Introduction about training scheme & trade

Objectives: At the end of this lesson you shall be able to
- **explain above NCVT**
- **explain above various vocational training programme**
- **explain about refrigeration and airconditioning**
- **explain about qualities of good mechanic**
- **explain the history of refrigeration.**

We are the citizen of peaceful nation, out policy and economy is based on the method of peace itself. W all know we got the political freedom by fighting for number of years

At present we want to win the economical freedom, further we should develop a balanced economy and promote.

During second world war there was a high demand of technicians in defense services. In order to meet the sudden demand of technicians, in the year 1940 GOVT of India started the war TECHNICIAN TRAINING SCHEME.

we got the Independence on 15th August 1947. After the independence many of new factories have been expanded. Day by day production capacity increased in the country. To meet this demands there was a requirement of man power, not only a man power some industries of out country needed huge number of well doing SKILLED CRAFMENS' so, in the year 1950 Govt. of India started the CRAFTMEN SKILLED SCHEME on national basis. Latest to ensure the regular supply of skilled man power Govt. of India introduced number of various training schemes with the control of directorate general of employment and training (DGE&T) under the ministry of labour. Now it is DGT. The state Govt. are responsible for the administration and implementation of training scheme in industrial training institutes (ITI).

National council for a vocation training (NCVT)

In the year 1956 NCVT was set up by GOVT of India to maintain the uniformity in the standard of training in all the country.

It is an advisory body which will conduct the all INDIA TRADE TSET at the end of the course and this will award the **National Trade Certificates (NTC)** for the successful candidates.

Various vocational training programme

1 Craftsmen training scheme

2 Apprenticeship training scheme

3 Foreman training scheme

4 Craft instructor training programme

5 Advanced vocational training scheme etc...

Craftsmen training scheme

Craftsmen training scheme was introduced in 1950 the year with following objectives.

A To ensure a steady flow of skilled workers in different trades for industry.

B To reduce unemployment among the educated youth & to equipping them for suitable industrial employment.

C To raise the quality and quantity of industry production by systematic training of workers.

It is a basic skill training program under this scheme training is provided in 32 engineering trades and 44 non engineering trades to the youth in the age group of 15-25 years. The duration of the courses varies from 1 to 2 years minimum educational qualification is SSLC of equivalent and +2 for some trades.

Apprenticeship training scheme

Apprenticeship training scheme was introduced by the GOVT. of India the apprenticeship act was implemented in 1961 and it came into force with effect form 1/03/1962 and which was passed in Rajyasabha in 1971.

The objectives of this scheme is to

A To impact on the job training to the youth and to expose them into actual work environment of industry to meet the industrial needs.

B To work on the production jobs there by to gain confidence.

Mechanic refrigeration & air conditioning

Mechanic

A person who has through knowledge of.....

- Different types of equipment, Accessories and material used in the trade and their working.
- Identify the possible troubles, their causes and their remedy.
- Manipulate and handle the tools, equipments & materials, and chemicals used for manufacturing, installing, Maintaining, servicing, repairing in the trade.
- Independently diagnose troubles and carry out repairs.
- Adopting safety precautions and first aid and many more.

Refrigeration

Refrigeration is the method of producing cold or refrigeration is an artificial method of removing heat.

More specifically refrigeration may be defined as that the branch of science, which deals with process of reducing and maintaining their temperature of the space or product below the temperature of the surrounding.

Air conditioning

Air conditioning is the simultaneous control of the following four factors.

1 Temperature

2 Humidity

3 Air motion

4 Purity of air

Temperature

Human body feels comfortable when air is at 22° C. If the outside air is hot the air conditioning system should reduce the temperature by removing heat and if the outside air is cold it should increase the temperature, maintain desired temperature in all conditions.

Humidity

The moisture contents of air should be increased or decreased to suit the requirement in the conditioning space. The human body feels comfortable when the humidity is between 40 to 60%.

Air motion

Air should be maintained at proper velocity is in the conditioned space for proper distribution to feel comfortable.

Purity of air

For human comfort air should be free from dust and other impurities, therefore air should be filtered cleaned and purified before allowing into the conditional space.

Qualities of good mechanic

A good mechanic should have the following qualities.

1 Educational qualification

a Should have a government -recognized diploma or certificate.

b Must have undergone through practical training.

2 Mastery over his/her trade

Should have through knowledge of

- Various types of function and correct usage of tools, instruments, equipments and accessories.
- Behavior of gases and chemical used in the trade.
- Major hazards like explosion. Fire and effects of gases.
- Proper use of fire extinguishers.
- Electricity and its behavior.
- Safety precaution and first aid.
- Possible troubles that may latest development in the trade.

3 Personality characteristics

- Should maintain sound health and good physique.
- Should wear proper dress suitable to his work.

a **Alertness:** Ability to aware of things happening around.

b **Wisdom:** Combination of knowledge and experience.

c **Human Relation:**

- Impartiality
- Patience
- Courtesy
- Loyalty
- Self control

Development of refrigeration

Modern refrigeration has much application. The first and probably still the most important of food.

Most food kept at room temperature spoil rapidly. This is due to the rapid growth of bacteria. At common refrigeration temperatures of about 39°F (4°C), bacteria growth quite slowly. Food at this temperature will keep much longer. Refrigeration preserves food by keeping it in cold. Other important uses of refrigeration include air conditioning, beverage cooling, and humidity control. Many manufacturing process also use refrigeration.

The refrigeration industry became important commercially during the 18th century. Early refrigeration was obtained by use of ice. Ice from lakes and ponds was cut and stored in the winter in insulated store rooms for summer use.

The use of natural ice required building insulated container or iceboxes.

Ice was first made artificially about 1820 as an experiment. Jacob Perkins, an American engineer invented the machine which led to our modern compression systems. Michael Faraday discovered the principles for the absorption type of refrigeration as early in 1824. It was not actually built until 1855 by a German engineer.

During 1890, a warm winter resulted in shortage of natural ice. This help start the mechanical ice making industry.

Mechanical domestic refrigeration first appeared about 1910. J.M. Larsen produced a manually produced household machine in 1913. By 1918 kelvinator produced the first automatic refrigerator for the American market. They sold 67 machines that year.

The first of the sealed or “hermetic” automatic refrigeration units was introduced by General Electricity in 1928. It was named the Monitor Top.

Beginning with 1920, domestic refrigeration became an important in industry. The Electrolux, which was an automatic domestic absorption unit, appeared in 1937.

Fast freezing to preserve food for extended periods was developed about 1923. This marked the beginning of modern frozen foods industry. Automatic refrigeration unit, for the comfort cooling parts of air conditioning appeared in 1927.

Mechanical refrigeration systems were first connected to heating plants to provide summer cooling in the late 1920s. by 1940, practically all domestic units were of the hermetic type. Commercial units had also been successfully made and used. These units were capable of refrigerating large commercial food storage systems. They could provide comfort cooling of large auditoriums. That could also produce low temperatures used in may commercial operations.

In 1935, Frederick McKinley Jones produced an automatic refrigeration system for lonhaul trucks. From a small, slow start in the late 1930d, air conditioning of automobiles has also grown rapidly.

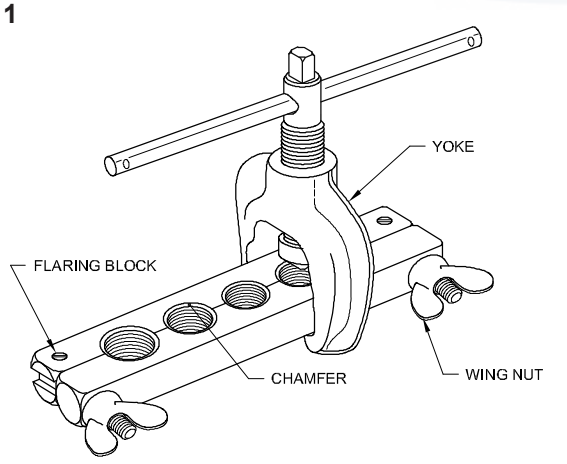
Starting in the 1960s, the home air conditioning market experienced tremendous growth. Energy was in expensive, and therefore, simple air conditioning became common in many homes. Solar energy and other alternative energy sources became additional sources for powering heating and cooling system.

Due to tremendous growth in technology, by 1990 all areas of refrigeration and air conditioning were using microprocessor control systems. The purpose of this system is to increase reliability and efficiency of the heating and cooling units. By 1990, the automobile air conditioner became as standard as the automatic transmission.

