

## TROUBLE SHOOTING RECIPROCATING PUMPS PUMP DOES NOT DISCHARGE

### Suction lift Too High:

At sea level a steam pump handling cold water should not have a suction lift greater than 22 ft. check the lift by connecting a vacuum gage at the pump suction in . If the lift exceeds 22 ft. either lower the pump so it is closer to the water level or raise the water level the pump so it is closer to the water level or raise the water level so it is closer to the pump.

### Pump not Primed:

Prime the pump by filling the suction line above the foot valve with cold liquid. Open any vents on the pump discharge side and leave them open until the pump and piping are free of air.

### Worn Parts:

Worn suction valves ,piston -rod packing or piston packing can cause a pump to lose suction. Examine the pump suction valves and seats and piston and rod packing . replace valve, seats or packing as necessary. In badly worn liquid cylinders it may be necessary to rebore the iners and replaces the old pistons.

## PUMP SHORT- STROKES

### Packing too tight:

Check for a small amount of leakage around the rods at the steam and liquid cylinders. If there is no leakage the packing is too tight. Loosen the gland . If the pump still short -strokes check the liquid -piston packing. it may have absorbed excess moisture.

### Gas or air in liquid:

duplex pumps short stroke excessively when there is too much gas or air in the liquid pumped. Correct by altering the suction look -up to prevent the entrance of air.

## PISTON HITS HEAD

### Piston Rings worn :

If the ring on the steam piston are badly worn they will not hold the cushion .Replace worn rings .reborn the liner if , necessary.

### Leaky Liquid valves :

This can lead to long stroking . replace worn valves with new ones.

## LOW DISCHARGE PRESSURE

### Valves Or Ring Worn :

Inspect the steam piston rings and valves for excessive wear. replace with new or repaired parts.

## PUMP STOPS

### Valves Trouble:

Incorrectly set or worn steam valves can cause a steam pump to stop . Always set the steam value in the manner recommended by the manufacture .Leakage of the steam valves may cause a duplex to hesitate or stop as it passes mid stroke. A simplex pump may stall at the end of its stroke when its steam value leaks.

## Power Pumps

Some of the troubles met with power pumps have the same general cause as in steam pumps. Typical troubles and their cures are listed below in the manner as for steam pumps.

### PUMP DOES NOT DISCHARGE

Pump not primed:

prime the pump by filling the suction line above the foot valve with cold liquid. Open any vents on the pump discharge side and leave them open until the pump and piping are free of air.

### EXCESSIVE PACKING WEAR

Piston Rod Defects:

Worn or bent piston rods can cause an even wear of the packing. Leading to early replacement, check for burrs on the rod too. Replace badly damaged rods with new or repaired ones. Also check for misalignment of the pump.

## 2. USE OF TOOLS: (10 HOURS)

1. Working table
2. Hammers
3. Filing
4. Chisels
5. Hack Saw & sawing
6. Screw driver
7. Wrenches & spanner
8. Plier
9. `V` Block
10. Divider
11. Scriber
12. Bench vice
13. Electrician testing pencil
14. Plier Side Cutting
15. Flat plier insulated
16. capiler Out side & Inside
17. Center punch
18. Pully Puuller
19. Types of taps & Threading Dies
20. Steel rule
21. Try square
22. Micrometer
23. Vernier Calliper
24. Feeler Gauge
25. Wire Gauge
26. Screw Pitch Gauge
27. Dial Test Indicator
28. Radius gauges

## Pump Operator Cum Mechanic Trade

### Introduction:-

In this trade the trainees have given knowledge about basic fitter, Basic Electrician, Basic Diesel Mechanic and water pumps. Means they are also given knowledge about fitting of motor on tube-wells or water works. After fitting the motor, they are trainees how to given connection of Electricity, During electrical cuts, they are trained about the use of Generator or basic knowledge of diesel. During this process if water pumps unable to pick up the water then several problems can arise such as leakage or any distruction to water pumps, this knowledge is provided to them. All these trades works to give basic knowledge to mix or this collective knowledge is given the main shape of Pump Operator cum Mechanic Trade.

