2

Electrical Safety

2.1 ELECTRIC SHOCK

2.1.1 Introduction

Though the electricity is very useful in bringing the human life very comfortable. But, it may be fatal, if not handled carefully. The human failure in handling the electrical components or repairing the distribution system without switching ‘off’ the supply, or not following the rules strictly, may cause severe problems, which may cause threat to the human life.

When a live conductor is touched by hand or any part of the body, current escapes through the body to earth. It may pass through the heart also. It is difficult to specify the exact voltage, which is likely to be fatal voltages below 100 volts may also cause a severe accident.

The result of electric shock on human body may be fatal due to:

(a) Fibrillation of heart, i.e., damaging the heart and causing the stopping of breathing.
(b) Stopping of breathing action caused by blockade in the nervous system causing respiration.
(c) Local over heating or burning of the body due to sparking.

Note: The fibrillation of the heart is the most serious cause of death and there is no cure, although there is a possibility of rescuing a man who has suffered by the causes mentioned above (b) and (c).

2.1.2 Electric Shock and its Effects

Frequency of Current

When the frequency is low, the electric shock is more severe and dangerous. This is the reason that direct current shock is most severe. Direct current does not vary and its full value passes through the body for the entire duration of contact. Alternating current varies and its value comes down to zero in every half cycle. At the time of zero value of the current, there is chance to detach the contact which lessen the damage to the human body.
4. Send for a doctor.
5. Observe the victim whether he is unconscious and breathing normally. If the victim is not breathing normally, start giving artificial respiration without any delay. Proper training and practice is needed to give artificial respiration. After achieving the consciousness, stimulants should be avoided unless advised by the doctor.

2.1.4 Cure of Electric Shock

“Think twice; act once, correctly and quickly.” In case, the victim becomes unconscious and stops breathing and his or her heart still beats, the most urgent and immediate cure for the victim is that he should be given artificial respiration in the proper manner. The step-by-step methods are described below and it should be continued until the victim starts breathing normally. It should be borne in mind that if the artificial respiration is stopped just after the victim recovers, he or she is liable to become unconscious again. In some cases, the artificial respiration is required for one or more hours. Since fresh air drawn into the lungs prevents the blood from becoming impure and will thus keep alive the sensitive brain cells.

2.1.5 Artificial Respiration

First Method

1. Lay the patient in a comfortable position on his stomach with his face to one side. Remove any obstruction from the patient’s mouth by freeing the neck from clothing and see that passage of his throat is clear. Remove false teeth, tobacco, if any from the mouth.
2. Kneel over him or at his side as may be convenient and place the palms of your hands flat on his back, with the thumbs nearly touching and the fingers spread out on each side of the body under the lowest side of the ribs.
3. With arms straight, lean forward gradually over the patient bringing the weight of your body to bear on the patient for about a second. Next release all pressure for about three seconds by swinging your body backward but without lifting your hands from the patient.
4. Repeat this application and relaxation of pressure as described above, without any marked pause between the movements at the rate of about 12 to 15 times per minute until natural breathing is restored.
5. Do not give up efforts to restore natural breathing, until the victim is pronounced to be safe by a doctor. There is every possibility that the victim may survive even after more than an hour of unconsciousness.
6. The patient should be kept warm with blankets or coats and hot water bottles, if available, should be applied to the feet.
7. Do not give any liquid until the patient is conscious.
tongue into the throat and blocking the air passage. But this can be prevented in the new technique if the victim’s head is tilted back.

**Artificial Resuscitator**

It is recommended to have artificial resuscitator in all the electrical installations and maintenance and repair personnel. Its main components are rubber balloon, a valve, a mouthpiece and tubing. During artificial respiration, the mouthpiece is cupped on the mouth of the patient. Air is pumped into the chest of the affected person by deflating the balloon. In the next step, the balloon is allowed to be released so that it gets inflated by entering the atmospheric air through valve. The balloon is deflated again. The process is required to be repeated till the affected person restores normal breathing. Artificial resuscitator is shown in the Figure 2.4.

What to do if the heart stops beating?

1. The following main points may be of great help in reviving heart stoppage due to drowning, choking or electric shock:

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**Fig. 2.3 A.** Modern mouth-to-mouth respiration (Step-I).