Flaring tool with yoke (Fig 1) : It is used for making of different sizes of flares of copper tubes. It has two parts.

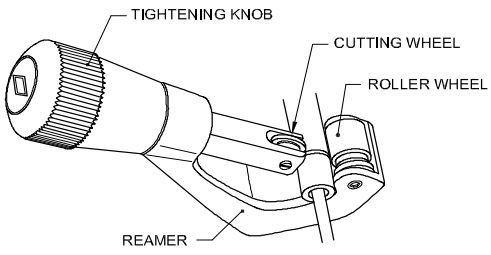
Flaring block and yoke. Flaring block consists of two parts in which forming holes of different size or tubing. These parts are clamped together with using nut and bolts. The face of each hole is cut out 45° angle sheet. To produce a flare die or cone in yoke rotate against the flare sheet.

Fig 1



Tube cutter (Fig 2) : Small diameter annealed (soft) copper tubes are used in most refrigeration work. Tube cutter is used to cut these tubes. It consists of a 'V' block against which the tube rests and an adjustable round blade of carbon steel which cuts the tube. After placing the tube in 'V' block blade is adjusted and tube cutter is revolved the tube and cut the tube. Some tube cutters are equipped with a Reamer for removing the burr at the cutting end of the tube. Its size depends upon the maximum diameter of the tube which it can cut.

Fig 2

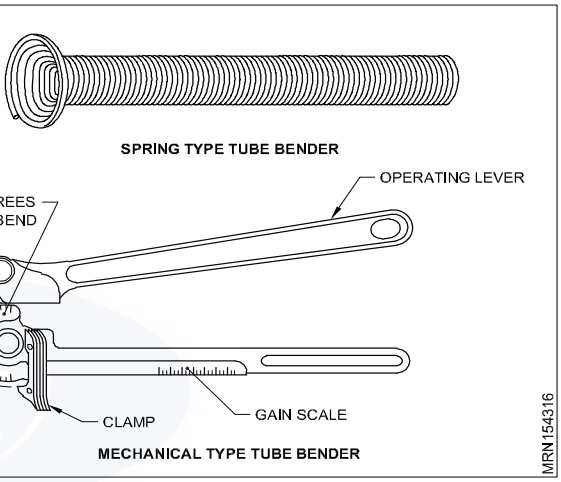


BUILTIN TYPE TUBE CUTTER

Pipe bending tool (Fig 3) : There are External coil spring bending tools where the external spring is designed to be used near the ends of tubes.

A lever type tube bender is used to form bends neatly and accurately with out buckling the tubing. These tools will form bends up to 180° in the continuous operation. The forming wheel is calibrated to show the degree of bend attained. Each of these tools is used with one size of bending.

Fig 3

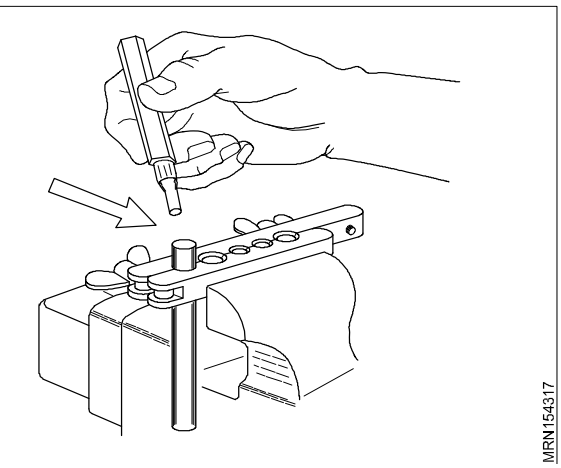


MECHANICAL TYPE TUBE BENDER

Swaging tools (Fig 4) : Swaging is a means of shaping copper tubing so that operation is accomplished with a punch type or screw type swaging tool. The tubing is clamped into the flaring block and the specially designed punch is hammered into the tubing, swaging or expanding the end. So that it will fit over the end of another piece of tubing.

Pinching tools: It is used for sealing or closing the diameter of copper tubes. It consists of two bars forming jaws and holes of various sizes and are clamped together with using nuts and bolts. The tube is pinched off both the two jaws.

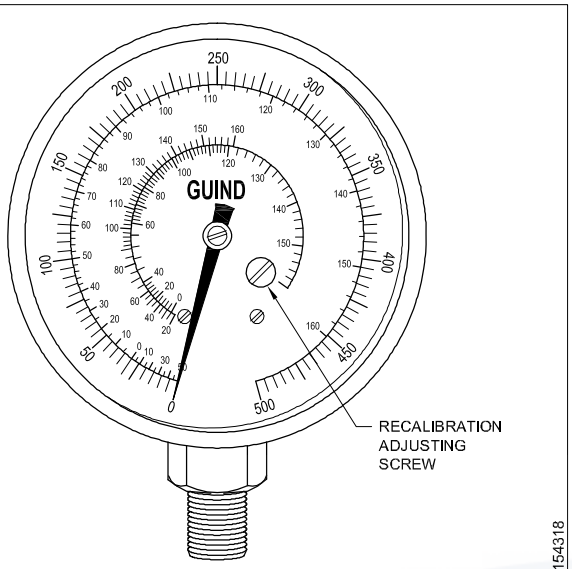
Fig 4



Pressure gauges (Figs 5 &6) : It is used to check the pressure of the refrigerant in refrigeration unit. There are high pressure vacuum and compound gauges.

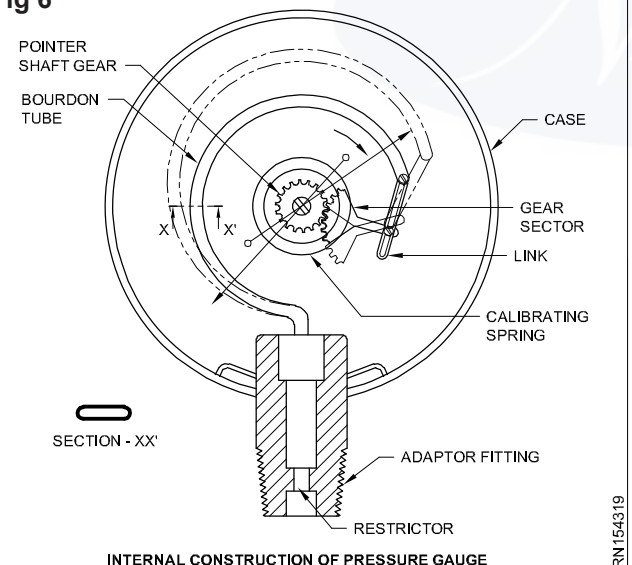
A pressure rise in Bourdon tube makes it tend to straighten. This movement will pull on the link, which will turn the gear sector counter clockwise. The pointer shaft will then turn clockwise to move the needle. Most popular gauges have a 2½" dial and are connected into refrigeration system with 1/8" male pipe thread.

Fig 5



PRESSURE GAUGE

Fig 6



INTERNAL CONSTRUCTION OF PRESSURE GAUGE

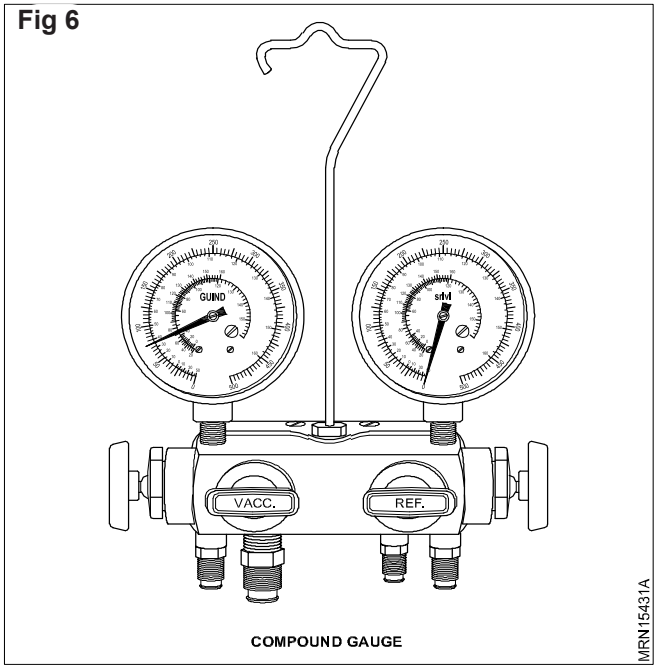
Compound gauge (Fig 7) : It measure both pressure and vacuum. It is usually calibrated from 0 to 30 Hg and from 0 to 200 PSIG.