### Pump Operator Cum Mechanic Trade (20 hours)

#### (i) Basic Training in Fitter:-

Fitter is one of the trades in which Training is given to the technicians. In simple words, fitter is a technician, who fits something. But this definition is not adequate. in fact, fitter trade is a wide field. Under this trade, we can have three broad categories.

#### (1) Machine Fitter:-

Technicians who let different parts and assemble or produce a machine, come under this category. These parts might have been made by a technician of some other trade or by the fitter himself.

#### (ii) Bench Fitter:-

Technicians who made or repair a part of a machine by using different kind of hand tools, Generally come under this category.

#### (iii) Pipe Fitter:-

Pipe Fitter is one who performs all kinds of pipe – fitting jobs. These may be pipes used for taps in houses, Tubewell pipes used in cold storages or pipes used Agriculture Farms.

#### II Basic Electricity:-

Electric energy is convenient and efficient for production of light, mechanic energy and in information processing. Electric energy generation is generally a three step process –naturally occurring chemically bonded energy (as in fossil fuels –coal and oil) or nuclear energy is converted to heat form by combustion/ nuclear fission, the thermodynamic cycle converts it to mechanic form which then is employed to run an electric energy generator, Electric as in batteries or solar energy is converted to electric energy in a solar cell. because of economy of scale, trend in electric energy generators is towards mega sizes.

Information is Light; usually visual or audio signals or coded messages have to be processed and or Transported by the intermediate form of electric energy.

**Works:-** Work is done whenever an object moves in a field of force, F (unit

of force is Newton, N). if the object moves in the direction of force, work is done by the force.

**Energy:-** It is the capacity for doing work, when a weight is lifted against gravity, work done by an external agency is lifting it gets stored in the weight as potential energy. If the weight were now allowed to fall the potential energy will get converted to kinetic energy.

Energy, W is measured in unit of joules, J or Newton-metres, N-m, as it equal force  $\times$  distance moved (m).

**Power:-** It is the rate of doing work (i.e.rate of transferring energy)

$$P = W/L \quad J/S \text{ or watts (w)}$$

**Electric Field:-**

An electric field is established in the space surrounding an electric charge and is manifested in form of force exerted on another charge brought into the field. This force is given by Coulombs's Law.

$$F = \frac{Q_1 Q_2}{4\pi \epsilon_0 r^2}$$

Alternating Current(A,C)

Alternating current or as is cyclic in nature with current following in positive in half the cycle and in negative direction in the other half, which is of very common occurrence in circuits.

Direct Current ( D, C)

Unidirectional current is known as direct current ( DC) and unless otherwise indicated it is assumed to have constant value with time.

**Basic Training in Diesel Mechanic:-**

**Engine:-** It provides the motive power for all the various functions which the vehicle or any part of it, may be required to perform. The engine for automotive use is of internal combustion type.

**Types of Engines:-**

- (i) Engine Cycle (1. Otto cycle 2. Diesel cycle)
- (ii) Number of stroke
- (iii) Fuel used
- (iv) Type of ignition
- (v) Number & arrangement of cylinder
- (vi) Valve arrangement
- (vii) Type of cooling

Number of Strokes:-

1. Two Stroke Engine:-

The air fuel mixture from the carburetor enters the crank case through the inlet port during the upward movement of the piston. At the same time the mixture in the cylinder is compressed which is ignited when the piston is just at T.D.C. The Combustion takes place and the piston moves imparting motion to the crankshaft. During the downward movement of the piston the mixture in the crankcase is compressed and pushed into the cylinder through the transfer port, which pushes out the exhaust gases through the exhaust port, at the same time filling the Cylinder with a new charge. Thus the whole cycle is completed in to

two stroke i.e. one revolution of the crankshaft.

2. Four stroke Engine:-

The cycle of events that take place in a 4-stroke engine. The charge is compressed when the piston moves up at the end of which the mixture is ignited. The gases under high pressure then expand and push the piston down., there by imparting the motion to the crankshaft. Finally the exhaust gases are driven out of the cylinder. Thus the entire cycle is completed in four strokes i.e. 2 crankshaft revolution.