**Fig. 2.3 B.** Modern mouth-to-mouth respiration (Step-II).
2. Check for pulse, if no pulse is apparent, start working at once without waiting seconds in asking for equipment or help. The lack of sufficient oxygen carried in the blood to feed the brain may result in peril of any heart. The brain is the most sensitive tissue of the body.

3. Lay the patient face up on a solid bed or floor.

4. Tilt the head back.

5. Kneel on the body so that you can use your weight in applying pressure. Place the heel of your right hand on the breastbone with fingers spread and raised so that pressure is only on the breastbone not on the ribs.

6. Place your left hand on top of the right and press vertically downwards, firmly enough to depress the breastbone one to one and a quarter inch. The chest of an adult is resistant when he is conscious. It will be surprisingly flexible when he is unconscious.

7. Release the pressure immediately, lifting the hands slightly, and then repeat in a frequency of 60 to 80 thrusts per minute approximating the normal heart action.

8. If normal heartbeat and respiration has resumed, even then the patient should be shifted to hospital as soon as possible.

9. Continue the massage until you get professional medical aid for the patient. Also continue if possible, the mouth to mouth breathing until the patient is put on oxygen.

### 2.2 ELECTRIC SAFETY

#### 2.2.1 Introduction

“Electricity respects those who obey safety laws. Risk is not always apparent; be careful; take no chance”. Electricity has revolutionized our lives and level of livings but human errors are the causes of most electrical accidents. It comes with risk and becomes lethal if not handled properly. One should not forget that electricity and machines have no ‘feelings’ for men’s ‘failings’. Safety rules and codes must be religiously followed. Electrical faults occur due to various non-electrical causes such as mechanical, thermal, chemical and magnetic.

Electrical safety essentially embraces four aspects, namely:
- Safety of people and other living beings
- Safety of materials and premises
• Safety of devices and machinery
• Protection of electrical equipment and circuitry

2.2.2 Classification

The electrical safety is categorized into two broad areas:
• Indoor and
• Outdoor

Above each of both are again subdivided into:
• Low voltage and
• High voltage

The areas can further be classified as follows:
• Domestic: Electric fittings, appliances, toys, showpieces, etc.
• Industrial: Administrative building, plant, campus, and common amenities, etc.
• Public utility: Streetlights, gardens and playgrounds, railway-substations, etc.
• Public services: Water supply, firefighting, sanitations, etc.
• Business organizations: Offices, banks, etc.
• Educational institutions
• Commercial establishments: Shops, service centres, etc.
• Workshops
• Substations
• Generating stations
• Distribution lines
• Hospitals-Medical centres
• Theatres, Auditoriums
• Religious places: Temples, Churches, and Mosques, etc.
• Temporary connections: Festivals, functions, pilgrimages, trade fair, exhibitions, circus, etc.
• Electric traction

2.2.3 Safety Precautions for Indoor Installations

Human body is a good conductor of electricity. Following safety precautions must be followed to avoid the risk of injury, or even death:
1. Do not put on the switches with wet hands especially during monsoon season.
2. Do not build houses/slums below the high-tension lines.
3. Frayed wires should be replaced at once.
4. Repair any appliance immediately that sparks, emit smokes, or shocks you.
5. Train children not to put things into electrical outlets. Plastic outlet guards are a good idea.
6. Keep work areas clean. Oily rags, newspapers, and sawdust can catch fire from electric spark.
7. Use the cutout fuses of appropriate ratings. Always switch off the main switch before replacing a blown fuse.
8. The main distribution board should have separate MCB for power (heating) and lighting besides a common DP switch. Any minor job should be done only after main DP switch and MCB are switched off.
9. Always maintain the earth connection in a satisfactory condition. Safety depends upon good earthing.
10. Be aware of live wires or conductors.
11. Always ensure that single pole switch is connected to the live line and not to the neutral.
12. Never disconnect a plug point by pulling the flexible wire.

