valves: Hydraulic valve properly directs the flow of a liquid medium; usually oil, through the hydraulic system. The direction of the oil flow is determined by the position of a spool. Hydraulic system can only function as per requirements by using valves. Thus, correct type of hydraulic valve must be chosen to serve the intended purpose.

Types of hydraulic valves:

A. **Directional Control Valve**: Controls the direction of flow of the hydraulic fluid to different lines in the hydraulic circuit.

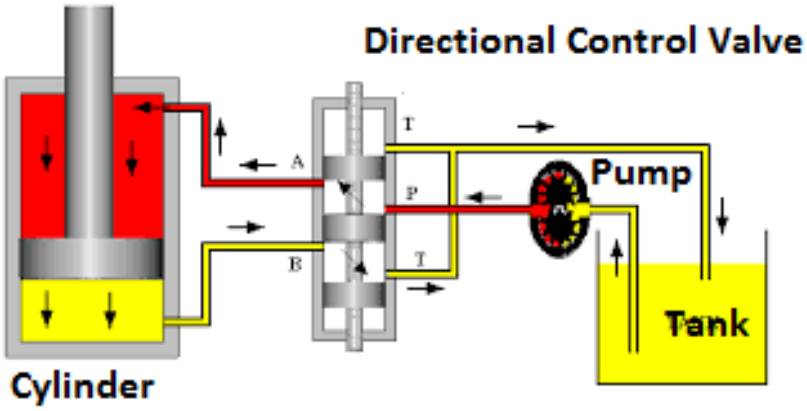


Fig. 1.2.6 (n) Directional Control Valve

B. Flow Control Valve: Controls the amount of fluid flow in the hydraulic circuit.

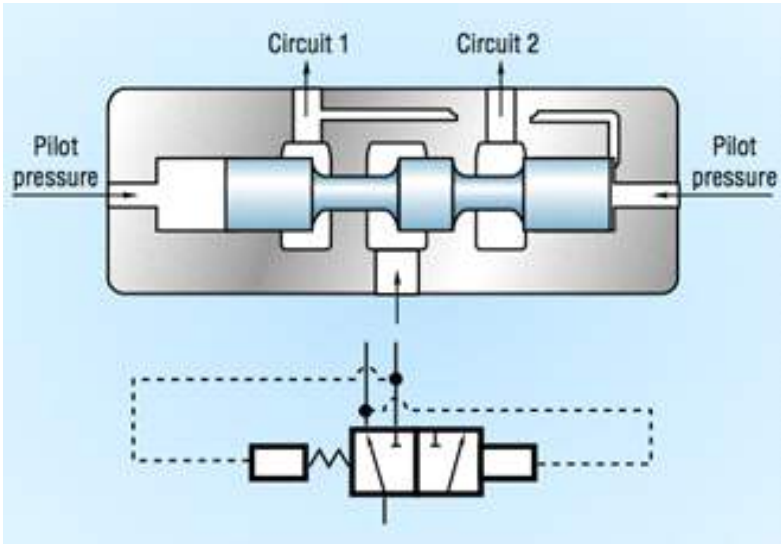


Fig. 1.2.6 (o) Flow Control Valve

1.2.6 Basic Components of Hydraulics Contd.

C. Pressure Control Valve: Controls the pressure in different segments of hydraulic circuit.

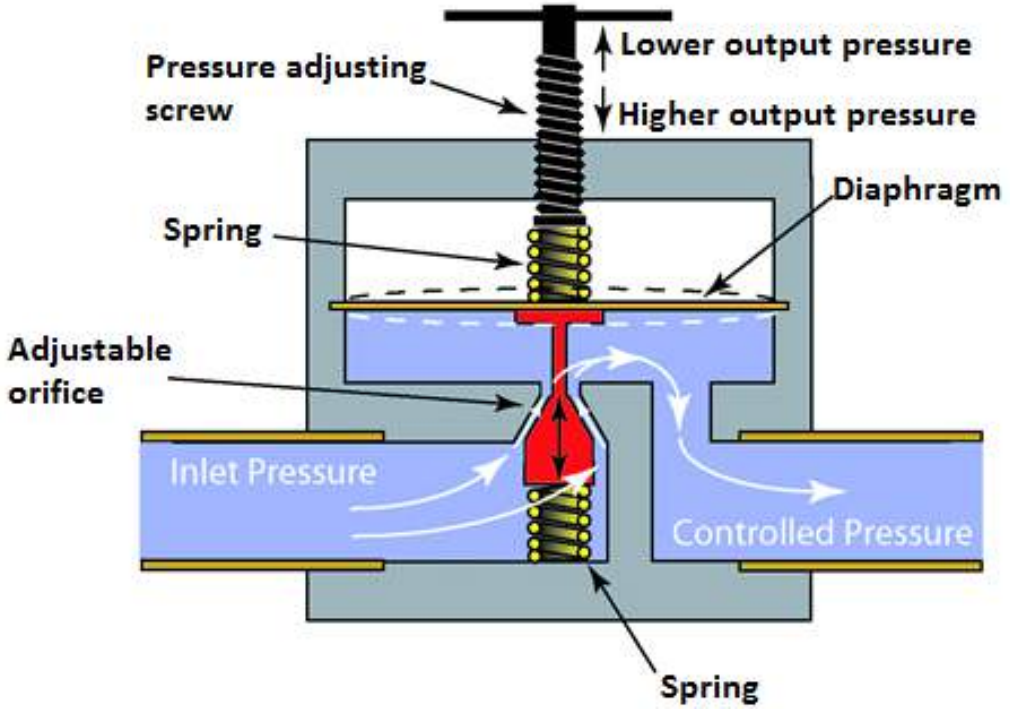


Fig. 1.2.6 (p) Pressure Control Valve

5. Actuators: An actuator is a component of a machine that is responsible for moving and controlling a mechanism or system, for example by opening a valve. In simple terms, it is a "mover". Hydraulic actuator consists of cylinder or fluid motor that uses hydraulic power to facilitate mechanical operation. The mechanical motion gives an output in terms of linear, rotatory or oscillatory motion. As liquids are nearly impossible to compress, the hydraulic actuator can exert a large force.

Hydraulic actuators are of two types:

A. Linear Actuator: Creates motion in a straight line. These actuators are used in machine tools and industrial machinery, in computer peripherals such as disk drives and printers, in valves and dampers, and in many other places where linear motion is required.