Thermometer (Fig 8) : The most common Thermometer scales are Celsius or Centigrade scale, and Fahrenheit. The two temperature determine the calibration of Thermometer.

– the temperature of melting ice

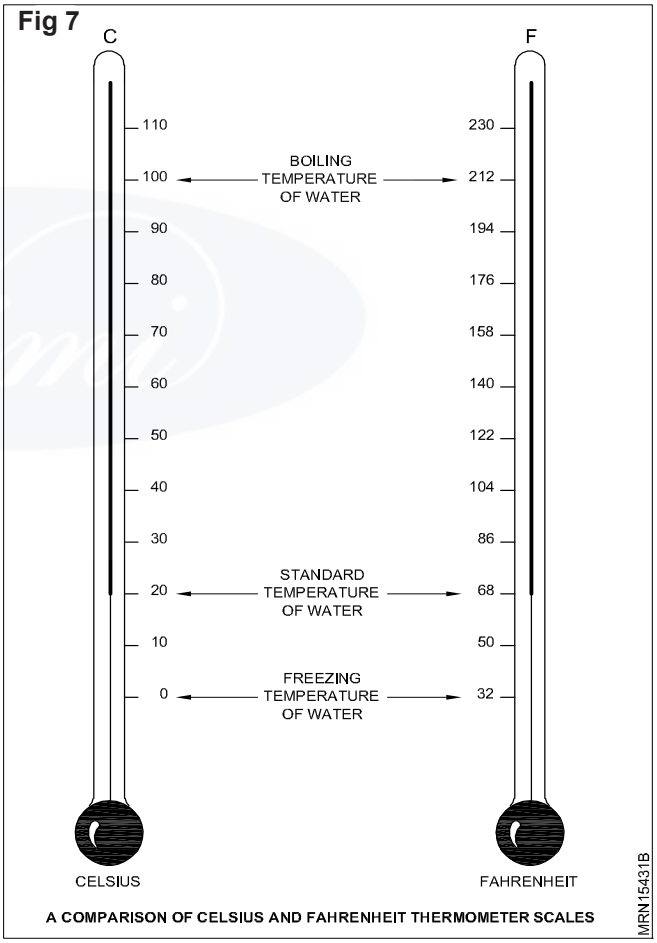
– the temperature of boiling point

Fig 6



COMPOUND GAUGE

Fig 7

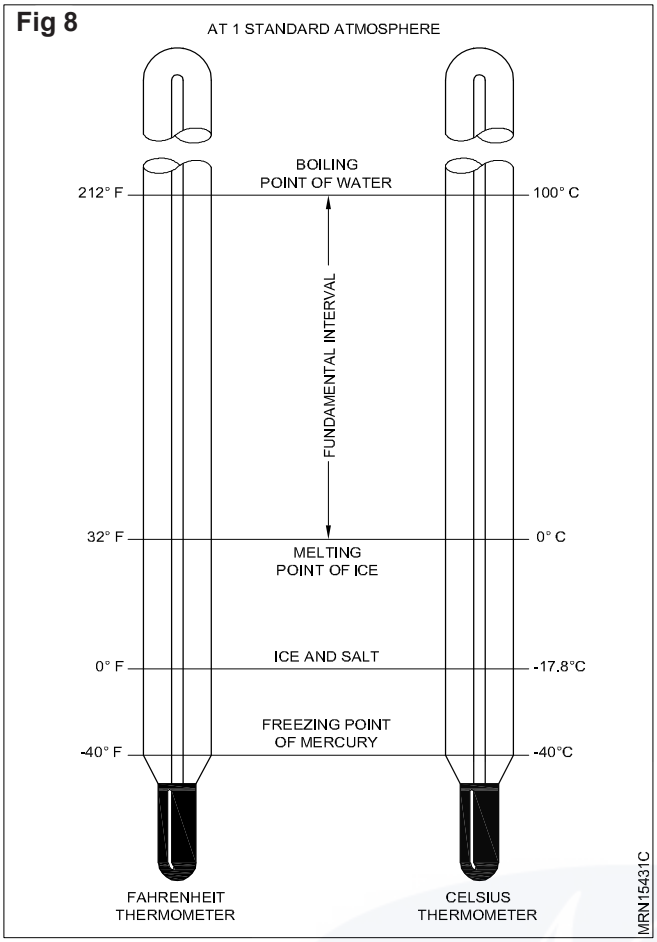


A COMPARISON OF CELSIUS AND FAHRENHEIT THERMOMETER SCALES

On Centigrade Thermometer the temperature of melting ice or the freezing temperature of water is 0°C. The temperature of boiling water is 100°C. There are 100 spaces or degrees on the scale between freezing and boiling.

On Fahrenheit Thermometer, the temperature of melting ice or freezing temperature of water is 32°F. The temperature of boiling water is 212°F. This provide 180 spaces or degrees between the freezing and boiling temperature. (Fig 9).

Fig 8



Leak detects

Soap bubble method: Clean all the joints with piece of dry cloth and soap solution is applied around all joints and supported place and leakage place given out bubbles.

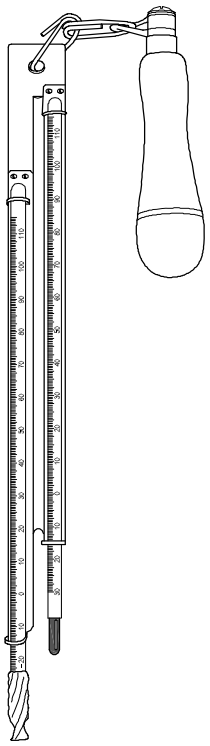
Halide torch method: In thin carbon element is heated by hydrocarbon flame in the Halide torch. The rubber tube in the torch extracts air on the element when flame burn. To find leak this tube is slowly moved on outside joint of the system, fittings at that slightest change in colour. If the flame colour become a very pint green, a small leak is indicated.

This flame will be green when large leak are encountered.

Electronic detector: The latest and most sensitive leak detector is an electrically operated electronic leak detector. It consists of control unit and probe.

The control unit incorporates an amplifier, a halogen sensitive element and air pump. The probe consists of plastic nozzle with transparent tip and a lamp. The probe is connected to the control unit with flexible tube and electric wires for a lamp.

Fig 9



SLING PSYCHROMETER

MRN15431D

To test the leaks, the probe is moved slowly along a tube or component around which leak is suspected. A signal is generated which causes the lamp in the probe to light, thus refrigerant leak is indicated and located.

Gauge manifold: These are arranged for one suction and one discharge gauge. Either three or four flared connections for lines from the vacuum pump, refrigerant cylinder and appliance are to be tested.

Sling psychrometer: Relative humidity is measured by an Instrument known as the Sling Psychrometer. This instrument consists of two ordinary Thermometer; securely fastened in a frame which is attached by chain. By means of this chain the instrument can be rapidly whirled around so that it comes in contact with maximum amount of air. Around the bulb of one Thermometer is a wick cloth which dampered with water when taking a reading.

The theory of the instrument is simply that the evaporation of moisture from the bulbs of the wet thermometer causes it to read lower than the one which is dry.

The rate of evaporation depends directly on the amount of moisture in the air at the time the test is made. The difference in the readings of the two thermometer enables one to find the relative humidity.

Tachometer, vacuum pump and air compressor

Objectives: At the end of this lesson you shall be able to

- **explain the necessary part, function and application of tachometer**
- **explain the necessary part, and function of vacuum pump**
- **explain the necessary part, and function of air compressor.**

Tachometer (Fig 1)

Necessary part

– Head spindle – Speed selector

– Pointer lock Sbutton – Speed scales

Function of Tachometer

Measurement of speed: Speed is defined as a scalar quantity. Electricians must know how to measure the speed of rotating electrical machines. The speed of rotating machines is measured in two ways.

- Direct method (contact method)
- Indirect (non-contact) method

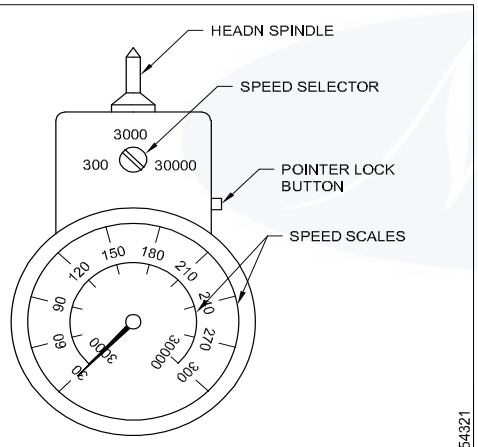
In practice both the methods are being used by electricians.