2.2.4 Safety Precautions for Outdoor Installations

1. Keep the items like ladders, antennas, kites, balloons, model aeroplanes, and trees away from overhead power lines.
2. Never use electric power tools or appliances in the rain or while standing in water.
3. Do not ever climb utility poles or transmission towers when they are charged.
4. Do not let anyone shoot or through anything at insulators.
5. The transformers are inside sturdy metal cabinets, which are locked for safety. Never pry them open.
6. If you are caught in lightning storm, stay away from trees and whenever possible, stay dry. Go, indoor and keep clear of windows.
7. Before digging, learn the location of underground power lines. Call your electric utility company or assistant.
8. The main control panel must be located at ground floor, out of reach of general public.
9. Periodic inspection, measurement of insulation level of equipment and of installations, resistance of earth system must be made and documented. Remedial measures must be confirmed to relevant standards.
10. ‘First aid’ and ‘Firefighting’ facility should be located at the centre of gravity of loads with easy access.
11. Even low-tension overhead line should not pass just over the terrace of any building. Otherwise human being may get electrocuted which may cause severe shock via sensual nerves leading to death.
12. Whenever overhead lines or even busbars are under repair, first job is to earth them.
13. Never pull out the porcelain HV fuse cutout without switching off the main switch or all the connected loads. Otherwise the eventual arcs may chase the person to burn him to death.
14. The stored energy in the capacitance of HV motors, transformers, U/G cables and busbars gets discharged while switching off for repair if these are not properly earthed.
15. Never attempt to remove a person from an energized circuit with your bare hands.
16. Outlets near water sources, i.e., bathrooms, kitchen sinks, garage, outdoors should be GFCI (ground fault circuit interrupter) and ELCB (earth leakage circuit breaker) protected.
17. Always wear a safety belt before starting work above ground level, or on a pole.
18. In case of fire, disconnect the supply immediately. Do not throw water on equipment.
19. Electrical equipment should be regularly inspected and tested.
20. Rubber mats should be placed in front of electrical panels or switchboards. Always use electric rubber gloves while working above 650 volts. Always seek permission to the work, while servicing live switchgear.

The electric safety is a very elaborate subject and every element such as generation, transmission, distribution and load end users are responsible. No one can be exception. Selection of quality product, proper use and observing adequate care are essentially required and no compromise should be done.

Electricity gives us light but do not take electricity lightly. Otherwise you may not get scope to say sorry.

2.2.5 First Aid Practice

First aid is necessary to meet out the preliminary treatment after getting electrical accidents. These are required for:
- Burns and scalds received by a person due to electric shock.
- Bleeding because of wounds sustained by the victim due to electric shock.
- The victims of chemical burns.

The aim and objectives of the first aid are:
- To reduce the effects of the heat and to relieve pain.
- To lessen contamination and the risk of contamination.
- To reduce discomfort and swelling.
- To ensure that the patient takes sufficient fluids.

**Burns**

The contact burns are generally found on the body of the victim at the points at which the current has entered and left. The deeper tissues of the bodies through which the current has passed are also affected. If the victim is severely burnt, do not waste time. Take him to the hospital for treatment immediately.

Burns are very painful, if the large areas of the body are affected. For the burns caused by chemicals, the chemicals must be washed off very carefully by clean water before starting the treatment. Any wound bleeding profusely specially on the wrist, hand or fingers must receive professional attention. For immediate relief, first aid by pressing the wound is the best means of stopping bleeding and avoiding infections. However, trained personnel or doctors should be preferred.
Equipment and First Aid Materials

The ready stock of the first aid for use in the emergency is listed below.

<table>
<thead>
<tr>
<th>S/N</th>
<th>Items</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>First aid kit</td>
<td>One set</td>
</tr>
<tr>
<td>2.</td>
<td>Adhesive wound dressings of different sizes</td>
<td>One set each</td>
</tr>
<tr>
<td>3.</td>
<td>Safety pins</td>
<td>One dozen</td>
</tr>
<tr>
<td>4.</td>
<td>Sterilized eye pad with bandage in a sealed packet</td>
<td>One packet</td>
</tr>
<tr>
<td>5.</td>
<td>Sterilized un-medicated dressings (small, medium and large)</td>
<td>One set each</td>
</tr>
<tr>
<td>6.</td>
<td>Adhesive plaster 25 mm x 5 metres</td>
<td>One spool</td>
</tr>
<tr>
<td>7.</td>
<td>100 gm packet of absorbent sterilized cotton wool</td>
<td>Two packets</td>
</tr>
<tr>
<td>8.</td>
<td>Triangular bandage of unbleached calico, the largest side of which measures not less than 125 cm and each of the other sides not less than 90 cm.</td>
<td>One set</td>
</tr>
</tbody>
</table>