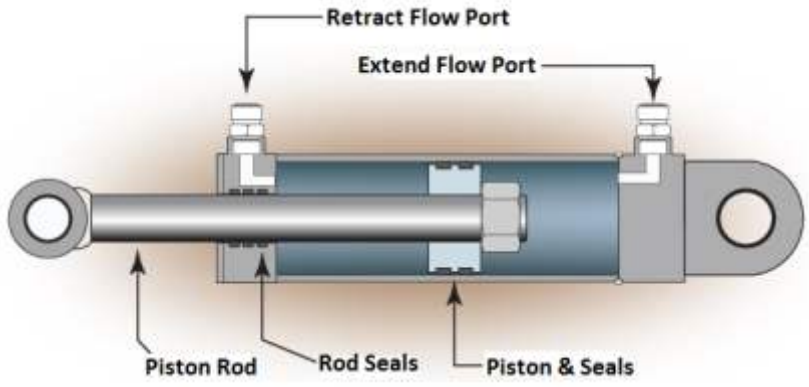
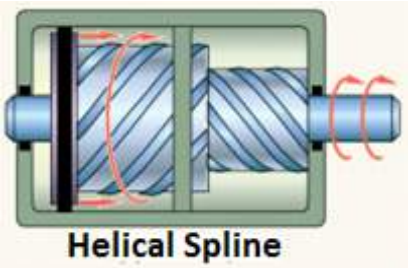


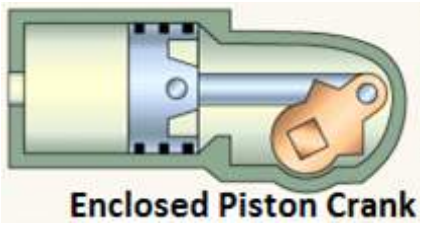
Fig. 1.2.6 (q) Linear Actuator

1.2.6 Basic Components of Hydraulics Contd.

B. Rotary Actuators: Rotary actuators produce a rotary motion or torque. Following are the types of rotary actuators.

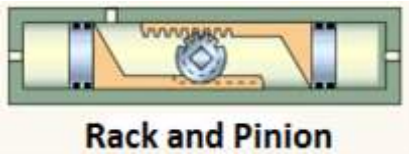


Consists of a cylindrical housing, a shaft and a piston sleeve. Converts linear piston motion into powerful shaft rotation. Helical spline actuators can be employed to actuate ball valves. Both the inside of the piston sleeve and the shaft (where it meets the piston) are splined with matching teeth. The device is hydraulically sealed so that the application of pressure to a port will drive the piston sleeve.

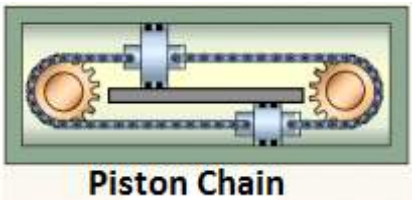


Consists of an adjustable arc of up to about 100°. This actuator is compact and has a few mechanical problems. Built-in bearing support overcomes side thrust forces. Fail-safe versions are equipped with a spring that returns the shaft to a safe position in case of power failure or loss of fluid. Torque generation follows a sinusoidal distribution.

Consists of two pistons connected rigidly by a common rod. The central drive pin on the rod engages a double yoke keyed to the output shaft which turns through arcs to 90° maximum. Torque outputs at the beginning and end of the stroke (breaking torque) is twice that at mid-point (running torque).



Consists of a long piston with one side machined into a rack engages a pinion to turn the output shaft. This gearset principle is adaptable for use in fail-safe, single-acting and double-acting models. Where balanced loading on the bearings is required, two bi-directional pistons with parallel racks are used; both racks engage the one centrally-located pinion.



Consists of a circular drive chain is held taut over two sprockets. One sprocket converts linear motion into torque output; an idler sprocket maintains tension. Two piston-shaped links are located at equal distances on the chain; one piston is larger than the other. The housing containing the mechanism has two parallel piston chambers and a port on each of the two opposite ends.

Fig. 1.2.6 (r) Types of Rotary Actuators

The simplest actuator is purely mechanical, where linear motion in one direction gives rise to rotation. The most common actuators though are electrically powered. Other actuators may be powered by pneumatic or hydraulic power, or may use energy stored internally through springs.

1.2.6 Basic Components of Hydraulics Contd.

6. **Reservoir**: Hydraulic reservoir is a container for holding the fluid required to supply to the system, including a reserve to cover any losses from minor leakage and evaporation. The reservoir can be designed to provide space for fluid expansion, permit air entrained in the fluid to escape, and to help cool the fluid.

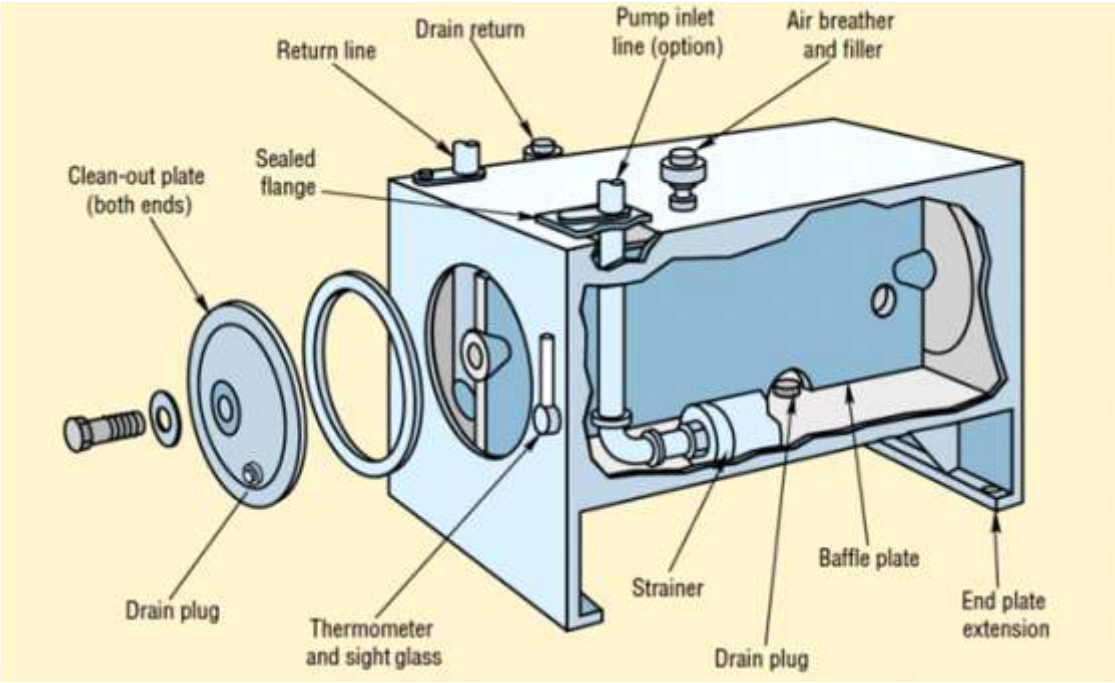


Fig. 1.2.6 (s) Hydraulic Reservoir

In addition to holding reserve fluid to supply to a hydraulic system's varying needs, a reservoir also provides:

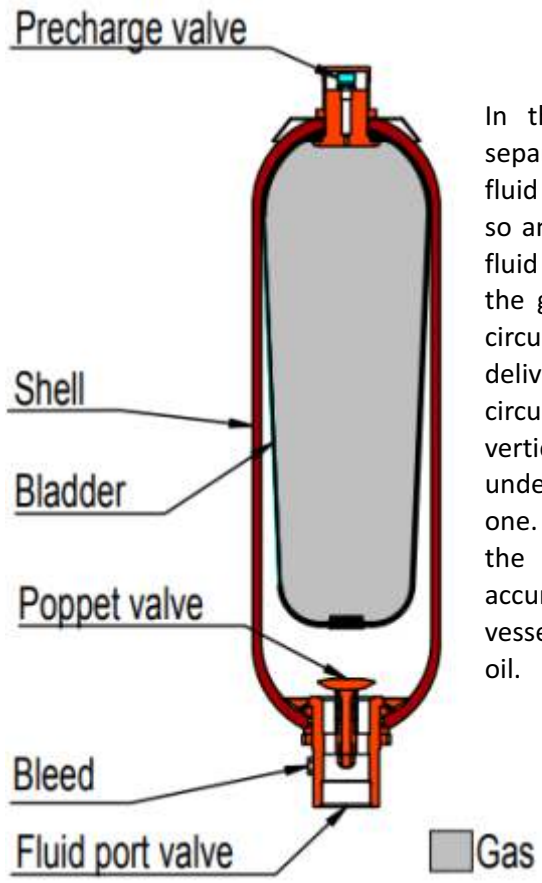
- a large surface area to transfer heat from the fluid to the surrounding environment
- enough volume to let returning fluid slowdown from a high entrance velocity. This lets heavier contaminants settle and entrained air escape
- a physical barrier (baffle) that separates fluid entering the reservoir from fluid entering the pump suction line
- air space above the fluid to accept air that bubbles out of the fluid
- access to remove used fluid and contaminants from the system and to add new fluid
- space for hot-fluid expansion, gravity drain-back from a system during shutdown, and storage of large volumes needed intermittently during peak periods of an operating cycle
- a convenient surface to mount other system components, if practical

1.2.6 Basic Components of Hydraulics Contd.

7. **Accumulator**: The main task of the hydraulic accumulator is to accumulate fluid under pressure and return it when necessary. Because the accumulator contains a fluid under pressure, it is treated as a pressure tank and must, therefore, be sized for the maximum operating pressure according to test regulations in force in the country where it is installed. To achieve the volume compensation and get the accumulation of energy, the fluid is pre-loaded by a weight, a spring or a compressed gas. There are three types of accumulators:

A. Bladder accumulators
B. Piston accumulators
C. Diaphragm accumulators

A. Bladder Accumulators:

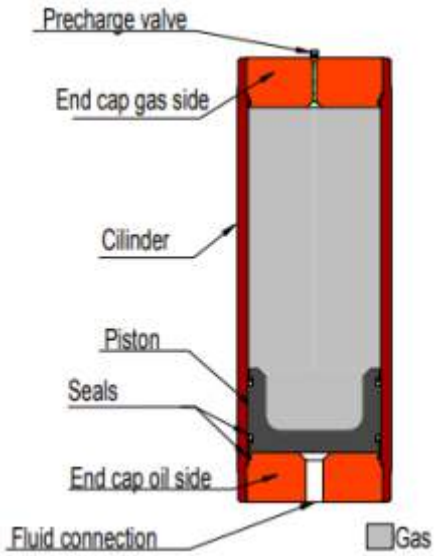


In the bladder accumulators, the fluid area is separated from the gas area by a flexible bladder. The fluid around the bladder is in contact with the circuit, so any increase in pressure causes the entry of the fluid into the accumulator and thereby compresses the gas. Vice versa, every drop of pressure in the circuit causes the expansion of the gas, resulting in delivery of the fluid from the accumulator to the circuit. Bladder accumulators can be installed in vertical position (preferable), in horizontal one and, under certain operating conditions, also in an inclined one. In the inclined and vertical positions, the valve on the fluid side should face down. The bladder accumulators include a pressure welded or forged vessel, a flexible bladder and the fittings for gas and oil.

Fig. 1.2.6 (t) Bladder Accumulator

1.2.6 Basic Components of Hydraulics Contd.

B. Piston Accumulator:



C. Diaphragm Accumulator:

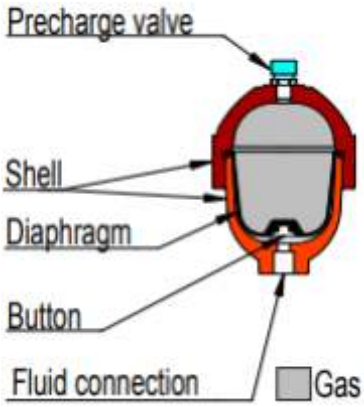


Fig. 1.2.6 (u) Piston and Diaphragm Accumulator

Piston Accumulator:
These are hydro-pneumatic accumulators with a free-moving piston as a separation element between a compressible gas cushion and the operating fluid.

Piston Accumulator:
These are hydro-pneumatic accumulators with a flexible diaphragm as a separation element between the compressible gas cushion and the operating fluid.

1.2.7 Basic Units used in Hydraulic Circuit

UNITS

- 1 Psi = 0.06894757 Bar
  6.894757 Kilo Pascal (KPa)
- 1 Bar= 14.50377 Psi
  100 Kilo Pascal (KPa)
- Q (Flow) = $\frac{\text{Displacement (CC) x Prime mover (RPM)}}{1000}$
- 1 kg/cm2 = 14.22 psi
- 1 Bar = 1.01 kg/cm2
- 1 HP = 746 Watts
- 1 Gallon = 3.78 liters
- Force = Pressure x Area

1.2.8. Gauges

PRESSURE GAUGES

- You may be wondering why you just don't use a gauge with the highest -pressure range all the time.
- Because on a gauge with a very high range, each portion of the dial represents a larger value in pressure.
- On higher pressure transducers, the low pressure values aren't as accurate. This makes it harder to see small pressure changes that would affect a system with a smaller range of acceptable operating pressures.

Fig. 1.2.8 (a) Gauges

ANALOG GAUGES

Advantages:

- Gauges are less expensive than digital meters.
- Gauges are available in a variety of pressure ranges.
- Speed of rice or fall of pressure within a circuit can be witnessed by technician.

Disadvantages:

- It is usually necessary to have multiple gauges for reading various pressures.
- Even with 2% accuracy, analog gauges may not be as accurate as digital meters.

Since the advantages can outweigh the disadvantages, analog gauges still have an important place in your hydraulic-system test kit.

Fig. 1.2.8 (b) Analog Gauges

1.2.8. Gauges Contd.

DIGITAL GAUGES

Advantages:

- Meters are capable of readings that are more precise.
- With just a few sensors, a digital meter is accurate across a wide range of pressures.
- Meters are more durable than gauges.

Disadvantage:

- Meters are more expensive than gauges.
- Trending on a digital gauge is tougher than on an analog.

Fig. 1.2.8 (c) Digital Gauges

1.2.9 Hydraulic Fluids

PRIMARY PURPOSE OF FLUIDS:

- To transmit power
- To lubricate the moving parts
- To seal clearance between parts
- To cool or dissipate heat

PROPERTY REQUIR ED IN OIL:

- Flow-ability
- Anti-wear
- Incompressibility
- Prevent corrosion

1.2.10 Hydraulic Fluids Viscosity

VISCOSITY TOO HIGH

- Increases friction
- High temperature
- Increased Pressure drop
- Sluggish operation
- Difficulty in separation
- Difficulty in separation of air from oil in reservoir
- High resistance to flow

VISCOSITY TOO LOW

- Increased Internal leakage
- Poor lubrication, increased wear
- Low pump volumetric efficiency
- Increased temperature

1.2.11 Hydraulic Fluids Contamination

CAUSES

- Inadequate system design
- Poor maintenance of system
- Poor housekeeping of system
- Operating condition

SYSTEM DESIGN

- Reservoir which cannot be cleaned, improper filtration.

POOR MAINTENANCE

- Improper / unclean practice when adding hydraulic oil, Failure to change filters and breathers.

POOR HOUSE KEEPING

- Improper sealant, gaskets, fittings and hose also welded fittings.