Comparison of Diesel Engine with Petrol Engine:-

1. In Petrol Engine, a mixture of air and petrol is drawn into the cylinder and compressed, whereas in case of diesel engine, air alone is compressed.
2. The compression ratio used in petrol engines are limited to the range 7:1 to 10:1, where as diesel engine employ compression ratio from 12:1 to 22:1. This results in higher thermal efficiency of the diesel engines.
3. Diesel fuel used in C.I, engines is cheaper and less volatile. This results in considerably saving in the running cost and the risk of fire is also comparatively less.
4. Important components of a petrol engine, like carburetor spark plug and the complete ignition system are not required in a diesel engine. Instead a fuel injection system, consisting of mainly an injection pump and injector is employed.
5. Because of comparatively lesser speeds in case of diesel engines and their more robust construction, there is reduced wear and tear and the intervals between the overhauls are increased.
6. Higher Combustion efficiency of diesel engines means less carbon monoxide and hydrocarbons.
7. With its smooth combustion, a diesel engine offers a high and more stable torque over a wide range for easier operation.
8. The initial cost of a diesel engine is high on account of mainly two factors. Firstly, because the engine has to be made more robust owing to the higher pressure involved compared to a petrol engine and secondly, due to high precision involved in the manufacture of fuel injection pump.
9. Another disadvantage of diesel engine is that it runs less smoothly and is more noisy than the petrol engine.
10. A Governor in a diesel engine is a must to control critical speeds like idling and maximum b.h.p.
11. In diesel engines sometimes, especially during a cold start in winter the cranking speed may not be sufficient to raise the temperature of compressed air to the self-ignition value. For this reason heater plugs or other starting aids have to be employed.

Basic Training in Pump Mechanic:-

Pump operating and maintenance procedure differ little from one industry to another. So procedures useful in one industry are, generally, equally applicable to the same types of pumps used in another industry.

1. Centrifugal Pumps
2. Rotary Pumpq

### 3. Reciprocating Pumps

#### **Centrifugal-Pump Operation:-**

Starting a Centrifugal Pumps for the first time can be a troublesome experience unless the plant crew has made a thorough check of the unit during and after installation. Factors to be considered in starting any centrifugal pump include pipe cleanliness, pump alignment, rotation, lubrication, position of valves, stuffing—box leakage effect of speed changes, bypass quantities, throttling of the discharge and performance checks.

#### **Where Trouble Occurs:-**

Failure of a centrifugal pump in service may be sudden, as when a shaft breaks, or gradual as when brackish water causes blistering of the impeller or casing. Fortunately, neither condition is common in well-operated and maintained pumps.

#### **Centrifugal Pump Trouble Shooting:-**

##### **No Liquid Delivered:-**

**Lack of Prime:-** Fill the pump and its suction pipe completely with the liquid being handled. To rid the casing and piping of air, open all the vent cocks while filling the pump and pipe. Leave the vents open until clear bubble-free liquid flows from them. Close the vents and start the pump.

##### **Discharge Head Too High:-**

Check all valves in the discharge line to see that they are wide open. Be sure that Gage valves are not stuck closed by some obstruction in the pipe. If the discharge head is still too high and no new devices have been installed in the system, check the piping for obstructions, from either solids contained in the liquid or scale buildup.

##### **Not Enough Liquid Delivered:-**

##### **Damaged Impeller:-**

Remove casing and inspect the impeller, replace with a new one if vanes or other parts are damaged or worn.

##### **Undersize Foot Valve:-**

Area of foot-valve openings should be at least equal to that of the suction pipe and preferably 1.5 to 2 times as large.

##### **Worn Wearing Rings:-**

Inspect the rings visually, if they are badly worn, permitting leakage in the pump, replace all rings.

##### **Pump Discharge Pressure Low:-**

**Gas or Air in Liquid:-** bubbles will form in the liquid when it enters the suction pipe. Check for this condition by reducing the pressure on the surface of a small amount of liquid and observe if any bubbles form, A Gas-separation chamber on the suction line near the pump may be needed to remove the gas or air from the liquid.