Procedure of Initial Treatment

<table>
<thead>
<tr>
<th>S/N</th>
<th>Electric burns and scalds</th>
<th>Chemical burns</th>
<th>Severe bleedings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Dip the parts affected in the cold water</td>
<td>Flush the areas of injury with running water</td>
<td>Make the patient lie down and rest.</td>
</tr>
<tr>
<td>2.</td>
<td>Make the parts dry and clean</td>
<td>Remove the contaminated clothing from the victim</td>
<td>If possible, raise the injured part above the level of the body.</td>
</tr>
<tr>
<td>3.</td>
<td>Remove the items restricting blood circulation, i.e., belts, rings, bangles, etc</td>
<td>Cover the affected areas with clean dressings till the medical assistance is received.</td>
<td>Apply pressure to the wound.</td>
</tr>
<tr>
<td>4.</td>
<td>Give small quantity of cold drinks at frequent intervals</td>
<td></td>
<td>Summon medical assistance immediately.</td>
</tr>
<tr>
<td>5.</td>
<td>In case burn is liable to get dirty, it should be covered by clean dressings till the medical assistance is received.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2.3 ELECTRIC FIRE

Fire generated danger to life of the working personnel in any plant, electrical generation, transmission or distribution system is most important issue of safety division. Safety to persons is always given higher weightage on property losses. Working personnel of the construction, operation and maintenance must be properly trained to prevent themselves during event of outbreak of the fire.

Fire gets ignited at a hot spot and if heat energy generated is more than the heat energy absorbed by the immediate atmosphere or radiated to the nearby medium is higher, it spreads along the combustible material to neighbouring area. However, expansion of the fire depends on the availability/presence of combustible material, air and local temperature rise.

High-risk zones must be equipped with automatic fire sensing and alarm system along with firefighting system. Automatic firefighting system minimizes the losses to the life as well as property in the event of fire. This also helps in minimizing the spreadover of the smoke and poisonous gases.
2.3.1 Initiation of Electric Fire

In general, the main causes of the occurrence of fire are:

- Lapse in safety management
- Negligence of working personnel
- Poor housekeeping
- Poor quality of wiring
- Old and worn out equipment
- Loose connections
- Ignorance of gas leakage
- Inadequate testing and maintenance
- Lack of awareness and training
- Sometimes fires takes place due to accidents beyond human control

2.3.2 Fires in Electrical Power Plants and Substations

Following may be the reasons of fires in electrical generating stations, substations and plants.

(i) Flashover due to failure of air insulation. Arc produced by the flashover may continue to spread over if there are flammable materials around the flashover point.

(ii) Short circuit may take place between phases, phase to ground or inter-turn in electrical machines.

(iii) Joints of the conducting path and connections at terminals sometimes found loosely connected and cause sparks. The repetitive sparks may overheat the parts of the equipment/machine resulting to fire and melting.

(iv) There is repetitive charging and discharging of the capacitance between phases to ground if required clearances are not maintained properly. This is called Corona Discharging and initiates from sharp points. Corona is prominent in moist weather. In the presence of flammable materials nearby the discharge may cause arcing ground and fire hazard.

(v) If due to any reason, temperature of windings or oil of the oil filled equipment exceeds permissible limits, electrical fires and explosion takes place.

(vi) Sometimes explosion takes place due to bursting of capacitors. Capacitor cans burst due to overheating by over voltages.

(vii) Flammable materials catch fire if static charges accumulated on the metallic surfaces of transformer tank and metallic parts placed below high voltage transmission line get discharged in the absence of earthing.

(viii) Underrated current resistor elements in the electrical equipment become red-hot and release heat leading to catch fire in insulation and other flammable materials.

(ix) Over-voltage caused by switching operations or lightning generates external/internal flashovers in the electrical equipment. Capacitors and circuit breakers are prone to such flashover.
2.3.3 Classes of Fires

For practical purposes fires are classified into Class A, Class B, Class C, Class D and Class E. These classes are adapted by European and United States Standards. The classes confirm the combustion materials involved and required extinguishing medium as given in the Table 2.3.