OPERATING CONDITIONS

- Very dusty and windy area.

EFFECTS

- All types of hydraulic components
- More wear in components
- Heat in a system

SOME OF THE POSSIBLE SOURCE OF CONTAMINATION

- Leakage in lines
- Control valve O ring leaking
- Shaft seal leakage
- Leakage in cylinder pickings

1.2.12 General Hydraulics Hints

- Most Important - heat
- All opening of reservoir should be sealed
- No welding to be done near hydraulic component
- All opening in cylinder, hose, fittings - To be sealed or capped until just prior to start.
- Examine hose and pipes prior to use.
- Carryout walk-around checks regularly.

Exercise

Briefly answers the following questions.

Label the different symbols of a hydraulic system in the following figure.

----------	
----------	
----------	
----------	
----------	
----------	

Table. Hydraulic Symbols

What is purpose of an accumulator in a hydraulic system?

_____
_____
_____
_____

What is purpose of an pilot valve in a hydraulic system?

_____
_____
_____
_____

What are the properties required in a hydraulic oil?

_____
_____
_____
_____

Tips

Following are recommended tips;

- Visit a hydraulic lab.
- Get to know the major parts of hydraulic system and their features in detail.

Notes

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2. Assist in Repair & Maintenance of Hydraulic Systems of Infrastructure Equipment

IESC
Infrastructure Equipment Skill Council

Unit 2.1 – Breakdown Repair Assistance

Unit 2.2 – Maintenance Work Assistance

IES/N1104

Key Learning Outcomes

At the end of this unit, you will be able to:

1. Learn fundamentals of hydraulics
2. Understand common symbols used in hydraulic circuit diagrams
3. Identify parts & components like hoses; pipes and fittings.
4. Understand basic working of various hydraulic system parts like pumps, motors, valves, filters, cylinders.
5. Explore Manufacturer's tech specs and brief service procedures for hydraulic parts/ system in use.
6. Identify and use of various hand & power tools; and their calibration.
7. Understand Specs and grade of lubricants; their identification & usage.
8. Learn procedure for removal of hydraulic parts / components from the system/equipment
9. Learn procedure for further removing sub- parts/ sub-components.
10. Understand techniques used to diagnose faults through visual inspection.
11. Learn techniques of cleaning and servicing different parts/components of hydraulic system.
12. Read & understand general instructions, maintenance manuals & work orders related to equipment
13. Record and document basic details of repairs and maintenance carried out.

UNIT 2.1: Breakdown Repair Assistance

Unit Objectives

At the end of this unit, you will be able to:

1. Check the hydraulic system for leakages.
2. Visually inspect various parts of the hydraulic system.

2.2.1 Breakdown Repair Guide

Fig. 2.2.1 Breakdown Repair Assistance

2.2.1 Breakdown Repair Guide

Problem	Cause	Corrective Action
Loss of hydraulic power (no flow from the gear pump).	Reservoir low on oil	Check for leaks. Fill the reservoir to the proper level
	Adapter kit between engine and tandem pump failure.	Inspect and replace the damaged parts as required. Check for proper alignment.
	Gear pump not Functioning	Inspect and replace damaged parts.
	Splined coupling failure in the hydrostatic pump	Refer to Repair Manual
Loss of hydraulic power (full flow from gear pump).	Control linkage disconnected or binding	Inspect, adjust, or replace parts
	Auxiliary hydraulics engaged.	Disengage the switch.
	Relief valve failure or out of adjustment.	Check pressure. Adjust or repair as required.
Hydraulic action jerky.	Reservoir low on oil	Check for leaks. Fill the reservoir to the proper level.
	Control linkages are loose or worn out	Inspect, adjust or replace parts.
	Air in hydraulic system.	Check for leaks between the oil reservoir and pump.
	Load check valve not functioning.	Inspect and replace damaged parts.
	Inspect and replace damaged parts.	Inspect and replace damaged parts.
Hydraulic cylinders will not support any loads. (leak down)	Control valve spools not centering.	Check control linkage and control valve spool spring centering device.
	Cylinder seal(s) failure	Check seals.
	Load check valve not Functioning	Inspect and replace damaged parts
	External leak between control valve and cylinders	Inspect and repair
Hydraulic oil overheating.	Reservoir low on oil.	Check for leaks and replenish as required
	Oil cooler plugged or dirty.	Clean the cooling fins.

Table. 2.2.1. Breakdown Repair Guide

2.2.2 Safety – Yours and Others

WARNING
Lifting Equipment

You can be injured if you use incorrect or faulty lifting equipment. You must identify the weight of the item to be lifted then choose lifting equipment that is strong enough and suitable for the job make sure that lifting equipment is in good condition.

WARNING
Raised Equipment

Never walk or work under raised equipment unless it is supported by a mechanical device. equipment which is supported only by a hydraulic device can drop and injure you if the hydraulic system fails or if the control is opiated(even with the engine stopped).

WARNING
Raised Machine

NEVER position yourself or any part of your body under a raised machine which is not properly supported. If the machine moves unexpectedly you could become trapped and suffer serious injury or be killed.

WARNING
Hydraulic Pressure

Hydraulic fluid at system pressure can injure you. Before connecting or removing any hydraulic hose, residual hydraulic pressure trapped in the service hose line must be vented. Make sure the hose service line has been vented before connecting or removing hosed. Make sure the engine cannot be started while hosed are open.

CAUTION
Cleaning

Cleaning metal parts with not recommended solvents can cause corrosion. Use only company recommended cleaning agents and solvents.

UNIT 2.2: Maintenance Repair Assistance

Unit Objectives

At the end of this unit, you will be able to:

1. Know the parts of hydraulic components that you need to inspect as per the conditions.
2. Check the oil and fluid levels.

2.2.1 dehtification of Repair Tools

Construction equipment services technicians use following tools;

1. Computers and equipment
    A. Oscilloscope
    B. Onboard computer program
2. Power and machine tools
    A. Pneumatic wrenches,
    B. Lathes, and
    C. Welding equipment
3 . Hand Tools
    A. Screwdrivers
    B. Pliers
    C. Wrenches

Fig. 2.2.1.1. Identification of Repair Tools

2.2.1 Identification of Repair Tools

Oscilloscope

Welding equipment

Onboard computer program

Screwdrivers

Pneumatic wrenches

Pliers

Lathes

Wrenches

Fig. 2.2.1.2. Identification of Repair Tools

2.2.2 Hydraulics Maintenance Overview

Hydraulic systems aren't as complicated as you might think. Through regular maintenance you will become familiar with the components and be able to diagnose potential problems.

The components of hydraulic systems work together intimately. As a result, damage to one component may cause further damage to others. For instance, overheated oil caused by a leaky cylinder seal can break down and cause damage to other cylinders or the pump. That's why it pays to perform regular maintenance and preventative inspections to eliminate problems before they occur.

Most hydraulic systems consist of a pump, hoses and lines, cylinders and motors, valves, a cooling unit, a reservoir, filters and hydraulic fluid (oil). The pump is the heart of the system, which uses energy from the engine to pump the fluid and create hydraulic flow and pressure. Valves control the flow of the fluid by restricting or redirecting it. Cylinders and motors are the "muscles" of hydraulic systems. Cylinders have a straight, push-pull action while motors use the energy from the fluid to turn a shaft. The speed at which these components operate is determined by the hydraulic-oil flow rate, while the hydraulic pressure determines the force they exert. The cooling unit acts to cool the fluid after it has gone through the system and the reservoir feeds the pump. Connecting all of these components are hoses, line and fittings.