In the direct method two types of instruments as stated below are used for measuring speeds.

- Revolution counter and stop watch
- Tachometer

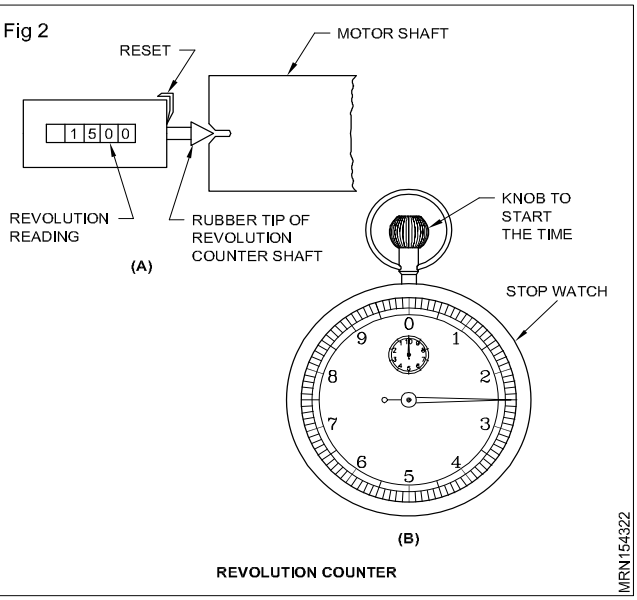
Revolution counters: Revolution counters are of two types; one is a dial type counter which is an earlier version and has become obsolete (Fig 1). The other type is a digital counter which is shown in (Fig 2). The spindle of the counter which is provided with a conical rubber bush is placed in the countersunk portion of the machine shaft for measuring speed. The revolution counter counts the number of revolutions as long as its rubber brush is in contact with the shaft. To get the revolution per minute, it is necessary to have a timing device.

Fig 1



TACHOMETER

Fig 2



REVOLUTION COUNTER

Hence to measure the speed of the rotating shaft with the revolution counter, a stop watch is also necessary. Just when the rotation of the shaft speed is transferred through friction to the counter, the stop watch begins to tick. Both the revolution counter and the stop watch are stopped at the same time and the number of revolutions indicated in the counter per minute gives the speed of the shaft in r.p.m. The accuracy of this method is not very great, as human reflexes are involved.

The second instrument used for direct measurement of speed is a tachometer as shown in (Fig 3). The speed is directly shown by a needle over a calibrated dial.

The tachometer is used in the same way as that of the revolution counter except that a stop watch is not required.

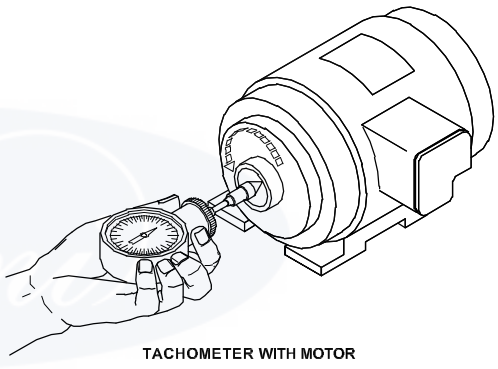
Applications: Tachometers are of two types

– Analog type

– Digital type

Both are employed to measure the speed of the compressor motor, pump motor, fan motor and other revolving parts. Knowing the RPM of the motor we can easily judge the efficiency of the motor.

Fig 3



TACHOMETER WITH MOTOR

Parts and function of vacuum pump (Fig 4)

– vacuum pump

– vacuum hose

Function of vacuum pump: Conventional and high vacuum type have been discussed earlier and both are available in portable sets suitable for site work. Not that high vacuum models use a special high quality paraffin based oil. Its vapour pressure at 37.7°C (100°F) is no more than 0.005 mm (5 micron) and a vacuum pump cannot pull a total absolute pressure less than the vapour pressure of its sealing oil.

High vacuum gauges: These are the electronic type as shown in (Fig 5). The range covered should be 20 mm to zero enabling unit pressure to be watched through out the dehydration process which starts at approx. 21°C (70°F).

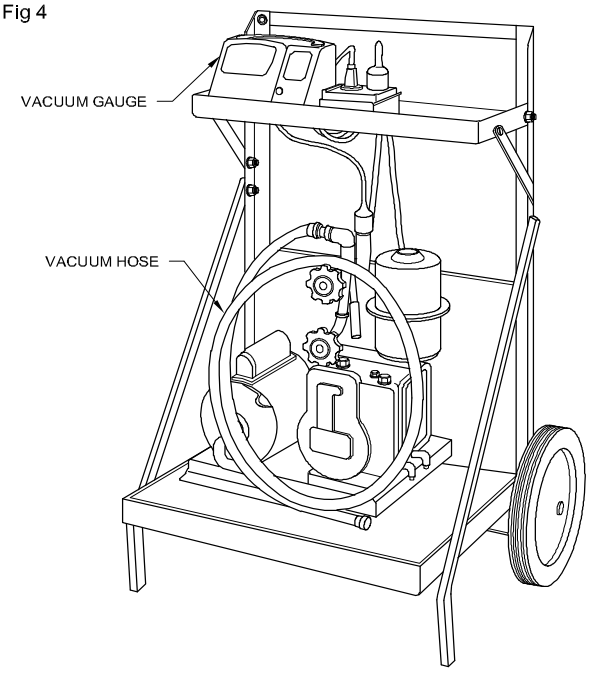
Application: The vacuum pump is used in our refrigeration system every unit before gas charging vaccumizing of system. After vacuum we charge gas in system.

Parts of air compressor

– vacuum gauge

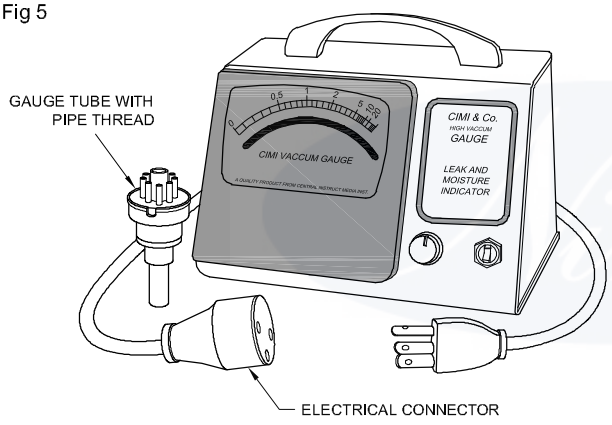
– vacuum hose

Fig 4



PORTABLE HIGH-VACUUM PUMP

Fig 5



HIGH-VACUUM GAUGE

Function of air compressor (Fig 6)

Air compressor: An air compressor is used for various purposes in auto garages like washing, greasing and cleaning of the vehicle and the auto parts and inflate tyres.

Compressor main parts

Reservoir: A tank for storage of air

Motor: Drives the engine (compressor)

Compressor: Sucks air from the outside (atmosphere) compresses and fills up the reservoir at a higher pressure.

Pressure gauge: It shows the pressure of the stored air in the reservoir

Safety device: It is a safety device for the reservoir. A release pressure valve is provided to protect the air reservoir from bursting. When the air pressure in the reservoir exceeds the specified limit the safety valve opens and releases the excess pressure.

Drain plug: The moisture in the air when compressed condenses into water and this will accumulate in the reservoir. It must be drained through the drain plug periodically to prevent corrosion of the tank.

Care and maintenance: The recommended grade of oil should be used.

