Electrical Safety

Guideline For Schools

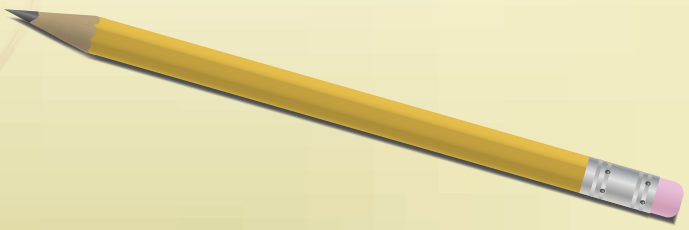
PUBLIC UTILITIES COMMISSION OF SRI LANKA

Economic, Safety and Technical Regulator of Electricity Industry

Contents

Foreword

The Public Utilities Commission of Sri Lanka (PUCSL) commenced the economic, safety and technical regulatory activities of the electricity industry with the enactment of Sri Lanka Electricity Act No. 20 of 2009 on 8th April 2009. To accomplish the government aspiration of ensuring electrical safety for all Sri Lankans, the PUCSL has launched several short term and long term practical measures to increase awareness and motivation among all layers of Sri Lankan society towards fulfilling their individual and communal obligations and responsibilities towards achieveing the national goal of electrical safety. This guideline has been developed for use in a school environment and is expected to enhance the general knowledge of students and teachers on electricity and its safe usage. Further, these guidelines are also expected to enhance curiosity among ordinary level and advanced level students on the subject and encourage advanced learning on the subject. Additionally, these safety guidelines can also be applied for similar situations in different environments, (domestic, workplace etc)



Approach and Outcomes of the survey

The PUCSL aims to identify the pro's and con's of the prevailing electrical wiring systems in Sri Lankan schools and suggest practical solutions to be implemented in the long run. To achieve this objective, the PUCSL has formulated a holistic approach to mitigate electricity related hazards and enhance awareness among children and staff members of government schools on the electrical safetyConsidering the difficulties in visually observing and testing each and every school in the country, the PUCSL conducted inspection and awareness programs in 121 schools covering all districts and different geographical areas. Electrical installations of those schools were critically evaluated to identify shortcomings and major causes leading to hazardous situations. (Refer Annexure 01). Conclusions arrived form these inspections through careful analysis will be used for long term policy planning and to impose regulations to establish a safety code for electrical installations. This will ensure electrical safety to occupants and property.

From the surveys, PUCSL has identified many common defects in electrical installations in the school sector, some of these defects have a high potential to create electrical hazards to the occupants.

All such observations are deviations from the established regulations and can cause electrical hazards. The scale of the damage may range from small fire, equipment damage etc., to causing a sizable fire, damage to entire building and loss of lives. Therefore, it is very important to be vigilant about electrical systems and there proper maintainenance and compliance to prevailing standards. Further, it is equally important to understand and be aware on how to handle electricity safely, its limitations, electrical hazards and how to prevent such accidents.

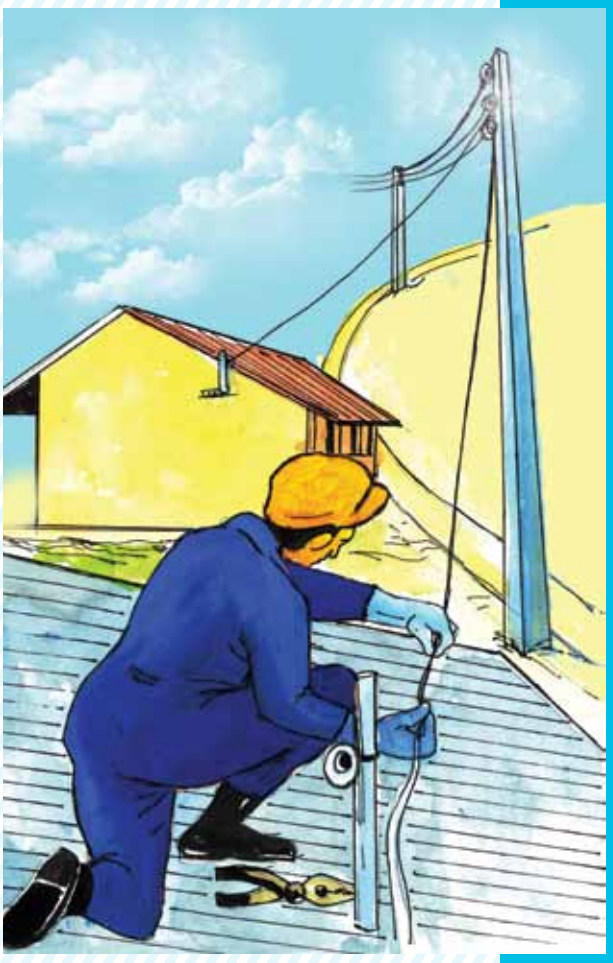
Purpose:

Ensuring the safety of all students, staff, employees, contractors and general public who use electrical equipment and appliances or who may be exposed to electrical hazards within the school environment. This guideline covers the requirements associated with electrical safety such as maintenance of electrical equipment, identification of defective electrical equipment andprevention of electricity related accidents and tips on providing first aid in the case of an accident.

Scope:

This guideline applies to all students, staff, visitors, contractors and any other person associated with the school.

Definitions:



For the purpose of this guideline, following definitions apply:

- ***Electrical installations*** – A system that supplies electricity to a building, including switchboards, distribution boards, fixed wiring and socket outlets.

- ***Competent person*** – A person who has the necessary practical and theoretical skills, acquired through training, qualification, experience or a combination of these, to correctly and safely undertake the tasks prescribed by these guidelines. .

- ***Power Distribution Board (Fixed in the Installation)***-An Assembly containing switches or Protective devices(Main Breaker, circuit breakers, Isolators, RCD etc) associated with one or more outgoing circuits, but fed through the Breaker and the RCD which are capable of handling a fault level associated in the location.

- ***Main Breaker***-Master making and breaking device located at power receiving with electro- mechanical and thermal switching intended to isolate the power supply of entire system if operated beyond the safe limits. Usually integrated with other protective devices to ensure automatic disconnection. This device could be either a Molded Case Circuit Breaker (MCCB) or a Miniature Circuit Breaker (MCB)

- ***Circuit Breaker***- Located at the sub-distribution board where a particular section or circuits originate. . This consists of thermal and magnetic based mechanical switching intended to cutoff the power supply automatically, if operated beyond safe limits. Basically protects particular section or circuit.

- ***Isolator*** - Usually installed where mechanical isolation is required. No inbuilt automatic action and user must manually make or break.

- ***Fuse***- An electrical device that can interrupt the flow of electrical current when it is overloaded. A fuse often has a component that melts and opens the circuit when it's overloaded.

- ***Residual Current Device (RCD)*** – An electro-mechanical switching device intended to isolate the circuit when the current imbalance attains the rated operating leakage current value of the device. Available in different sensitivities for diverse applications, however 30mA RCD shall be used to ensure personnel safety in domestic installations.

- ***Earth Electrode*** - A metal plate, pipe, or other conductor of electricity partially buried in the earth so as to constitute and provide a reliable conductive path to the ground.

- ***Electrical appliances*** – A device or apparatus that is connected to the electrical power supply through a general purpose outlet in the form of a plug-in type.

- ***Extension cords/leads*** – a length of flexible electrical power cable (flex) with a plug on one end and one or more sockets on the other end.

- ***Fixed equipment*** - Equipment that is fastened to a support, secured in a position located in a specific location

- ***General purpose outlets*** – Three pin wall socket outlet (used for 230 V)

- ***Personal equipment*** – Any privately owned equipment of plug-in type, which is used in schools; examples: radios, televisions, computers etc.

- ***Extension board*** – A device having a single plug intended for connecting main socket outlet, sheath flexible cord and an assembly of one or more socket outlet.

- ***Risk management*** – The culture, processes and structures that are directed towards realizing potential opportunities whilst managing adverse effects.

- ***Nominated Key Teacher*** – a teacher appointed by the principal with his or her concurrence to ensure electricity related safety of the school occupants

- ***Electrical Discrimination***: Electrical discrimination is the selection of protection device (circuit breaker or fuse) so that the device adjacent to a fault will operate before a bigger circuit breaker (or a fuse) which is further away from the fault. The main reason is to guarantee that the fault is cut off and supply is maintained to other parts of the system with no interruption.