2.2.3 Hydraulics Maintenance Checklists

Below mentioned are the mandatory checklists for Maintenance of Hydraulic System

1. A fluid ounce of prevention. If you are able to keep contaminants out of hydraulic systems, you will avoid nearly all common problems and failures.
2. Change the fluid and filter after the initial 50 hours of use.
3. Check oil before each use.
4. Regularly check the temperature of the hydraulic fluid during operation.
5. Inspect hoses and lines.
6. Check the hose routing.
7. Inspect hoses at flex points.
8. Check all fittings on hoses to make sure they are snug.
9. Check couplings.
10. Keep the hoses clean by washing machinery on a regular basis.

Fig. 2.2.3. Maintenance Checklist

Exercise

Briefly answer the following questions.

List any three major breakdown repair with root cause and corrective actions.

_____

_____

_____

_____

What checklists for Maintenance of Hydraulic System?

_____

_____

_____

_____

Tips

Following are recommended tips;

- Visit a hydraulic lab.
- Observe hydraulic system operations and talk to an operator and get to know more in detail.

Notes

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3. Assist in Maintenance of Workshop Area, Tools & Machinery

Unit 3.1 – Workshop Area Maintenance

Unit 3.2 – Tools & Machinery Maintenance at Work

Unit 3.3 - Reporting & Documentation

IES/N7801

Key Learning Outcomes

At the end of this unit, you will be able to:

1. Carry out lifting and handling procedures.
2. Identify different types of cleaning equipment & their usage.
3. Identify different types of machine guards for equipment.
4. Understand effects of contamination on products i.e. oil, dirt .
5. Interact with mechanics/ supervisors to seek clarifications and understand issues
6. Ensure a clean & hazard free work area.
7. Maintain tools and equipment as per guidelines
8. Ensure safe handling of tools, equipment and machinery
9. Carry out cleaning as per schedule and limit of responsibility
10. Ensure use of right cleaning material/equipment & methods
11. Report the need for maintenance and/or cleaning outside area of responsibility
12. Follow instructions to minimise waste & ensure safe disposal of same
13. Assist in carrying out checks to ensure environmental conditions are met

UNIT 3.1: Workshop Area Maintenance

Unit Objectives

At the end of this unit, you will be able to:

1. Assist the mechanic in inspecting the workshop for safe operations.
2. Understand the communication symbols used to guide the mechanic.
3. Identify the symbols used for site safety.

3.1.1: Inspection Of The Workshop

Inspecting for restricted flow:

Slow hydraulics are the result of restricted flow. Low oil level, restricted hoses and lines,and damaged valves, pumps, cylinders and motors are all possible ca uses.

- Activate the hydraulic system and determine which individual system components are operating slowly. If, for instance, the bucket on your skid-steer loader does not raise or lower at the normal speed, but other hydraulic attachments do, then the restriction is in the lines and components that service the bucket. Visually inspect these components for leaks. Pay particular attention to connecting points.

- If no external restriction is obvious, then the obstruction may be internal. Large contaminants may be blocking a valve or have become lodged in part of a cylinder or motor.

- If you cannot isolate the obstruction and the entire system is operating slowly, then check the pump. If you hear the sound of cavitation, then the pump is not getting enough flow. Ensure that fluid levels are adequate and the all filters and strainers are clean. If the problem persists, check the inlet line to make sure that there is no blockage or kinking. Also, verify that the pump shaft is operating and not damaged.

Fig. 3.1.1. Inspection Of The Workshop

3.1.2 Signals To Guide A Mechanic

The signaler should stand in a secure position where he/she can see the load and can be seen clearly by the operator and should face the operator if possible. Each signal should be distinct and clear.

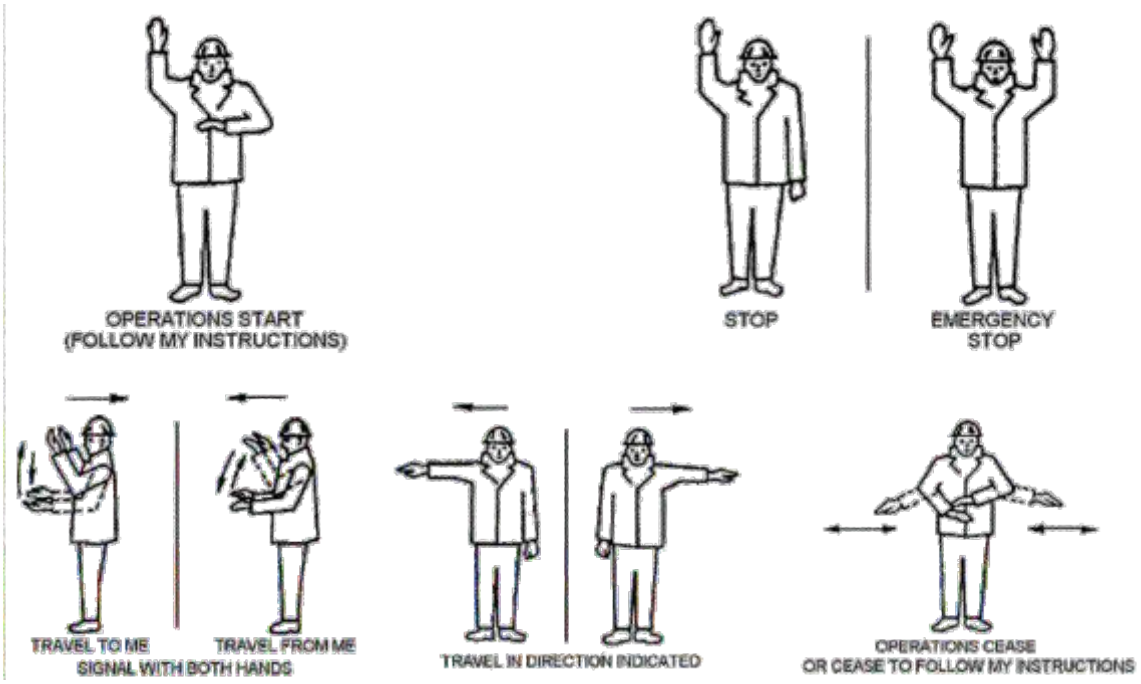

Fig. 3.1.2. Signals To Guide A Mechanic

3.1.3 Sample Site Safety Notice

Below listed are few of the sample Site safety notices.

Fig. 3.1.3. Site Safety Notice

3.1.4: Safety While Mounting and Dismounting

Mounting and dismounting are the major causes of personal injury, so you should:

- Always use steps and handholds for safety movement within the manufacturing plant.
- Keep three points of contact (both hands and one foot or both feet and one hand) at all times and always face the machine for safe entry or exit.
- Do NOT use the controls as hand holds for entry or exit.
- NEVER mount or dismount a moving machine.
- Be careful when conditions are wet or slippery.