**Gas Or Air in Liquid:-** Bubbles will form in the liquid when it enters the suction pipe. Check for this condition by reducing the pressure on the surface of a small amount of liquid and observe if any bubbles form, A Gas-separation chamber on the suction line near the pump may be needed to remove the gas or air from the liquid.

**Pump Water Passages Obstructed:-**

Open the casing and check the water passages for freeness. Remove any obstructions and replace the casing.

**Pump Overloads Driver****Discharge Head Low:-**

With too low a discharge head the pump delivers too much, liquid, overloading the driver, It may be possible to turn down the outside diameter of the impeller, thereby reducing its capacity. But never do this without complete advice from the pump manufacture. Serious damage can occur otherwise.

Speed Too High, or Wrong Direction of Rotation:-

Correct as described above.

Packing Too Tight:-

Release the gland pressure, then retighten reasonable. Check the leakage of the seal liquid from the packing. If there is no leakage while the pump runs, replace the packing, replace worn sleeves with new or refinished ones.

Stuffing Boxes Overheat:-

Common causes of this trouble include packing that is too tight, not enough packing lubricant, wrong grade of packing, not enough seal liquid flowing to the packing, and incorrect installation of the packing. Remember, there is a correct way of installing each type of packing, check with the manufacturer.

Pump Will Not Start

Impeller Locked:-

Sand causes many locks. Try to raise and lower the impellers, using the adjusting nut. This may free them. If it does not, backwash the pump using clear water or whatever other liquid the pump normally handles. Try turning the shaft at its top, using a small pipe wrench. Be careful –the shaft is easily damaged by a wrench. If the impellers cannot be freed, pull the pump and tear down the bowl assembly to get at the rotating parts.

**Trash in Casing:-**

Rags, wood, or metal jammed in the pump may prevent it from turning. Tear down the pump and remove the obstruction. Fit the suction with a strainer to keep trash out of the pump.

Pump Capacity Low

**Low Liquid Level:-**

Vent the well, check the pump inlet for excessive turbulence, vortexing or eddies. The velocity of the liquid entering the pump must be that recommended by the manufacturer and the suction submergence sufficient. Check the bowls and well screen for sand, rust, or bacterial blocking.

**Impeller Wear:-**

metal loss from the outer tips of the impeller vanes reduces pump capacity. Loss at the inner or suction end has not must effect. If fully enclosed impellers have the usual wearing rings, the trouble may be in them. Look for excessive clearance. With semi open impellers not having button should or wearing rings, a close running clearance is needed at the bottom of the vanes.

**Pump Vibrates Excessively**

**Rough Operation:**

Check to see that the impeller and bowl passages are free of wood, rags, sand, other material that might throw the pump out of balance. Check the driver by disconnecting it and operating it alone. Look for excessive wear in the rotating parts.

### **Rotary-Pump Installation and Operation:**

Rotary pumps of a number of different types are popular in a variety of services in industry. Usually Positive-displacement units, rotary pumps consists of a fixed casing containing gears, vanes, pistons, cams, segments, screw or similar element operating with minimum clearance. Instead of throwing a liquid as in a centrifugal pump, the rotary pump traps it, pushing it around the closed casing must like a reciprocating pump. But unlike a piston pump, a rotary discharges a smooth flow. The rotary pump generally receiving pump, pump location, Foundation, Alignment, Suction piping, Foot valve, discharge piping, relief valve, Pump Bearings, Initial Prime, Packing.

### **Operation:-**

Before starting a rotary pump for the first time, make a hydrostatic test of the suction and discharge piping to see that there are no leaks. Flush all piping to remove dirt, welding beads, pipe scale, thread turnings and other debris.

Prime the pump before starting by filling the case with the liquid to be handled. Be sure that the casing is full, so all air is driven out. Vent the discharge line so liquid flowing through the pipe for the first time can displace any air present.

Open the suction and discharge valves before starting the pump. Always follow this procedure; otherwise there is danger of developing excessive pressure in the discharge piping, or overheating the liquid. If the pump does not begin to discharge liquid immediately after being started. stop it and check for the cause.