Table 2.3: Classes of fires

<table>
<thead>
<tr>
<th>Fire class</th>
<th>Involved combustion medium</th>
<th>Fire extinguishing medium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class-A</td>
<td>Wood, Coal, Plastics, Cloth, Paper, Rags, Rubbish, Construction and Packing materials, Rubber</td>
<td>Cooling and wetting of materials with the help of water or high water content solution helps in extinguishing the fire (Water is not suitable)</td>
</tr>
<tr>
<td>Class-B</td>
<td>Transformer oil, Diesel oil, Solvents, Liquid chemicals, Lubricating oils, Paints, Varnishes, Thinner, Greases</td>
<td>Limiting the air or oxygen supply, Inhibiting fire dry varnishes, Thinners, Greases chemicals, Foam, Halon (Water is not suitable)</td>
</tr>
<tr>
<td>Class-C</td>
<td>Fires involving in live electrical equipment and/or in energized state. If equipment is dead Class is A or B</td>
<td>CO₂ gas, Dry chemicals</td>
</tr>
<tr>
<td>Class-D</td>
<td>Fires involving in Metals like Magnesium, Titanium</td>
<td>(Normal extinguishing media not suitable) Special chemicals and techniques are used</td>
</tr>
<tr>
<td>Class-E</td>
<td>Fires involving Flammable Gases and Fuels like Hydrogen, Ammonia, Acetylene, LPG, Petrol, Furnace oil</td>
<td>Starvation of fire is most useful, Special methods, Necessary inlet valve closed</td>
</tr>
</tbody>
</table>

2.3.4 Removal of Fire

Heat, oxygen and flammable materials are the basic needs for initiation of fire and its sustenance. For essentially removal of fire, following processes are helpful:

- Cooling
- Smothering
- Starving
- Interrupting chain reaction of fire

Cooling means removal of heat. Temperature of the affected area should not increase beyond the ignition temperature. So, by cooling overall temperature of the vicinity of the affected area is lowered down. By maintaining the higher rate of cooling than the rate of heat generation by combustion extinguish the fire.

First disconnect the electrical supply and then spray the easily available coolant (that may be water) on the affected area of the fire. The other important method is to provide sufficient ventilation that is release of heat. Slabs above fire zone should be ruptured to release the heat to the atmosphere.

Smothering also known as blanketing is removal of oxygen supply and it is done by supplying the CO₂, foam, halon, etc.

Starvation means removal of flammable or combustible materials. If combustible materials like oil or gases are there, its supply must be stopped by closing the inlet valve from the supply end. Dry nitrogen gas should be supplied if possible. Oil tanks should be immediately drained and evacuated.
Interrupting chain reaction of fire is separation of combustible materials from ongoing fire. Dry chemicals and hydrogenated hydrocarbons are commonly used for breaking chain reaction of fire.

2.3.5 Prevention of Fire

Electrical power stations and substations have combustible materials like fuel oils, transformer oils, insulating materials, cooling gas, chemical gases. It is better to prevent occurrence of fire. Several preventive actions starting from the planning, designing, installation and testing are essential. Preventive actions for fire are also equally important during commissioning, operation and maintenance of electrical equipment and plants.

Preventing the fire means avoiding the simultaneous presence of flammable materials, oxygen (air), local temperature rise and ignition or spark.

Following suggestions are advised to be incorporated for prevention of fire in electrical plants and apparatuses:

- Necessary precautions should be taken during storage and handling of combustible materials. Suitable guard should be provided to isolate the flammable materials from flashovers, arcs, sparks, hot spots, etc. that causes the temperature rise.
- Welding and carrying of open flames must be carefully handled.
- Explosive materials, cigarette buts and open resistance heaters should not be allowed in the control room.
- Prescribed moderate temperature must be maintained surrounding insulating materials.
- During filling up the oils in transformers, circuit breakers and furnaces, special care should be taken.
- Overloading of the electrical equipment must be avoided at any cost. Proper protective schemes for overloads, over-current and temperature rise must be commissioned and maintenance.
- Leakage must be attended without delay. Scrap, waste oil, waste wood and waste papers should be disposed off as early as possible.
- Correct ratings of fuses and MCBs should be installed along with good quality of wiring and wiring materials.
- Scheduled and regular periodic inspection and corrective measures are inevitable for fire prevention.
- Metallic bodies of the equipment and pipes, cabinets, etc. should be properly earthed. Earthing helps in discharging the static charges.

Subsystems must not be energized unless the fire protection systems are commissioned and are in alert workable state.

Gas cylinders and chemicals must be stored separately as per safety recommendations. Following fire-extinguishing materials should be kept in ready stock.

Water (H₂O) is mostly used as fire extinguishing medium. Water jet is required to be injected on the fire-affected area. Water evaporates absorbing the heat of fire and cools down the combustible materials below ignition temperature. Water is suitable for extinguishing Class-A fires.
Carbon dioxide (CO₂) is an inert gas having property of not supporting the combustion. Carbon dioxide is suitable for extinguishing Class-C fires and not proper for extinguishing Class-A fires.