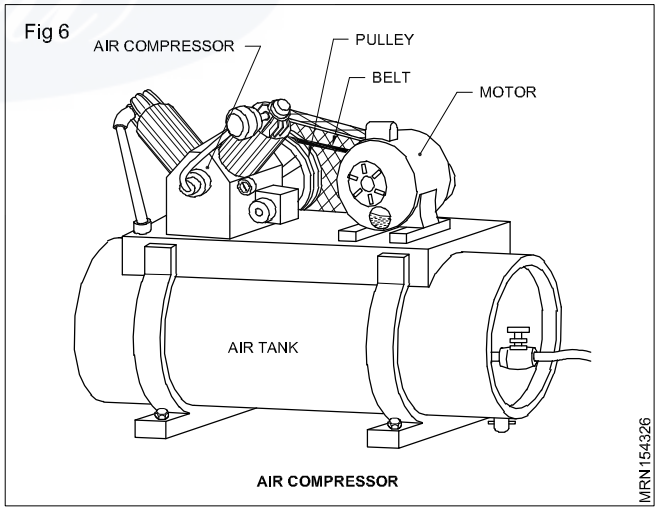
The level of the oil should be maintained at specified mark shown on the dip stick.

Ensure that the belt guards are fitted properly. Ensure that the drive belts are in good condition and their tension is correct.

Application of air compressor

– It is used to test the leakage by building up pressure
– It is used to flush the refrigeration A/C systems
– Also use in choke system we clear to the pressure of system
– In a spray painting a unit cabinet uses air compressor.

Fig 6



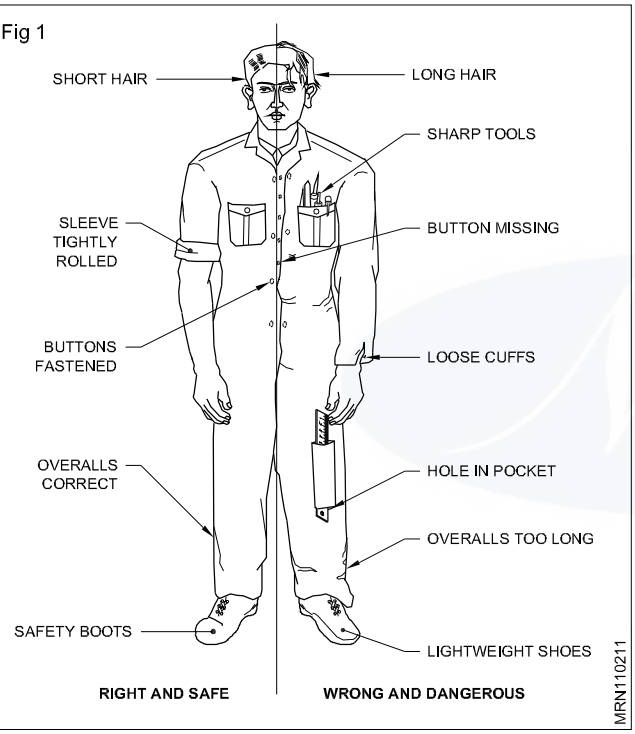
AIR COMPRESSOR

Safety & Guidelines for good shop floor maintenance

Objectives: At the end of this lesson you shall be able to
- **state the importance of safety**
- **list out and explain the safety precautions to be observed in a work shop**
- **list the benefits of a shop floor maintenance**
- **state what is 5S**
- **list the benefits of 5S.**

Generally accidents do not happen; they are caused. Most accidents are avoidable. A good craftsman, having a knowledge of various safety precautions, can avoid accidents to himself and to his fellow workers and protect the equipment from any damage. To achieve this, it is essential that every person should follow safety procedure. (Fig 1)

Fig 1



Safety in a workshop can be broadly classified into 3 categories.

- General safety
- Personal safety
- Machine safety

General safety

1 Keep the floor and gangways clean and clear.

2 Move with care in the workshop, do not run.

3 Don't leave the machine which is in motion.

4 Don't touch or handle any equipment/ machine unless authorised to do so.

5 Don't walk under suspended loads.

6 Don't cut practical jokes while on work.

7 Use the correct tools for the job.

8 Keep the tools at their proper place.

9 Wipe out split oil immediately.

10 Replace worn out or damaged tools immediately.

11 Never direct compressed air at yourself or at your co-worker.

12 Ensure adequate light in the workshop.

13 Clean the machine only when it is not in motion.

14 Sweep away the metal cuttings.

15 Know everything about the machine before you start it.

Personal safety

1 Wear a one piece overall or boiler suit.

2 Keep the overall buttons fastened.

3 Don't use ties and scarves.

4 Roll up the sleeves tightly above the elbow.

5 Wear safety shoes or boots or chain.

6 Cut the hair short.

7 Don't wear a ring, watch or chain.

8 Never lean on the machine.

9 Don't clean hands in the coolant fluid.

10 Don't remove guards when the machine is in motion.

11 Don't use cracked or chipped tools.

12 Don't start the machine until
- the work piece is securely mounted
- the feed machinery is in the neutral
- the work area is clear.

13 Don't adjust clamps or holding devices while the machine is in motion.

14 Never touch the electrical equipment with wet hands.

15 Don't use any faulty electrical equipment.

16 Ensure that electrical connections are made by an authorised electrician only.

17 Concentrate on your work. Have a calm attitude.

18 Do things in a methodical way.

19 Don't engage yourself in conversation with others while concentrating on your job.

20 Don't distract the attention of others.

21 Don't try to stop a running machine with hands.

Machine safety

1 Switch off the machine immediately if something goes wrong.

2 Keep the machine clean.

3 Replace any worn out or damaged accessories, holding devices, nuts, bolts etc as soon as possible.

4 Do not attempt operating the machine until you know how to operate it properly.

5 Do not adjust tool or the work piece unless the power is off.

6 Stop the machine before changing the speed.

7 Disengage the automatic feeds before switching off.

8 Check the oil level before starting the machine.

9 Never start a machine unless all the safety guards are in position.

10 Take measurements only after stopping the machine.

11 Use wooden planks over the bed while loading and unloading heavy jobs.

12 Safety is a concept, understand it. Safety is a habit, cultivate it.

Benefits of a shop floor maintenance

Some of the benefits which may be derived from the utilization of a good Shop Floor Maintenance are as follows:

- Improved Productivity
- Improved operator efficiencies.
- Improved support operations such as replenishment moves and transportation of work in process and finished goods.
- Reduction of scrap
- Better control of your manufacturing process
- More timely information to assist shop floor supervisors in managing their assigned production responsibilities.
- Reduction of down time due to better machine and tool monitoring.
- Better control of Work In Progress inventory, what is and where it is improved on time schedule performance.

5S Concept

5S is a Japanese methodology for works place organisation. In Japanese it stands for

1 Seiri (SORT),

2 Seiton (SET)

3 Seiso (SHINE)

4 Seiketsu (STANDARDIZE)

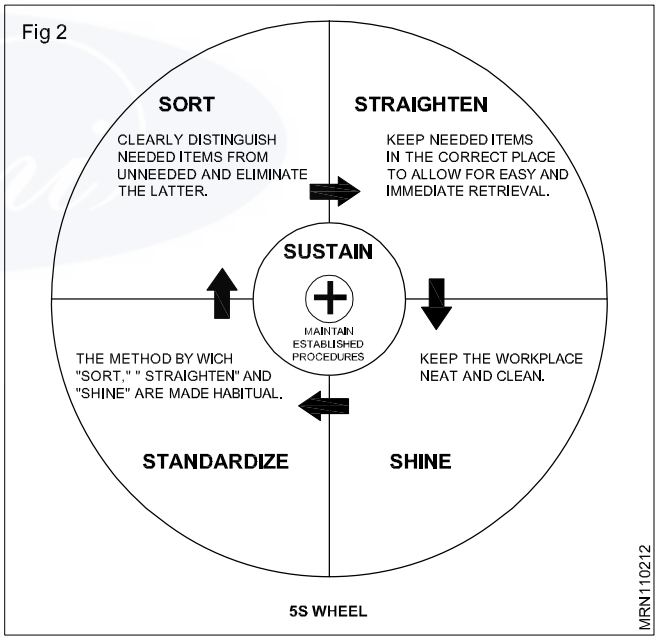
5 Shitsuke (SUSTAIN).

The list describes how to organize a work space for efficiency and effectiveness by identifying and storing the items used, maintaining the area and items, and sustaining the new order.