Do's & Don'ts

- Never Use Hand Acceleration for the purpose of Forward and Reverse Movement.
- Never allow any person inside the cabin during transportation or loading, the cabin is designed only for a single person.
- Never use hands to check the leakages.
- Use a paper to inspect any kind of leakage.
- Never open Radiator cap when the temperature of the engine is hot.
- Never use any local Hoses for Transmission & Drum pressure hose.
- Stop the machine immediately if the transmission hose or Drum Hose pipe fails out.
- Never inspect anything below or near the Drum or Loading arm is at lift position.
- Always Replace Parts with Genuine spare parts.
- Crush the hydraulic oil filter and other filters just after the usage, in order to avoid the reuse of old one.

UNIT 3.2 :Tools/Machinery Maintenance At Work

Unit Objectives

At the end of this unit, you will be able to:

1. Understand about hydraulic operations.
2. Follow various instructions given by mechanic.

3.2.1 Maintenance Of Hydraulics On Machinery

Below are the maintenance activities for hydraulics components on machinery;

Pumps:

Aside from inspecting the pump for any obvious external wear and damage, you should listen for cavitation. Follow these steps every 50 hours or so to check for cavitation.

Listen to the pump when the hydraulics is operating. If it rattles or sounds like it is full of marbles or rocks, then cavitation is occurring and the system should be shut down immediately.
Check the fluid level and filter to determine if they could be limiting or restricting flow. Next, determine if any previous modifications have been made to the reservoir, inlet lines or pump. If any of the components are altered, the pump inlet flow may be affected.

Check inlet lines for any leaks, bends, pinching or other discontinutites that may restrict flow. Also, many systems have inlet strainers that act as a second filter to keep damaging contaminants from reaching the pump. If your system has a strainer, regularly clean it to maintain the needed inlet flow.

Most important, maintain clean fluid and filters. Pumps have check valves, vanes, pistons and gears that can be scoured and damaged by contaminants. This will result in inefficient pumping and cause wear on other parts of the equipment.
pumping and cause wear on other parts of the equipment.

Cylinders and motors:

Cylinders have seals and rings that can be damaged by excess pressure and contaminants in the fluid. Once again, be sure that your hydraulic fluid is clean. Check the points where the cylinder rod moves in and out of the cylinder housing for leaks. Check the length of the cylinder rods for any dings, dents or other damages that could allow fluid and pressure to escape.

A cylinder is designed to take loads along its axis only. Side loads can decrease cylinder life by causing excess wear on seals and the rod. With hydraulic motors, as with pumps, your primary maintenance consideration is clean hydraulic oil. The gears, vanes and pistons can be abraded by contaminants, resulting in pressure loss. Before each use, check the drive shaft of the motor for any damage or leakage. Be sure that motors are started and operated at the correct rpm. The owner's manua l will provide this information.

Valves:

Valves consist of tight-fittng components that block or direct flow. These can be abraded and leak (internally), resulting in low hydraulic pressure. Contaminants can lodge in valves and restrict flow. Again, maintain clean hydraulic fluid to keep valves in good working order.

3.2.1 Contd.

Fig. 3.2.1. Maintenance Of Hydraulics On Machinery

UNIT 3.3: Reporting and Documentation

Unit Objectives

At the end of this unit, you will be able to:

1. Identify and understand a mechanic pre-use checklist.
2. Identify and understand a mechanic workshop inspection checklist.
3. Assist mechanic in filling the report and checklist documents suitably.

UNIT 3.3.1: Pre-use Checklist

Say

Pre-use checklist is a type of information, which is used to reduce failure. It helps to ensure consistency and completeness in carrying out a task.

Explain

The pre-use checklist of a hydraulic equipment and its advantages.

Note general vehicle condition. Clear away all collected debris, steam clean if necessary. Check for general damage, loose, missing, broken parts and leaks. Report faults to your supervisor or the maintenance department, whichever your company requires.

Before starting engine, check the following:

WALK-AROUND ITEMS (VISUAL)	STATUS OK	NO	N/A	REMARKS
Walk-around inspection (warning decals, capacity plate, etc.)	☐	☐	☐	
Forks/locking pins, carriage, mast or boom	☐	☐	☐	
Wheels, tires & lug nuts (condition/pressure)	☐	☐	☐	
Engine (check oil level & for leaks)	☐	☐	☐	
Transmission (check oil level & for leaks)	☐	☐	☐	
Engine belts (check for adjustment/wear)	☐	☐	☐	
Air cleaner (check indicator, clean or change as required)	☐	☐	☐	
Radiator (check coolant level & for leaks)	☐	☐	☐	
Hydraulic tank (check oil level & for leaks)	☐	☐	☐	
Fuel tank (secure, valve open & fuel level)	☐	☐	☐	
Overhead guard/ROPS (no damage)	☐	☐	☐	
Seatbelt	☐	☐	☐	

After starting engine, check the following:

START-UP ITEMS	STATUS OK	NO	N/A	REMARKS
Engine (does it sound normal?)	☐	☐	☐	
Instruments (check for normal readings)	☐	☐	☐	
Exhaust system (check for leaks & excessive smoke)	☐	☐	☐	
Wipers & lights (spotlights, turn signals, etc.)	☐	☐	☐	
Horn & backup alarm (strobe lights)	☐	☐	☐	
All hydraulic controls (normal operation – lift, tilt, etc.)	☐	☐	☐	
Transmission & clutch (direction & speed range)	☐	☐	☐	
Brakes (parking & service brakes)	☐	☐	☐	
Steering (all modes)	☐	☐	☐	

Note anything abnormal or in need of repair: _____

Operator Name: _____

Vehicle #: _____ Hour Meter Reading: _____ Date: _____

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Fig 3.3.1 Pre-use Checklist

Ask

Why are the pre-use checks required?

Notes for Facilitation

Prepare a sample checklist and explain the checks to be done before starting repairing work at the workshop.

Do

- Show demo on how to perform pre-use checks before starting repairing work.
- Make participants to fill the check list as per live demo.

Exercise

Briefly answer the following questions.

What all do you inspect in a workshop?

_____

_____

_____

_____

_____

_____

List steps to monitor and be sure of right hydraulic actuation.

_____

_____

_____

_____

_____

_____

Tips

Following are recommended tips:

- Visit a hydraulic lab.
- Observe hydraulic operations on equipment and talk to mechanic.

Notes

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4. Work Shop Health & Safety

Unit 4.1 – Environmental Safety, Health Policies

Unit 4.2 – Types and Uses of Personal Protective Equipment

Unit 4.3 – Common Hazards and Preventive Measures

Unit 4.4 – Segregation and Disposal of Waste

Unit 4.5 – Basic Fire Fighting Equipment and Use

Unit 4.6 – Common Injuries and Appropriate First Aid

IES/N7602

Key Learning Outcomes

At the end of this module, you will be able to:

1. Closely understand environmental, safety, health (ESH) policies and guidelines of the company & their importance's.
2. Identify contact details of personnel responsible for ESH related matters & in case of emergencies.
3. Identify the location of first aid room / station and assembly points.
4. List the types, use and importance of Personal Protective Equipment (PPE).
5. List the types of common hazards and risks at workshop and preventive measures.
6. Understand to prevent common injuries and appropriate basic first aid treatment.
7. Acquire Firefighting equipment basic knowledge of handling and using them accordingly.
8. Understand guidelines regarding for transport, storage and disposal of hazardous materials and waste.
9. Safety signs/symbols and warnings used in workshops and their meaning.
10. Comply with safety, health, environment and security related regulations & guidelines at work.