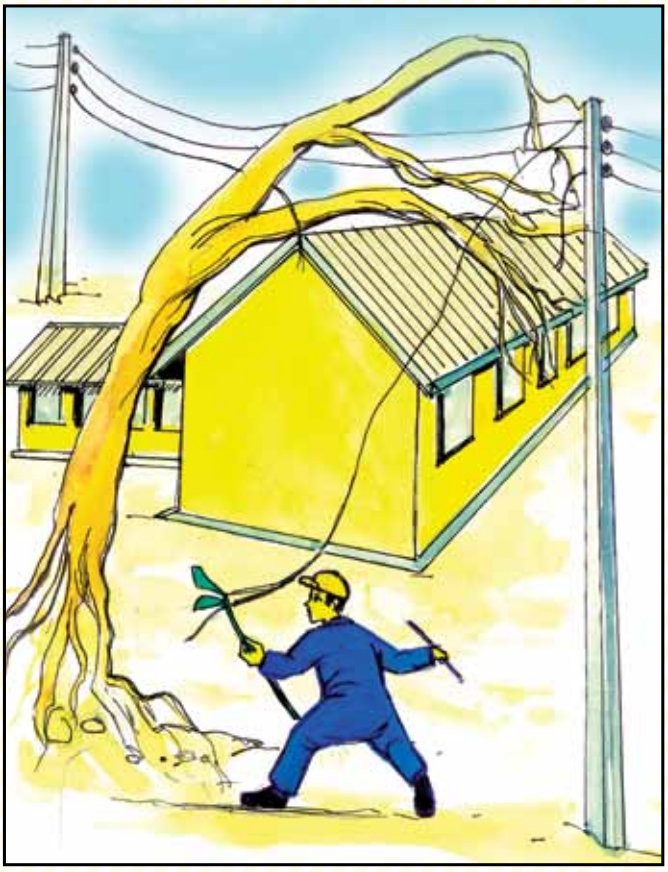
- ***BS***-British Standard

- ***IEE***-Institute of Electrical Engineers

- ***Class II Type*** - A Class II or double insulated electrical appliance, is one which has been designed in such a way that it does not require a safety connection to the electrical earth.

- ***Surge Protection Device***- A surge protection device is an appliance designed to protect electrical devices from voltage spikes. A surge protector attempts to limit the voltage supplied to an electric device by either blocking or by shorting to ground any unwanted voltages above a safe threshold

1 Management of Electrical Accidents/ Hazard in schools



Electricity: A Friend, A Foe?

- Of course electricity is your friend.
- You've had it for years and you really rely on it.
- But if you don't treat electricity with respect and become careless it can easily become your foe.
- It is a powerful and versatile form of energy that can be dangerous and deadly, if it is not used properly

1.1 Causes for Electrical Accidents

Electrical accidents are caused by one or a combination of the following factors. By addressing them appropriately, we can mitigate electrical related accidents and hazards.

- Design shortcomings in respect of safety standards etc
- Poor construction methodologies
- No proper investigation, testing and commissioning mechanism.
- Use of sub-standard switchgears, materials and accessories.
- School premises made unsafe by the environment

- Mistakes and carelessness when dealing with electrical installations
- Lack of proper operation and maintenance practices
- Employment of incompetent persons for maintenance, upgrading etc.
- Not employing competent personnel for periodic inspections and rectification
- Lack of proper knowledge on electricity and its safe usage.

1.2 Electrical Currents and Its Effect on the Human Body

The effects of electricity on the human body depend on many variables, these being;

- The magnitude of current
- Duration of contact
- Body mass (small frames provide less resistance, large frames provide more)
- Gender of the person
- Moisture on the body
- The path of the current
- The type of current, Alternating Current (AC)/ Direct Current (DC)

Did you know?

- Electricity wants nothing more than to go to ground
  - When you touch or come close to an electric line it may flow through you
  - Less than one ampere of electricity can burn, severely injure or cause death.
  - In reality, the current drawn by a tiny 15 Watt, 230 Volt Compact Fluorescent Lamp (CFL) could be enough to kill you
  - Electricity is fast and travels at approximately 299,330 km per second
  - Leaves no room for mistakes, so never put yourself into electricity's path