The Benefits of the 5s system

- Increases in productivity
- Increases in quality
- Reduction in cost

Fig 2



5S WHEEL

Safety practice - fire extinguishers

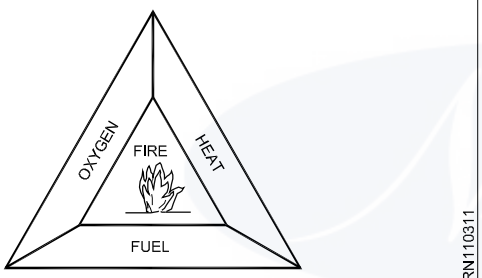
Objectives: At the end of this lesson you shall be able to
- **state the effects of a fire breakout**
- **state the conditions required for combustion relevant to fire prevention**
- **state the general precautionary measures to be taken for fire prevention**
- **distinguish different types of fire extinguishers**
- **determine the correct type of fire extinguisher to be used based on the class of fire**
- **describe the general procedure to be adopted in the event of a fire.**

Fire is the burning of combustible material. A fire in an unwanted place and on an unwanted occasion and in uncontrollable quantity can cause damage or destroy property and materials.

Fires injure people, and sometimes, cause loss of life. Hence, every effort must be made to prevent fire. When a fire outbreak is discovered, it must be controlled and extinguished by immediate correct action.

Is it possible to prevent fire? Yes, by eliminating anyone of the three factors that cause fire. (Fig 1)

Fig 1



The factors that must be present in combination for a fire to continue to burn are as follows.

Fuel Any substance, liquid, solid, or gas will burn if given oxygen and high enough temperature.

Heat Every fuel will begin to burn at a certain temperature. Solids and liquids give off vapour when heated and it is this vapour which ignites. Some liquids give off vapour even at normal room temperature say 15°C, eg. petrol.

Oxygen Usually it exists in sufficient quantity in air to keep a fire burning.

EXTINGUISHING OF FIRES

Isolating or removing any of these factors from the combination will extinguish the fire. There are three basic ways of achieving this.

- Starving the fire of fuel by removing the fuel in the vicinity of fire.
- Smothering - i.e. by isolating the fire from the supply of oxygen by blanketing it with foam, sand etc.
- Cooling - i.e. by using water to lower the temperature..

Preventing fires

Most of the fires could be prevented with more care and by following some rules of simple common sense.

- Accumulation of combustible refuse (cotton waste soaked with oil, scrap wood, paper, etc.) in odd corners are of fire risk. Refuse should be removed to collection points.

The cause of fire in electrical equipment is misuse or neglect. Loose connections, wrongly rated fuses or cables, overloaded circuits cause over heating which may in turn lead to fire. Damage to insulation between conductors in cables also causes fire.

Clothing and anything else which might catch fire should be kept well away from heaters. Make sure the heater is shut off at the end of a working day.

Highly flammable liquids and petroleum mixtures (Thinner, Adhesive solutions, Solvents, Kerosene, Spirit, LPG Gas etc.) should be stored in a separate place called the flammable material storage area.

Blow lamps and torches must not be left burning when they are not in use.

Classification of fires and recommended extinguishing agents.

Fires are classified into four types in terms of the nature of fuel.

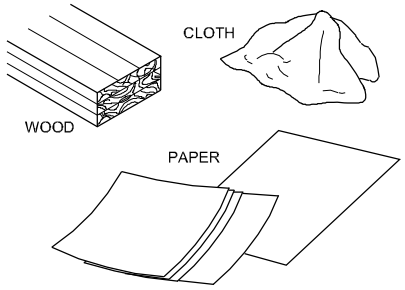
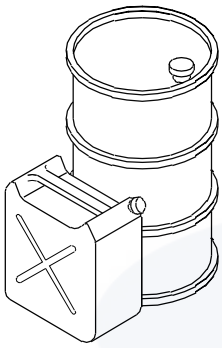
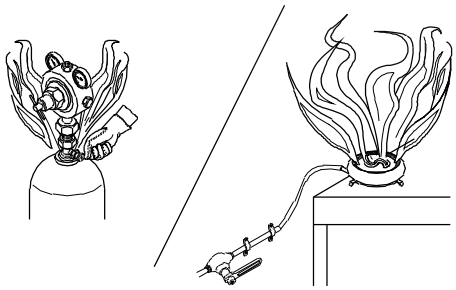
- ` Class A Fire
- Class B Fire
- Class C Fire
- Class D Fire

Different types of fire have to be dealt with different ways and with different extinguishing agents.

An agent is the material or substance used to put out the fire, and is usually (but not always) contained in a fire extinguisher with a mechanism for spraying into the fire.

It is important to know the right type of agent for a particular type of fire; using the wrong one can make things worse.

There is no classification for 'electrical fires' as such, since these are only fires in materials where electricity is present.

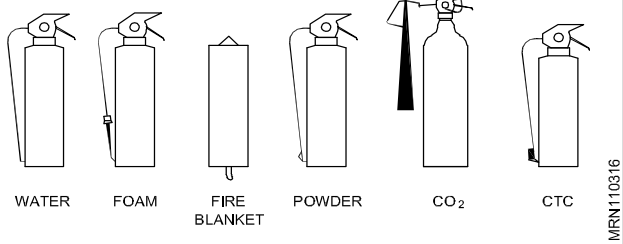
Fuel		Extinguishing
CLASS 'A' Fire	Wood, paper, cloth etc. Solid materials. 	Most effective i.e. cooling with water. Jets of water should be sprayed on the base of the fire and then gradually upwards.
CLASS 'B' Fire	Flammable liquids & liquifiable solids 	Should be smothered. The aim is to cover the entire surface of the burning liquid. This has the effect of cutting off the supply of oxygen to the fire. Water should never be used on burning liquids. Foam, dry powder or CO_2 may be used on this type of fire.
CLASS 'C' Fire	Gas and liquified gas 	Extreme caution is necessary in dealing with liquified gases. There is a risk of explosion and sudden spreading of fire in the entire vicinity. If an appliance fed from a cylinder catches fire - shut off the supply of gas. The safest course is to raise an alarm and leave the fire to be dealt with by trained personnel. Dry powder extinguishers are used on this type of fire. Special powders have now been developed which are capable of controlling and/ or extinguishing this type of fire.
CLASS 'D' Fire	Involving metals 	The standard range of fire extinguishing agents is inadequate or dangerous when dealing with metal fires. Fire on electrical equipment. Carbon dioxide, dry powder and vapourising liquid (CTC) extinguishers can be used to deal with fires in electrical equipment. Foam or liquid (e.g. Water) extinguishers must not be used on electrical equipment under any circumstances.

Types of fire extinguishers

A fire extinguisher, flame extinguisher or simply extinguisher is an active fire protection device used to extinguish or control small fires, often in emergency situation. It is not intended for use on an out off control fire.

Many types of fire extinguishers are available with different extinguishing 'agents' to deal with different classes of fires. (Fig 6)

Fig 6

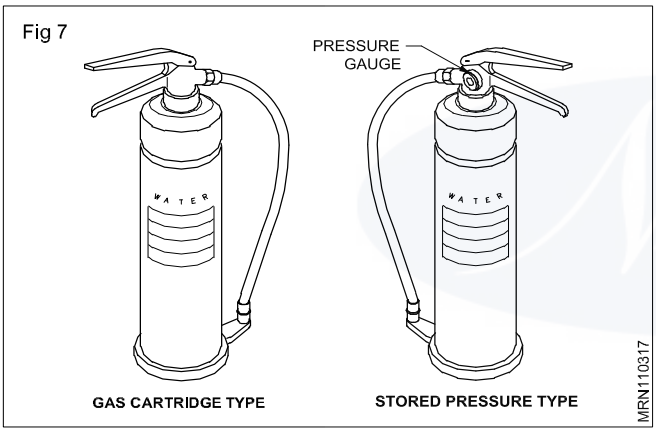


Water-filled extinguishers

There are two methods of operation. (Fig 7)

- Gas cartridge type
- Stored pressure type

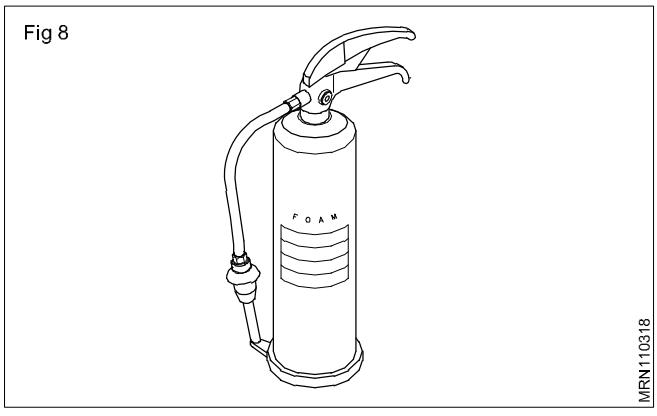
Fig 7



With both methods of operation the discharge can be interrupted as required, conserving the contact and preventing unnecessary water damage.