### **Pump Does Not Discharge (Trouble Shooting)**

#### **Suction-Line Troubles:-**

Check for air leaks at the joints in the suction line, a closed valve, obstruction in the pipe. clogged strainer, liquid level too low in the supply tank or a clogged or stuck foot valve. To eliminate air leaks in the suction piping, tighten the bolts in flanged joints and the couplings or nipples in threaded joints. Paint the exterior of the piping, applying atleast two coats. Always open the suction valve wide before starting a rotary pump. using the suction valve too throttle flow into the pump can lead to excessive noise, cavitation and wear. Attach a vacuum gage to the suction Line, close to the pump. it will show if leaks are present and it the suction valve us closed.

#### **Pump Not Primed:-**

Fill the pump casing full of the liquid handled. Be sure a small amount of liquid overflows from the casing. Then all the air in the casing has been displaced by the liquid.

#### **Driver Troubles:-**

Check to see that the pump turns in the correct direction and that the motor or engine turns it at rated speed. These Troubles are most common with new and overhauled pumps.

Excessive Noise

Misalignment:-

Check the pump alignment, if the pump handles not liquid, check the alignment both before the pump is started and after it reaches its operating temperature. if the piping transmits, strains to the pumps casing, Loosen the connections and move the piping to a position where it places no strain on the pump. if this is not possible insert expansion joints in the pipe, close to the pump.

Discharge Pressure Too high:-

This heads to a crackling or Grinding noise. Check the discharge – Pressure Gage to see that it gives the correct reading. Reduce the pressure setting on the relief valve if the discharge pressure is higher than the rated value., when the pump is not equipped with a relief valve, fit one.

Reduced Capacity

**Suction Line Troubles:-**

Follow the same procedures listed under this heading above. Inspect the check for excessive friction in the suction pipe caused by too small a suction pipe, too many fittings in the pipe, clogged strainer, excessive suction lift, insufficient submergence of the suction pipe inlet, too high a lift, insufficient submergence of the suction pipes inlet., too high a rift, and air leaks in the suction pipes its flanges a screwed connections.

Pump Loses Its Suction

**Suction in Line Troubles:-**

Check for the following conditions, air or gas leaks in the suction pipe, air pockets bin the pipe, vaporization of liquid in the suction line, and insufficient submergence of the line inlet. Correct as detailed earlier.

Excessive Wear

Casing Distortion:-

This can be caused by excessive strains being transmitted from the piping to the pump casing. Correct as discussed earlier in this casing.

Liquid Troubles:

This can be traced to corrosion of the pump working parts, no liquid supply, and abrasive dirt in the liquid. Routine wear of Rotary pumps is generally extremely low, excessive wear should not be tolerated because it increases the pump, slip, reducing the capacity and leading to early replacement of the unit.

Insufficient or no liquid supply causes the pump to run without its requirement lubrication. if possible provide a suction head on the pump. Keep sufficient liquid in reserve at all time to operate the pump for several minutes, should the liquid is supply fail. Never operate a rotary pump dry.

Reciprocating-Pump Installation and Operation:-

Never use a suction pipe smaller than the size of the suction connection on the pump. In general do not use a lift of over 25 ft. Have the suction line completely airtight. While many manufacturers recommend that the pump be installed in the light, clean, dry warm places, this is not always possible.

Operation:-

With the pump properly installed and ready to operate lubricate all

bearings, joints of moving parts and piston rods. make sure all valve in the suction, discharge steam and exhaust lines are open.

When the pump is to pull a suction lift, it should be primed before starting. Open the air cock on the liquid cylinder cap to allow air to escape. Then close it when the pump is filled with liquid. if the pump is cold, open the exhaust valve and then crank the steam valve just enough to warm the pump. Then gradually open the steam valve until the piston begins to move slowly. When the steam end is free of condensate, close the drain valve, open the steam valve until the pump come up to its working speed.

Too stop the pump, first close the steam valve, then the exhaust, suction and discharge valves. Lastly be sure to open the drain valves before leaving the pump.