1.2.1 Magnitudes of Current and its effect on human body

Current	Effect
Below 1 Milliampere	Generally not perceptible
1 Milliampere	Faint Tingle
5 Milliampere	Slight shock felt. Not painful but disturbing. Average individual can let go. Strong involuntary reactions can lead to other injuries.
6 to 25 Milliampere (women)	Painful shocks. Loss of muscle control.
9 to 30 Milliampere (men)	The freezing current or "let go" range. If extensor muscles are excited by shock, the person may be thrown away from the power source. Individuals cannot let go. Strong involuntary reactions can lead to other injuries.
50 to 150 Milliamperes	Extreme pain, respiratory arrest, severe muscle reactions. Death is possible.
1.0 to 4.3 Amperes	Rhythmic pumping action of the heart ceases. Muscular contraction and nerve damage occur; death is likely.
10 Amperes	Cardiac arrest, severe burns, death is probable.

Table 1: Magnitudes of current and its effect on human body

1.3 Electrical Accident Preventive Strategies

1.3.1 Mandatory Design Requirements

1.3.1.1 General Safety Precautions

- No new school building should be constructed close to existing High Voltage (HV)/Low Voltage (LV) lines and no HV/LV line should be allowed to be installed close to existing school buildings. If any such scenario is presently observed, area should be isolated until such lines are cleared.

- Always employ a competent contractor/ electrician to carryout school electrical installations

- All the electrical installations in buildings should be in accordance with BS 7671 (2008), IEE Wiring Regulations 17th Edition or the latest and ICTAD SA8. I

- Steel buildings and all other metal members/sections (steel gutters, cable trays) shall be properly connected (bonded) to the earthing system.

- Inspection certificate should be issued by a Chartered Electrical Engineer, stating that the installation wiring has been carried out in compliance with the above mentioned standards.

Adhere to prevailing electric line clearances when constructing a house. Contact an authorized representative from your local electricity service provider (CEB, LECO) for more information.

- Each building should be separately earthed as required to ensure safety and convenience of construction

- Earth electrode (earth pit) shall be mechanically protected with openable cover to allow periodic inspection.

- Only under water lights rated at 12V fed from 230/12V isolation transformers are permitted in swimming pools. Other outdoor garden lights, lights for ponds shall also be 12V rated fed from an isolation transformer.

- Inter building wiring connections should be fastened properly and frequent observation should be carried out in case where animals (monkeys etc.) use such path to move around. All such wiring shall be concealed in electrical conduits to provide adequate mechanical protection.

- Internal surface wiring shall be concealed in conduits, trunking or in casings to provide adequate mechanical protection to protect from rodents and other potential threats.

- Make sure electric pumps don't electrify the water of garden ponds and water fountains through proper insulation and taking other protective measures.

1.3.1.2 Trip Switch & Distribution Board

- RCD type trip switches with the appropriate rating should be installed for each and every building

- Always make sure ratings of selected switchgears are suitable for the intended purpose. (Eg. For 30A, single phase installation we must use 32A, 2 pole, MCB and 40A, 2 pole, 30mA RCD)

- Approaching path to the main switch boards and other sub-switch boards should be kept free from any obstructions to enable quick access to knock off the supply in case of an emergency.

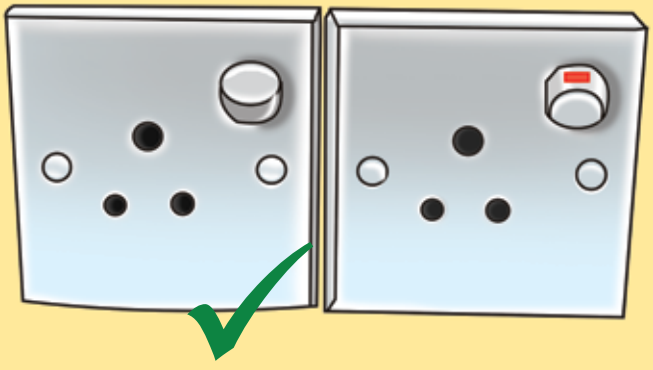
- Keep an insulated mat on the floor in front of the switch boards/switches where operator stands for operation

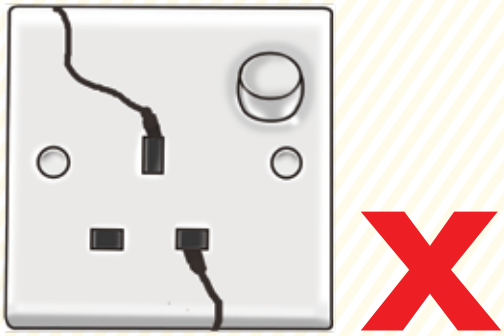
- Distribution Board should be mounted in a properly ventilated, dry area and should not be located on external walls so as to avoid the exposure to extreme weather conditions.