Foam extinguishers (Fig 8)

Fig 8



These may be of stored pressure or gas cartridge types.

Always check the operating instructions on the extinguisher before use.

Foam extinguishers are most suitable for:

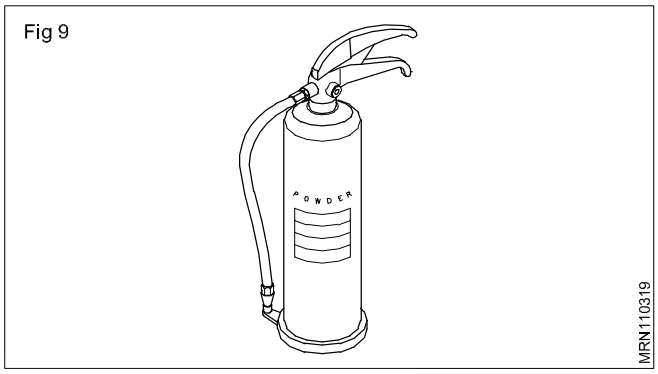
- flammable liquid fires
- running liquid fires

Must not be used where electrical equipment is involved.

Dry powder extinguishers (Fig 9)

Extinguishers fitted with dry powder may be of the gas cartridge or stored pressure type. Appearance and method of operation is the same as that of the water-filled one. The main distinguishing feature is the fork-shaped nozzle. Powders have been developed to deal with class D fires.

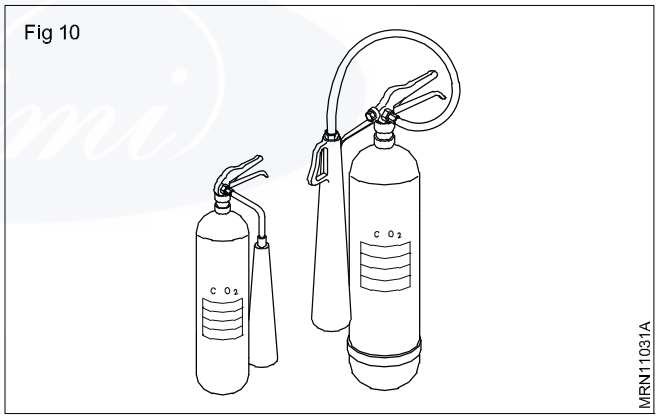
Fig 9



Carbon dioxide (CO_2)

This type is easily distinguished by the distinctively shaped discharge horn. (Fig 10)

Fig 10



Suitable for class B fires. Best suited where contamination by deposits must be avoided. Not generally effective in open air.

Always check the operating instructions on the container before use. Available with different gadgets of operation such as - plunger, lever, trigger etc.

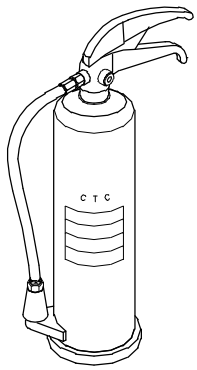
Halon extinguishers (Fig 11)

Theses extinguishers may be filled with carbon tetrachloride and bromochlorodifluoro methene (BCF). They may be of either gas cartridge or stored pressure type.

They are more effective in extinguishing small fires involving pouring liquids. These extinguishers are particularly suitable and safe to use on electrical equipment as the chemicals are electrically non-conductive.

The fumes given off by these extinguishers are dangerous, especially in confined space.

Fig 11



MRN11031B

General procedure to be adopted in the event of a fire to be adopted.

- Raise an alarm.
- Turn off all machinery and power (gas and electricity).
- Close the doors and windows, but do not lock or bolt them. This will limit the oxygen fed to the fire and prevent its spreading.
- Try to deal with the fire if you can do so safely. Do not risk getting trapped.
- Anybody not involved in fighting the fire should leave calmly using the emergency exits and go to the designated assembly point. Failure to do this may mean that some person is unaccounted for and others may have to put themselves to the trouble of searching for him or her at risk to themselves.

Personal Protective Equipment (PPE)

Objectives: At the end of this lesson you shall be able to
- **state what is personal protective equipment and its purpose**
- **list the conditions for selection of personal protective equipment**
- **define safety**
- **state the goal of occupational health and safety**
- **explain need of occupational health and safety**
- **state the occupational hygiene**
- **explain occupational hazards.**

Personal Protective Equipment (PPE)

Devices, equipments, or clothing used or worn by the employees, as a last resort, to protect against hazards in the workplace. The primary approach in any safety effort is that the hazard to the workmen should be eliminated or the workmen through the use of personal protective controlled by engineering methods rather than protecting the workmen through the use of personal protective equipment (PPE). Engineering methods could include design change, substitution ventilation, mechanical handling, automation, etc. in situations where it is not possible to introduce any effective engineering methods for controlling hazards, the workman shall use appropriate types of PPE.

As changing times have modernized the workplace, government and advocacy groups have brought more safety standards to all sorts of work environments. The Factories Act, 1948 and several other labour legislations 1996 have provisions for effective use of appropriate types of PPE. Use of PPE is very important.

Ways to ensure workplace safety and use personal protective equipment (PPE) effectively.

- Workers to get up-to date safety information from the regulatory agencies that oversees workplace safety in their specific area.
- To use all available text resources that may be in work area and for applicable safety information on how to use PPE best.
- When it comes to the most common types of personal protective equipment, like goggles, gloves or bodysuits, these items are much less effective if they are not worn at all times, or whenever a specific danger exists in a work process. Using PPE consistently will help to avoid some common kinds of industrial accidents.
- Personal protective gear is not always enough to protect workers against workplace dangers, Knowing more about the overall context of your activity can help to fully protect from anything that might threaten health and safety on the job.
- Inspection of gear thoroughly to make sure that it has the standard of quality and adequately protect the user should be continuously carried out.

Categories of PPE-Small's'

Depending upon the nature of hazard, the PPE is broadly divided into the following two categories.

Non- respiratory: Those used for protection against injury from outside the body, i.e. for protecting the head, eye, face, hand, arm, foot, leg and other body parts

Respiratory: Those used for protection from harm due to inhalation of contaminated air.

They are to meet the applicable BIS (Bureau of Indian Standards) standards for different types of PPE.

The guidelines on 'Personal Protective Equipment' is issued to facilitate the plant management in maintaining an effective programme with respect to protection of persons against hazards, which cannot be eliminated or controlled by engineering methods listed in table 1.

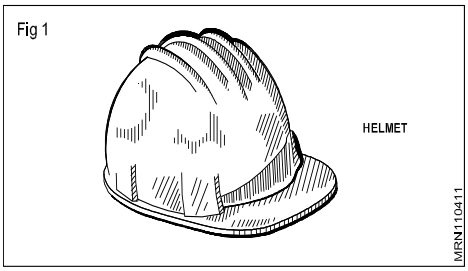
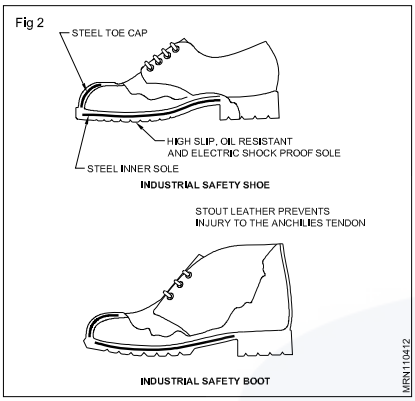
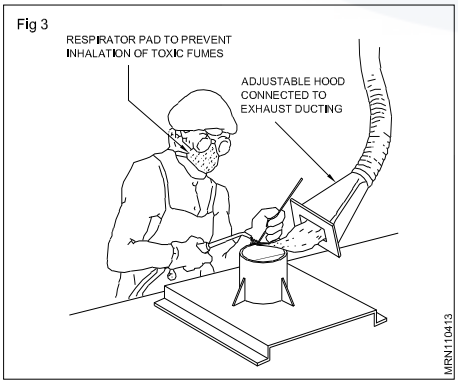
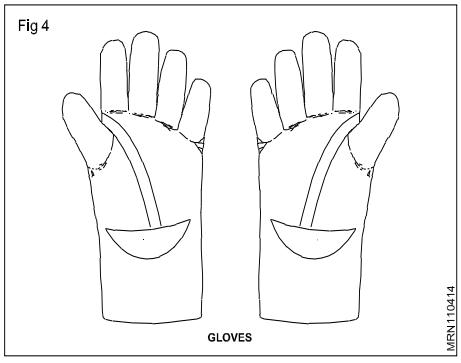
Quality of PPE's