## TROUBLE SHOOTING RECIPROCATING PUMPS PUMP DOES NOT DISCHARGE

Suction lift Too High:

At sea level a steam pump handling cold water should not have a suction lift greater than 22 ft. check the lift by connecting a vacuum gage at the pump suction in . If the lift exceeds 22 ft. either lower the pump so it is closer to the water level or raise the water level the pump so it is closer to the water level or raise the water level so it is closer to the pump.

Pump not Primed:

Prime the pump by filling the suction line above the foot valve with cold liquid. Open any vents on the pump discharge side and leave them open until the pump and piping are free of air.

Worn Parts:

Worn suction valves ,piston -rod packing or piston packing can cause a pump to lose suction. Examine the pump suction valves and seats and piston and rod packing . replace valve, seats or packing as necessary. In badly worn liquid cylinders it may be necessary to rebore the iners and replaces the old pistons.

## PUMP SHORT- STROKES

Packing too tight:

Check for a small amount of leakage around the rods at the steam and liquid cylinders. If there is no leakage the packing is too tight. Loosen the gland . If the pump still short -strokes check the liquid -piston packing. it may have absorbed excess moisture.

Gas or air in liquid:

duplex pumps short stroke excessively when there is too much gas or air in the liquid pumped. Correct by altering the suction look -up to prevent the entrance of air.

## PISTON HITS HEAD

Piston Rings worn :

If the ring on the steam piston are badly worn they will not hold the cushion .Replace worn rings .reborn the liner if , necessary.

Leaky Liquid values :

This can lead to long stroking . replace worn values with new ones.

### **LOW DISCHARGE PRESSURE**

Values Or Ring Worn :

Inspect the steam piston rings and values for excessive wear. replace with new or repaired parts.

### **PUMP STOPS**

Values Trouble:

Incorrectly set or worn steam values can cause a steam pump to stop . Always set the steam value in the manner recommended by the manufacture .Leakage of the steam values may cause a duplex to hesitate or stop as it passes mid stroke. A simplex pump may stall at the end of its stroke when its steam value leaks.

### **Power Pumps**

Some of the troubles met with power pumps have the same general cause as in steam pumps. Typical troubles and their cures are listed below in the manner as for steam pumps.

### **PUMP DOES NOT DISCHARGE**

Pump not primed:

prime the pump by filling the suction line above the foot valve with cold liquid.Open any vents on the pump discharge side and leave them open until the pump and piping are free of air.

### **EXCESSIVE PACKING WEAR**

Piston Rod Defects:

Worn or bent piston rods can cause un even wear of the packing .Leading to early replacement , check for burrs on the rod too.Replace badly damaged rods with new or repaired ones. Also check for misalignment of the pump.

2. USE OF TOOLS: (10 HOURS)

29. Working table
30. Hammers
31. Filling
32. Chisels
33. Hack Saw & sawing
34. Screw driver
35. Wrenches &spanner
36. Plier
37. `V` Block
38. Divider
39. Scriber
40. Bench vice
41. Electrician testing pencil

42. Plier Side Cutting
43. Flat plier insulated
44. capiler Out side & Inside
45. Center punch
46. Pully Puuller
47. Types of taps & Threading Dies
48. Steel rule
49. Try square
50. Micrometer
51. Vernier Calliper
52. Feeler Gauge
53. Wire Gauge
54. Screw Pitch Gauge
55. Dial Test Indicator
56. Radius gauges

### 3. **Safety and Standard Norms:-** (4 hours)

Life is a valuable gift. It is necessary to take all necessary precaution to save it. "safety first" is considered as the golden rule of preventing accidents. The number of accidents can be reduced to a great extent, if before doing anything due care is taken to prevent accidents. Some accidents are averted by the Grace of God. But the possibility of accidents can be reduced to the minimum by taking proper care at the time of work. if we analyse the factor responsible for accidents in technical jobs, the following courses can be listed:-

- (i) Inadequate knowledge of the job.
- (ii) lack of suitable working environments and proper facilities for work.
- (iii) urge to do a job hurriedly.
- (iv) To work more than one's capacity.

It is clear from the above facts that if adequate safety measures are taken before doing a particular job, the number of accidents in the workshop and factories can be reduced.