Install a trip switch (Residual Current Device) and check the operation at regular intervals (at least once a month) by pressing the test button. This avoids freezing of the device and ensure proper operation.

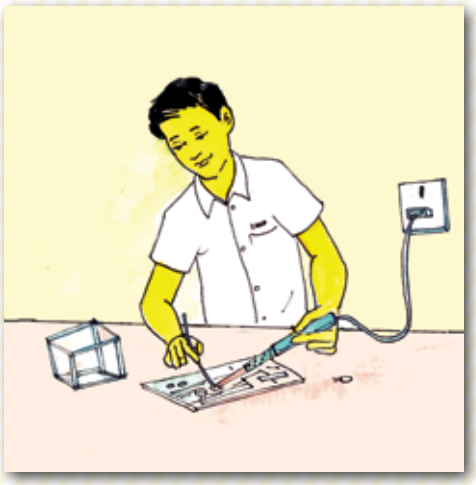
1.3.1.3 Socket Outlets & Electrical Appliances

- Socket Outlets, Electrical Appliances, etc should be located out of reach of water
- An easily accessible and identifiable switch should be provided near fixed appliances to cut off power in an emergency
- Any electrical appliance with a metal cover should be properly earthed
- Only fix socket outlets with interlock (shutters).
- Never connect bare wire ends directly to the socket outlets; Always connect through plug-tops.





1.3.1.4 Workshops and Computer Labs



- Separate double pole isolators should be installed for single phase equipment in workshops
- Separate four pole isolators should be installed for three phase equipment in workshops
- Use only 12 Volts power supply with isolation transformer for soldering iron/bouth

- Verify that the electrical supply is adequate to cater the expected load.

- Two socket outlets per workstation should be provided for the computer and monitor.

- All cables in the computer lab must be enclosed in plastic trunking.

1.3.1.5 Lightning Protection

- Install a direct lightning protection system for the structural protection of the building. The earthing lead should be buried at least 20 meters away from the Low Voltage (LV) installation. If Earthing lead or separation is difficult due to site constraints, both systems have to be properly bonded.

- Install a surge protection system to protect from line surges (Protect from indirect lightning)

- A proper earthing system should be made available for each building, especially when lightning protecting systems are installed (not more than 10 Ohms measured in a dry day).

- Isolate sensitive electronic items from electrical system under thunderstorm conditions.

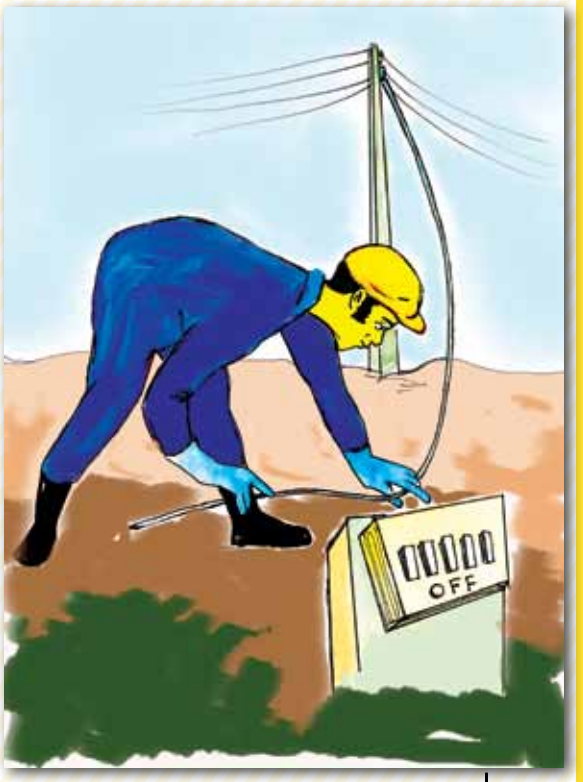
1.3.2 Mandatory Operational & Maintenance Requirements

1.3.2.1 Testing Intervals for Residual Current Devices (RCD)

- As per the IEE regulations human protection can be assured with RCDs having a sensitivity of 30mA or less. If 30mA RCDs are tripping due to excessive leakage current where human intervention is high, number of RCDs shall be increased in the system to share leakage current. However, increasing the sensitivity rating to cope up with high leakage cannot be recommended.