Foam is prepared by mixing aluminium sulphate and sodium bicarbonate in water. This is not recommended for electrical equipment. However, foam is suitable for extinguishing the fire in oils, varnishes, paints and flammable solvents.

Dry chemical powder is prepared by mixing sodium bicarbonate (90%), magnesium sterate (1.5%), magnesium carbonate (1%), and tricalcium phosphate (1%). This is recommended for extinguishing Class-C fires, Class-B fires and Class-E fires.

Halon (Halogenated Hydrocarbon) is prepared by composing Carbon and Halogen (a combination of chlorine, bromine, and fluorine). Halon has capability to break down the chain reaction of fire and effectively extinguishes the fire. These are recommended for extinguishing the fire of electrical equipment, flammable liquids and gases in open space only. Firefighters must use mask while using it, because with fire, halogen decomposes and releases corrosive poisonous gas like hydrogen fluoride (HF).

2.3.6 Fire Extinguishers

The prime jobs of a fire extinguisher are:

- Extinguishing fire
- Stopping spreading of fire
- Minimizing the smoke and poisonous gases
- Saving life
- Saving property
- Minimizing the risks to adjacent buildings and premises

Actions of Defence for Fire Fighting

- First act of defence must be to use Portable Fire Extinguishers immediately.
- Second act of defence must be to use Fire Hydrant, Hose and Nozzle.
- Third act of defence must be to use Automatic Fire Extinguishing System installed in the plant.
- Inform fire brigade.
- Vacate and leave the affected location.

Note: While operating the extinguishers, first remove the guard cap and then strike the plunger against a hard surface (may be the floor). Finally, direct the jet emerging from the nozzle on the fire.

Types of Fire Extinguishers

1. Water Expelling Fire Extinguisher

These extinguishers use water as fire extinguishing agent. Water is released in the form of jet while gas pressure is applied from the upper part of the container of the extinguisher. Applied
water on the burning materials is directly converted into steam. This steam helps either way to reduce the percentage of available oxygen.

These are not used on fire involving electrical equipment. However, if there is no other option first de-energize the electrical equipment, then apply the water expelling fire extinguishers. Following three types of water expelling fire extinguishers are generally in use but soda acid type is most common.

(i) **Constant Air Pressure Type Water Expelling Fire Extinguisher**

The container of this type of fire extinguisher is filled with water and dry air, which develops desired pressure. When it is required to use, safety pin is withdrawn and pressure level inside gets depressed which results a jet of water through the hose under internal air pressure.

(ii) **Gas Pressure Type Water Expelling Fire Extinguisher**

There are two compartments in such types of water expelling fire extinguishers. The inner compartment is filled up with CO₂ carrying cartridge under pressure. The outer container carries water. While using such type of water expelling fire extinguishers, the CO₂ carrying cartridge is first pierced open. Now, release of CO₂ under pressure takes place which drives water out through the discharge tube.

(iii) **Soda Acid Type Water Expelling Fire Extinguisher**

In this type of fire extinguishers, sodium bicarbonate solution is filled up in the main container. A bottle having Sulphuric acid is fitted at the top of the container fixed with a plunger. While using this fire extinguisher, the plunger is getting struck first to rupture the bottle of the Sulphuric acid. Now, the Sulphuric acid and the sodium bicarbonate solution react together and release CO₂. CO₂ gas works as propellant of the water and water extinguishes the fire by cooling effect. Figure 2.5 shows the sketch of a Soda Acid Type Water Expelling Portable Fire Extinguisher.

![Figure 2.5. Soda acid type water expelling portable fire extinguisher.](image-url)
14. List the main IE rules pertaining to electrical safety.
15. What first aid is recommended to stop severe bleeding?
16. List the precautions you take in attending to a victim affected by burns.
17. What cares will you take in attending the victims of chemical burns?
18. What should be the safety precautions observed while handling portable equipment?
19. What are the precautions to be taken before starting work on a live line?
20. Write a note on ‘initiation of electric fire and extinguishing it’.
22. Write notes on:
   (a) Effect of high electrostatic field on living beings
   (b) Different types of fire extinguishers
   (c) Fire extinguishing mediums
   (d) Classes of fires