UNIT 4.1: ESH Policies And Guidelines

Unit Objectives

At the end of this unit, you will be able to:

1. Know about the safety precautions that junior mechanic needs to follow while at work.
2. Strictly follow various Dos and Don'ts while working with the equipment.

4.1.1 Safety Precautions To Be Taken

It is in the interest of every employer and employee involved in the use of mobile plant and equipment to promote safety within their workplace.

The **junior mechanic hydraulics** too has a duty to:

1. Be responsible and careful to avoid himself or others life getting into risk.
2. Co-operate with and assist the mechanic hydraulics or any other person, as far as necessary, to enable them carry out their legal duties in health and safety.
3. Not interfere with or misuse any safety device or equipment .
4. Not intentionally or recklessly interfere with anything provided in the interest of health, safety and welfare.
5. Follow hydraulic mechanic procedures and the manufacturer's instructions which apply to the care and safe operation of the machine they are responsible for .
6. Inform the hydraulic mechanic, without unreasonable delay, of any work situation that they are aware of which presents a risk to the health and safety to them or others.
7. Immediately report any defects in plant and equipment which might endanger safety.

4.1.2: Do's and Don'ts During Operation

Do's

- Comply fully with instructions given by the junior mechanic.
- Follow the manufacturer's instructions (operator manuals) for the specific equpment you are assisting on.
- Take safety precautions when assisting on the machine prior to, during and after work.

Don'ts

- Assist on machine unless you have received appropriate training and are authorized to do so.
- Ignore hazards.
- Misuse, tamper or interfere with your machine and any associated safety equipment provided.
- Endanger your own and safety, or that of anyone else , by beng negligent.
- Endanger your own health and safety, or that of anyone else, by being negligent.

UNIT 4.2: Types and Uses of PPE

Unit Objectives

At the end of this unit, you will be able to:

1. Understand common personal protective equipment's.
2. List and know the various uses of PPE.

4.2.1: Personal Protective Equipment

PPE is equipment worn to minimize exposure to a variety of hazards. Examples of PPE include such items as gloves, foot and eye protection, protective hearing devices (earplugs, muffs) hard hats, respirators and full body suits.

Safety Helmets (Don'ts)

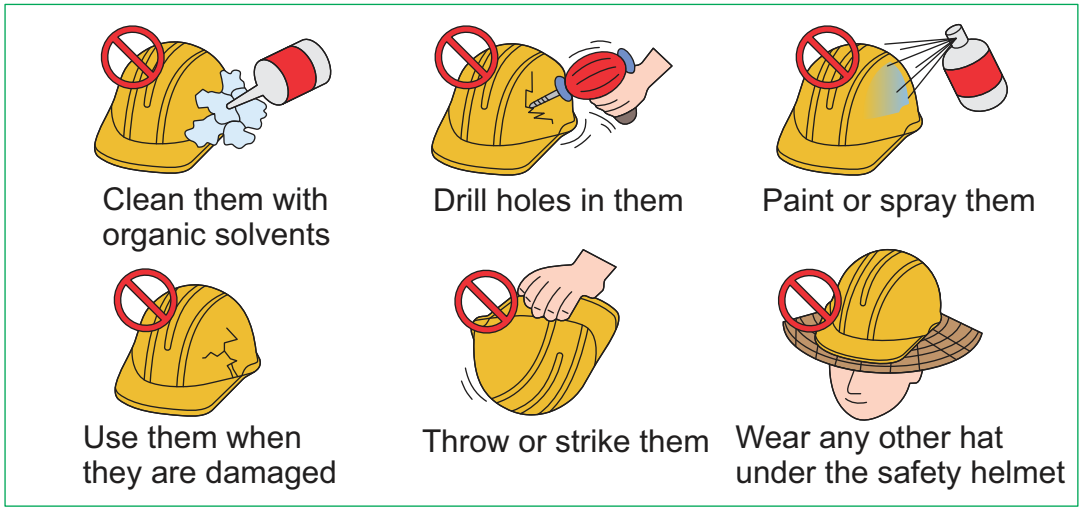

Fig 4.2.1 (a) Personal Protective Equipment

Eye Protectors

Fig 4.2.1 (b) Personal Protective Equipment

4.2.1 Personal Protective Equipment Contd.

Ear Protectors

Protective Gloves

Safety Footwear

Protective Clothing

Fig 4.2.1 (c) Personal Protective Equipment

Fig 4.2.1 (d) Personal Protective Equipment

UNIT 4.3: Common Hazards & Preventive Measures

Unit Objectives

At the end of this unit, you will be able to:

1. Understand the common hazards and preventive measures.
2. Follow the necessary Dos and Don'ts that may help avoid accidents at work.

4.3.1 Accident Prevention and Control Do's and Don'ts

Common accidents with hydraulic are overturns, falls, run overs and contact with other people and other objects. By following some basic Do's and Don'ts many of such accidents can be prevented:

Do's

- Wear all protective clothing and personal safety equipment issued to you or required by your working conditions.
- Understand and follow safety procedures when working on site and using plant and work equipment.
- Ensure you are fully aware of the job requirements and how they need to be carried out Know where to get help. Know the first aid and emergency procedures.
- Study the manufacturer's operator's manual for using your plant and equipment. If the manual is not provided, ask your supervisor or the suppliers of the plant / equipment to supply one.
- Report faulty / unsafe plant or equipment and any dangerous incidents Use the plant equipment safely so as not to affect its stability.
- Ensure you watch out for others who are affected by your actions.
- Ensure all personal injuries, no matter how slight, are reported and entered in the accident book (or equivalent).
- Take advantage of any training program offered by your employer or contractor. You are never too old to learn new practices or techniques.

Don'ts

- Use plant or work equipment that you have not been trained to use Throw or drop objects from plant or work equipment.
- Attempt to carry out work on moving parts of plant or work equipment with the safety guards removed.
- Indulge in horseplay on plant or work equipment.
- Attempt to operate any type of plant or work equipment under the influence of drugs, alcohol or any other substance, which affects your health or judgment Ignore warning instructions or safety signs.

UNIT 4.4: Segregation And Disposal Of Waste

Unit Objectives

At the end of this unit, you will be able to:

1. Understand to segregate different type of wastes.
2. Identify various ways to safely dispose of waste.

4.4.1 Waste Management

- Waste if not dealt properly is a big environmental issue. A junior mechanic needs to remember some basic waste management rules:
- Use ONLY authorized waste disposal sites.
- Never store lubricants in open or unlabeled containers.
- Never pour used engine oil into sewers, drains or on the ground.
- Look out for the proper bin (black in case of general rubbish) in case of non-industrial waste at your worksite. Most bins clearly mention the waste that can go in it.

Fig 4.4.1: Waste Management

UNIT 4.5: Basic Fire-Fighting Equipment And Use

Unit Objectives

At the end of this unit, you will be able to:

1. Identify various type of fire-fighting equipment's for different types of fire.
2. Understand and acquire suitable fire-fighting equipment operating.
3. Understand the usage of right firefighting equipment on type of fire.