- Check the operation of the RCD at regular intervals (at least once a month) by pressing the test button. This avoids freezing of the device and ensures proper operation.

1.3.2.2 Outdoor Environment



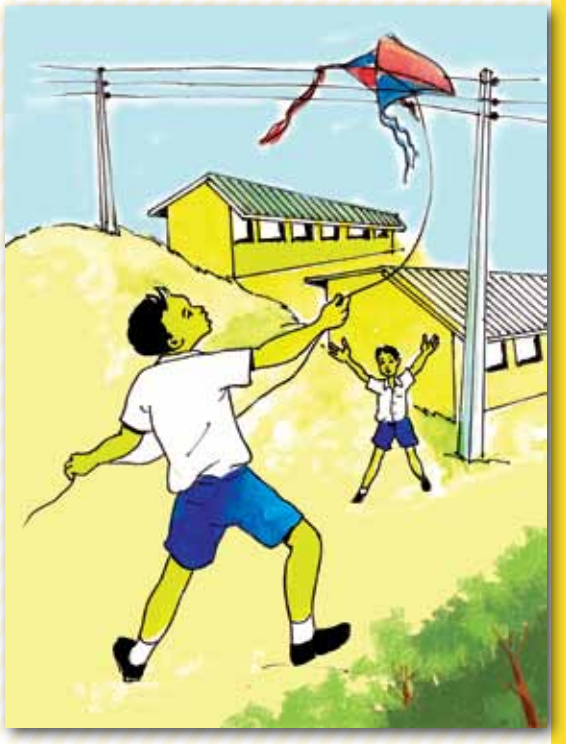
- Do not meddle with grounded (fallen) power lines. Inform the electricity authority and switch off the power from the main switch and sub-circuit.

- During cases of extreme emergency, , a competent person may use tested and approved rubber gloves to avoid accidents or reduce further damage.

- Avoid Transmission High Voltage (HV) network, towers, substations and their earthing systems within the school

premises. If it is available, it should be separated from a fence and should be beyond 3 meters from the fence.

- If HV networks/ tower etc. are situated close to school premises, students shall be advised not to tamper such systems. Playing with water, extending wet logs, extending steel rods may result in fatal accidents.



- If HV tower exists close to school premises students shall be advised not to roam or play at close vicinity under thunderstorm conditions as they can be subjected to the effect of step potentials if lightning grounds through the tower.

- Do not allow to hang advertisement boards or any other items on power carrying poles

- Do not allow vehicles to be loaded above the height of power lines within the premises

- Avoid erecting flags, mask/antennas near power lines within the school premises. In such a case the distance from the erecting point should be more than the height of the electric mast/pole.

- Make arrangements to remove the disturbances (tree branches) to the power lines through Supply Authority.

Be aware of your safety when engaged in activities close to power lines and other electrical infrastructure.

1.3.2.3 Extension Boards and Extension Cords

- Unsolicited connection (flexible wiring) should not be taken from power boards.

- Extension type cords that are not 3-wire type, not designed for hard usage, or that have been modified, should not be used
- Use only factory-assembled cord assemblies with fuse links.
- Use only cords, connection devices, and fittings that are equipped with strain relief mechanism.
- Remove plug top by pulling the plug, not by the cord

- Do not use flexible cords that have been damaged or with un-acceptable modification.
- All socket outlets installed on extension cords should be incorporated with shutters.
- Avoid use of extension leads along walkways and corridors
- Power Boards used in the school should comply with IEE Regulation
- Power Boards should have the minimum protection features such as over current protection with the reset option
- An individual switch should be available on the power board where their leads are more than 1.8 meters long

- Power boards must be in a safe location where it does not get damaged due to external body. Otherwise, it should be securely mounted on a work bench or floor where there is no external impact on the board
- Power boards/ extention cords should not be overloaded (i.e. piggy back one board onto another)
- Piggy- back plugs and double adaptor should not be used as they cause high risk on safety.
- Power board extension leads should be checked (inspected and tested) for any damages and should not be covered by mats , drawn across corridors or other congested areas
- Extension cords, which are in a tight coil, may overheat and catch fire
- An indicator lamp should be included in power boards and extention cords to check power availability.
- Plug socket outlets should not be overloaded
- Check all electrical plugs to make sure they fit snugly into their outlets. Plugs that are loose or that wobble in the outlet are potential fire hazards and should be repaired or otherwise removed from the service.
- Discolored and heated outlets, plug tops should be checked by a competent person to find out the cause and for rectification or replacement depending on the situation.
- Multi sockets should be removed from the outlet when they are not being used.