Different types of machines are produced and repaired in workshop by the technicians. These precaution for safety can be divided into three sections:-

- (i) Safety precautions for self
- (ii) Safety Precautions for the job.
- (iii) Safety precautions for protection of tools and machinery.

#### **Safety for Self:-**

First of all, each worker should take care to protect his body from accidents. A slight negligence can make a worker handicapped or disabled. In order to ensure personal safety, the following important points should be borne in mind:

(i)	While working in a workshop one should always wear only fit clothes and avoid wearing loose ones like dhoti, kurta, payjama etc.
(ii)	use of neckties and muffler should be avoided in the workshop.
(iii)	While a machine is in motion, one should not unnecessary touch any of it is parts. There are chances of accidents.
(iv)	Belt Guard should be used on machines run by belts. The belt Guards should not be removed while the machine is in operation.
(v)	Adequate provision of light and air should be there at the site of work.
(vi)	One should not more bare footed in workshops or factories.
(vii)	One should not touch cutting chips with hands, while working on a machine.
(viii)	If you donot have knowledge about working of a machine you should not operate it without the help of a person who knows its working.
(ix)	One should neither use a defective machine nor any defective tools.
(x)	A tool should be used only for the purpose for which it is intended, not for other purposes.

**Safety for Job:-**

Production or repair of a machine or any part of a machine costs a lot of money. if we do a job carelessly it would further increase its cost. Therefore it is also essential that one should do the job with due care and precautions for safety. The following safety measures are necessary to ensure safety for job;

- (i) Before taking up any job in the workshop, it is necessary too plan the operation of work and job should be performed accordingly otherwise it may result in loss of time and money and the job would not be done satisfactorily.
- (ii) If a machine is required to be used for doing a job, it should be ensured that job is carried out properly on the machine.
- (iii) While cutting a particular object one should not make a deep cut.
- (iv) Coolant and lubricants should be used according to the nature of metal, while doing a cutting job so, that there is not much change in its natural properties.
- (v) Proper tools with sharp edges, should be used for cutting jobs otherwise it would spoil the job.
- (vi) Proper arrangements should be made to fasten heavy jobs on machines.
- (vii) Use of right types of tools and machines for various jobs is very important for proper results. If right kind of tools and machines are not used. it may prove harmful and spoil the job.

**Safety for Tools and Machines:-**

Various operations are carried out and various types of tools and machines are used for production and repair of each machine or part of a machine. it is equally important to protect these tools and machines from loss or damage.

- (i) Each tools and machine has been made to perform certain specific jobs. It is important from the point of their safety that these tools and machines should be used only for the specific purposes for which these are meant.
- (ii) A file to be used for filling should not have any grease or oily substance on it. Nor we should use file in the place of a hammer.
- (iii) While using hacksaw, the blade should not be tightened too much, otherwise there are chances that it would break.
- (iv) Never use a new machine, whose function and operation is not known too you else it may damage the machine.
- (v) As far as possible gears of a running machine should not be changed nor these should be touched.
- (vi) In case of sudden failure of electricity, machine should be switched off.
- (vii) no machine should be given more than the load fixed for its operation.
- (viii) For heavy jobs special arrangement should be made with machines.

**Standard Norms**

This system is being followed in several field. This British system is known as F.P.S . The Government of India realized the importance of easy measurement

and weight system and entrusted the job of framing new system to Indian standards Institute. The I.S.I approved the C.S.S system.

F.P.S System:- This system remained prevalent in India and several other countries, In this system, foot, pound and second was used that is why it is named as F.P.S system, for measuring length, units of Inch, foot, yards and mile are used. For weighing purposes, dram, ounce and pound units are used. For measurement of time, units of second, minute and hours are used. This system was evolved by the British standard Institute and as such it is also known as B.S.I system.