4.5.1 Fire Extinguisher

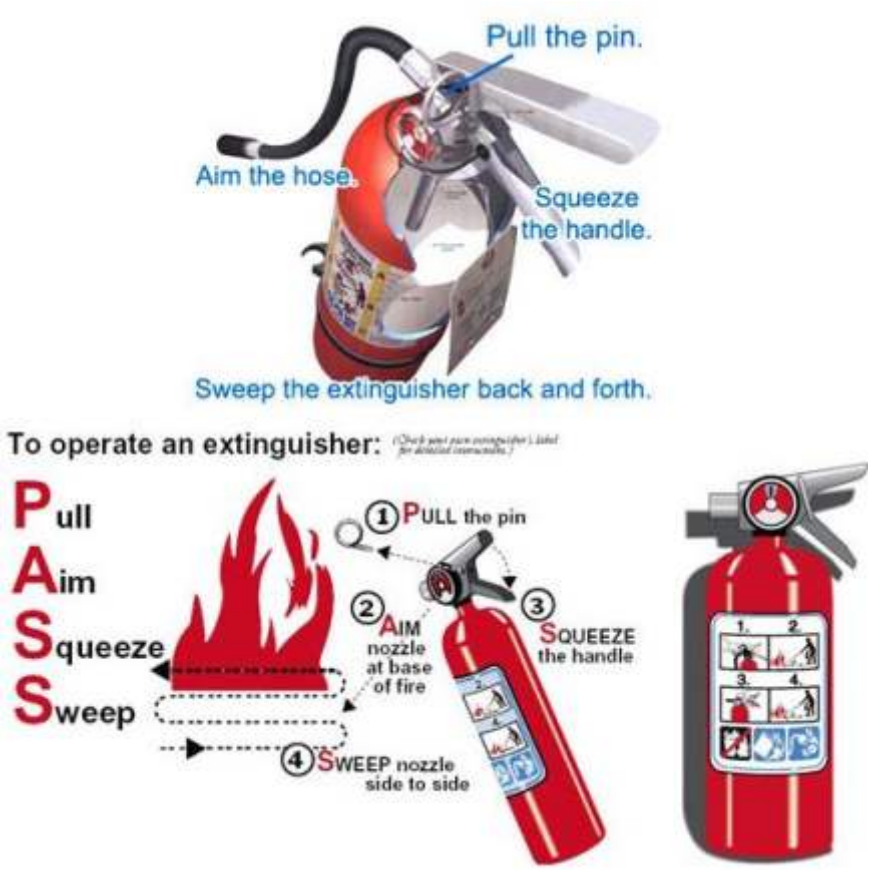

Fig. 4.5.1. Fire Extinguisher

4.5.2 Sand Bucket

Fig. 4.5.2. Sand Bucket

UNIT 4.6: Common Injuries And Appropriate First Aid

Unit Objectives

At the end of this unit, you will be able to:

1. Identify various contents in first aid kit.
2. Administer first aid for common injuries.

4.6.1 Basic First Aid Kit

A junior hydraulic mechanic must have basic knowledge of emergency medicines that can be used as primary medical service for cuts, wounds, fever, etc.

Scissors

Glove

Tweezers

Anticeptic wipes

Roller Bandage

Thermometer

Alcohol

Antibiotic ointments packets(approx 1g)

Fig. 4.6.1. Basic First Aid Kit

4.6.2 Administer Aid

Below mentioned is the Chart on Administer Aid;

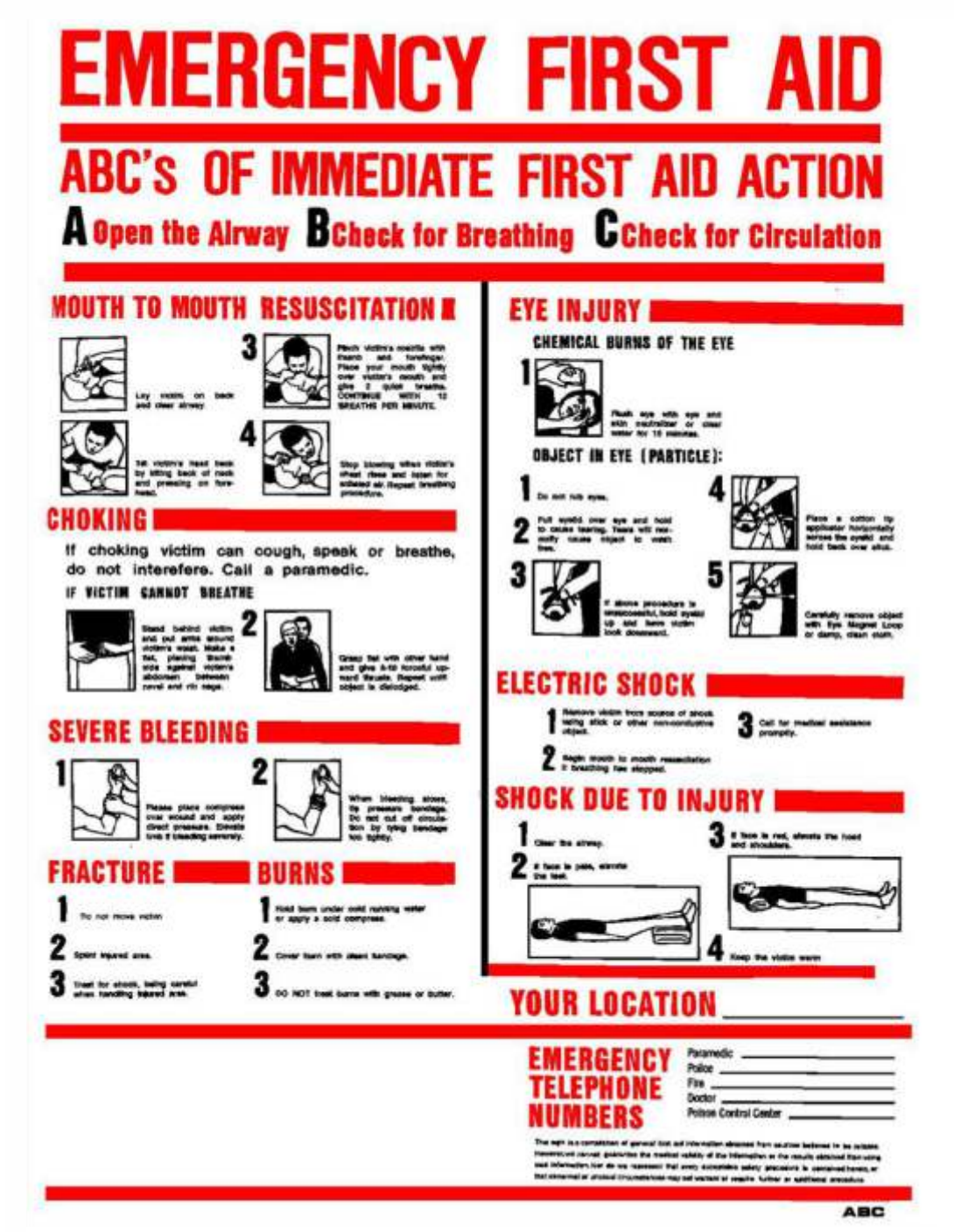

Fig. 4.6.2. Administer Aid

Exercise

Briefly answer the following questions.

How can the junior hydraulic mechanic help create a safer work place?

List some common PPE?

What precautions a junior hydraulic mechanic has to follow when dealing with waste?

What makes up a basic first aid kit?

Tips

Following are recommended tips:

- Wash skin contaminated with oil thoroughly in warm soapy water.
- Do not use petrol, diesel fuel or paraffin to clean your skin.

Notes

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