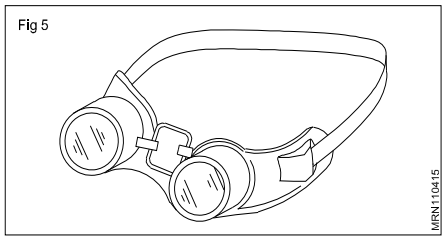
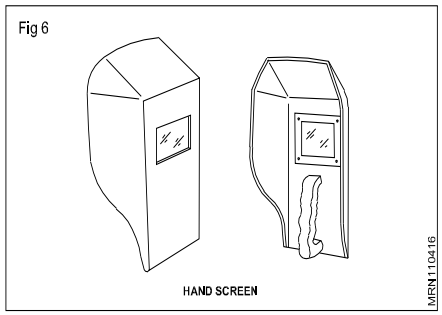
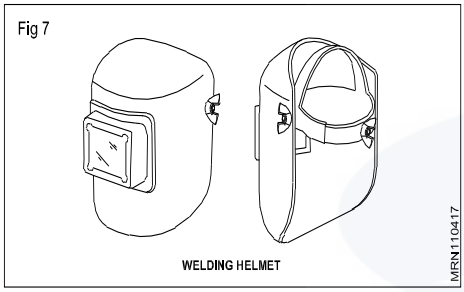
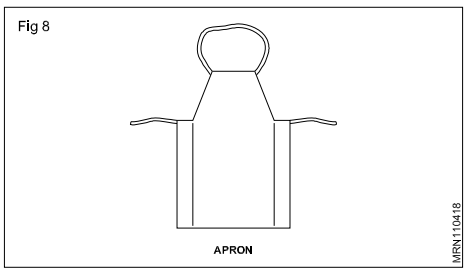
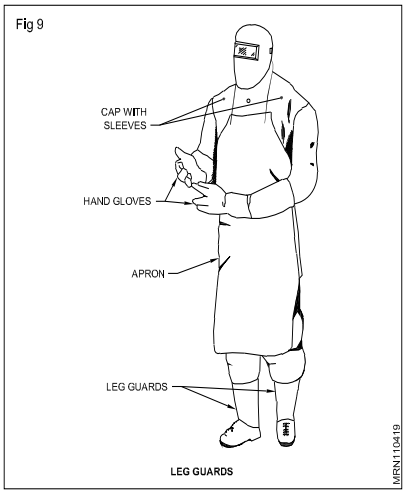
PPE must meet the following criteria with regard to its quality-provide absolute full protection against possible hazard and PPE's be so designed and manufactured out of materials that it can withstand the hazards against which it is intended to be used.

Selection of PPE's requires certain conditions

- Nature and severity of the hazard
- Type of contaminant, its concentration and location of contaminated area with respect to the source of respirable air
- Expected activity of workman and duration of work, comfort of workman when using PPE
- Operating characteristics and limitation of PPE
- Easy of maintenance and cleaning
- Conformity to Indian / International standards and availability of test certificate.

Personal protective equipments and their uses and hazards are listed in Table 2

Types of protection	Hazards	PPE to be used
Head protection (Fig 1) 	1. Falling objects 2. Striking against objects 3. Spatter	Helmets
Foot protection (Fig 2) 	1. Hot spatter 2. Falling objects 3. Working wet area	Leather leg guards Safety shoes Gum boots
Nose Protection (Fig 3) 	1. Dust particles 2. Fumes/gases/ vapours	Nose mask
Hand Protection (Fig 4) 	1. Heat burn due to direct contact 2. Blows spark moderate heat 3. Electric shock	Hand gloves

Types of protection	Hazards	PPE to be used
Eye protection (Fig 5 & Fig 6) Fig 5  MRN110415 Fig 6  HAND SCREEN MRN110416	1. Flying dust particles 2. UV rays, IR rays heat and High amount of visible	Goggles Face shield radiation Hand shield Head shield
Face protection (Fig 7) Fig 7  WELDING HELMET MRN110417	1. Spark generated during Welding, grinding 2. Welding spatter striking 3. Face protection from UV rays	Face shield Head shield with or without ear muff Helmets with welders Screen for welders
Ear protection (Fig 7)  Ear muffs Ear plug	1. High noise level	Ear plug
Body protection (Fig 8, & Fig 9) Fig 8  APRON MRN110418	1. Hot particles Fig 9  CAP WITH SLEEVES HAND GLOVES APRON LEG GUARDS LEG GUARDS MRN110419	Leather aprons

Proper use of PPEs

Having selected the proper type of PPE, it is essential that the workman wears it. Often the workman avoids using PPE. The following factors influence the solution to this problem.

- The extent to which the workman understands the necessity of using PPE
- The ease and comfort with which PPE can be worn with least interference in normal work procedures
- The available economic, social and disciplinary sanctions which can be used to influence the attitude of the workman
- The best solution to this problem is to make wearing of PPE' mandatory for every employee.
- In other places, education and supervision need to be intensified. When a group of workmen are issued PPE for the first time.

Occupational health and safety

Safety

Safety means freedom or protection from harm, danger, hazard, risk, accident, injury or damage.

Occupational health and safety

- Occupational health and safety is concerned with protecting the safety, health and welfare of people engaged in work or employment.
- The goal is to provide a safe work environment and to prevent hazards.
- It may also protect co-workers, family members, employers, customers, suppliers, nearby communities, and other members of the public who are affected by the workplace environment.
- It involves interactions among many related areas, including occupational medicine, occupational (or industrial) hygiene, public health, and safety engineering, chemistry, and health physics.

Need of occupational health and safety

- Health and safety of the employees is an important aspect of a company's smooth and successful functioning.
- It is a decisive factor in organizational effectiveness. It ensures an accident-free industrial environment.
- Proper attention to the safety and welfare of the employees can yield valuable returns.
- Improving employee morale
- Reducing absenteeism
- Enhancing productivity
- Minimizing potential of work-related injuries and illnesses
- Increasing the quality of manufactured products and / rendered services.

Occupational (Industrial) hygiene

- Occupational hygiene is anticipation, recognition, evaluation and control of work place hazards (or) environmental factors (or) stresses
- This is arising in (or) from the workplace.
- Which may cause sickness, impaired health and well being (or) significant discomfort and inefficiency among workers.

Anticipation (Identification): Methods of identification of possible hazards and their effects on health.

Recognition (Acceptance): Acceptance of ill-effects of the identified hazards

Evaluation (Measurement & Assessment): Measuring or calculating the hazard by Instruments, Air sampling and Analysis, comparison with standards and taking judgement whether measured or calculated hazard is more or less than the permissible standard.

Control of workplace hazards: Measures like Engineering and Administrative controls, medical examination use of Personal Protective Equipment (PPE) education, training and supervision.

Occupational hazards

"Source or situation with a potential for harm in terms of injury or ill health, damage to property, damage to the workplace environment, or a combination of these"

Types of occupational health hazards

- Physical Hazards
- Chemical Hazards
- Biological Hazards
- Physiological Hazards
- Psychological Hazards
- Mechanical Hazards
- Electrical Hazards
- Ergonomic Hazards

1 Physical hazards

- Noise
- Heat and cold stress
- Vibration
- Radiation (ionising & Non-ionising)
- Illumination etc.,

2 Chemical hazards

- Inflammable
- Explosive
- Toxic
- Corrosive
- Radioactive

3 Biological hazards

- Bacteria
- Virus
- Fungi
- Plant pest
- Infection

4 Physiological

- Old age
- Sex
- Ill health
- Sickness
- Fatigue.

5 Psychological

- Wrong attitude
- Smoking
- Alocoholism
- Unskilled
- Poor discipline
  - absentism
  - disobedience
  - aggressive behaviour
- Accident proneness etc,
- Emotional disturbances
  - violence
  - bullying
  - sexual harassment

6 Mechanical

- Unguarded machinery
- No fencing
- No safety device
- No control device etc.,

7 Electrical

- No earthing
- Short circuit
- Current leakage
- Open wire
- No fuse or cut off device etc,

8 Ergonomic

- Poor manual handling technique
- Wrong layout of machinery
- Wrong design
- Poor housekeeping
- Awkward position
- Wrong tools etc,

Safety Slogan

A safety rule breaker, is an accident maker