### **Units of Measurement of Length**

8 Gauges	=	1 inch
12 inch	=	1 Foot
3 foot	=	1 yard
220 yards	=	1 furlong
8 Furlong or	=	1 mile
1760 yards		

### **Units of Weight Measurement**

16 dram	=	1 ounce
16 ounce	=	1 pound
28 pound	=	1 quarter
4 quarter	=	1 hundred weight
20 hundred wt	=	1 ton

### **Measurement of Capacity**

4 gills	=	1 Pint
2 pint	=	1 quarter
4 quarter	=	1 gallon

### **Other Units**

8 Rati	=	1 Masha
12 Masha	=	1 Tola
5 Tola	=	1 Chhatank
16 Chhatank	=	1 seer
40 seer	=	1 Maund

Measurement of Time

60 seconds	=	1 Minute
60 minute	=	1 hour
24 hours	=	1 day

### **C.G.S System:-**

This system is also known as French or metric system. This is an international system for measurement and weighting physical things. The Indian standard institute has approved this system for adoption. under this system for measurement of length centimeter, for weight gram, and for time second have been taken as the basis, under C.G.S system the following units are used:

#### **Measurement of Length**

10 millimeters	=	1 centimeter
10 centimetres	=	1 decimeter
10 decimetre	=	1 meter
10 meter	=	1 decimeter
10 decimetre	=	1 hectometer
10 hectometre or 100 meters	=	1 kilometer

#### **Measurement Of Weight**

10 miligrams	=	1 centigram
10 centigtam	=	1 decigram
10 decigram	=	1 gram
10 grams	=	1 decagram
10 decagram	=	1 hecrogram
10 hecrogram	=	1 kilogram
100 kilogram	=	1 quintal
10 quintal	=	1 metric tonne

#### **Measurement of Capacity**

10 Mililitre	=	1 contilitre
10 contilitre	=	1 decilitre
10 decilitre	=	1 litre
10 litre	=	1 decalitre
10 decalitre	=	1 hectolitre
10 hectolitre	=	1 kilolitre

### **Measurement of Time**

60 second	=	1 minute
60 minutes	=	1 hour
24 hours	=	1 day
7 days	=	1 week
30 days	=	1 month
12 month	=	1 year
or 365 days.		

Apart from FPS system and CGS system, for measurement at large scale. Mks system is also prevalent in India. This system is almost similar to CGS system. For measuring length metre is used. For weighing things kilogram and for measuring time seconds unit is used.

### **Area Measurement (British System)**

144 sq inch.	=	1 sq.ft.
9 sq.ft.	=	1 sq.yard
4840 sq.yards	=	1 acre
640 acres	=	1 sq.mile

### **Area Measurement (Metric System)**

100 sq.milimeter	=	1 sq.centimeter
100 sq.centimetre	=	1 sq.decimetre
100 sq.decimetre	=	1 sq.meter
100 Sq.meter	=	1 acre
100 are	=	1 hectare
100 hectare	=	1 sq.kilometer

### **Measurement of Volume (British System)**

1728 Cubic inches	=	1 cubic ft.
27 cubic ft.	=	1 cubic yard

### Measurement of Volume (Metric System)

1000 cubic mm	=	1 cubic centimeter
1000 cubic cm	=	1 cubic decimeter
1000 cubic decimeter	=	1 cubic metre
1000 cubic metre	=	1 decametre
1000 decametre	=	1 cubic hectometer
1000 cubic hectometer	=	1 cubic kilometre

### Temperature and its units:-

Temperature indicates the level of heat of an article. organs of our body cannot measure the heat of the thing. if we put our finger in hot water and then put it into cool water, for this purpose a thermometer containing mercury is used. There are used as a scales between stages of temperature of an article. Normally Celsius (centigrade) and Fahrenheit thermometer are used. In centigrade thermometers the melting point at atmospheric pressure is 0 degree centigrade and the boiling point is at 100<sup>0</sup> centigrade. These degrees can be conveniently divided into equal parts. In the same way at atmospheric pressure in Fahrenheit thermometer, the melting point of ice is 32 degree F and boiling point of water is 212<sup>0</sup>F. These degrees are divided into equal parts and indicated on the thermometer.

Temperature Conversion Formula:-

From Centigrade to Fahrenheit

$$C^0 = 5/9 (F - 32)$$

From Fahrenheit to Centigrade

$$F^0 = 9/5 (C^0 + 32)$$