Only use extension leads fitted with suitably insulated connectors and plugs.

1.3.2.4 Safe use of appliances /equipment

De energize the relevant circuit or main isolator (breaker) if you are doing any of electrical related upgrading, repairing etc.

- Check whether flexible cords are effectively anchored.

- Check whether the inner cores of the flexible supply cords are not exposed or twisted
- Check whether the external sheaths are not cut, abraded, twisted or damaged to such extent that the insulation is visible
- Check whether covers and guards are in place and secured as required bymanufacturer/supplier
- Visually inspect all electrical appliances/equipment for any damage before use
- Remove any appliances/equipment with frayed cords, missing ground prongs, cracked tool casings etc. from service
- Switch off any appliances/equipment as well as plug base switches (if available) before plugging to electrical supply

- Check whether the power supply earthing system is properly grounded. Periodic inspection shall be carried out to check the integrity of connection between earth wire and earth electrode.

- Check whether the electrical appliances/equipment earthing arrangement is properly secured

- In case of two-wire systems, where there is no earthing conductor for the appliances/equipment, such appliances/equipment should not be connected unless the RCD 30mA protection is available. In most of these cases such equipment is equipped with equipment earth, and before use, the equipment earth point shall be connected to installation earth (general electrical earth) by an external cable of a recommended size.

- Do not remove ground pins/prongs from cords and plug connected appliances/ equipment or extension cords

- Ground all exposed metal parts of appliances/equipment through proper arrangement (through properly grounded plug bases)

- Do not use electrical appliances/equipment for purposes other than they have been designed, it will no longer ensure the safety features built in by the manufacturer.

- Do not use appliances/equipment meant to be used for indoor work for outdoor work

- Be extremely cautious when using electricity where there is water in the environment or on the skin

- Always switch off the power supply in case of replacement of bulbs and any apparatus

- Heavy load appliances (refrigerators, mixers, iron, wet grinders, washing machines,

heating appliances, UPS etc with three pin plug top should be used.) must be properly earthed through the installation earthing system.

- Portable Generators should not be connected to internal wiring installations without the advice of a competent person for safety reasons
- Hot water geysers should be installed by a competent person to ensure safety.
- Do not use electrical extension cords or appliances near swimming pools, without an earth leakage protection system. (connected circuit should have RCD of 30mA sensitivity).
- Do not use electric appliances in the bathroom, unless they are specially designed to be used in wet conditions
- Avoid the use of appliances/equipment under wet conditions which trigger the conductive properties

Check any old equipment before use for wear & tear and damages in insulation.

1.3.2.5 Testing & Tagging of new and old appliances/equipment

- Testing & Tagging of electrical equipment is required only for activities in workshops, construction sites or for equipment to be used in hostile operating conditions (annexure 02).

- Old and new appliances/equipment, extension cords and multiple-socket outlets should be tested by a competent person

- Any damaged appliances/equipment should be repaired or replaced, if beyond repair these should be repaired with the help of a competent person

- Ensure that the testing of appliances/equipment and tagging & keeping records for inspection are carried out periodically by a competent person.

- Tagging - After testing for usability, equipment should be tagged with a durable and legible label and attached as close as possible to the plug end of the lead indicating :

  - Test Date:
  - Next due date for testing
  - Identification barcode
  - Tested by:
  - Test Instrument details

- Ensure that any faulty equipment is removed from service until it is repaired for safe operation

1.3.2.6 Maintenance and record keeping

- Test and tag relevant appliances/ equipment, extension cords and multiple-socket outlets and keep records for inspection. Maintenance activities should also be recorded. For details refer (annexure 03).

- Any damaged appliances/ equipment should be repaired or replaced if it is beyond repair with the help of a competent person. Maintain a register for damaged/ failed equipment. For details, please refer (annexure 04).

- Hard Copies of such records should be maintained for at least 7 years by the principal.

1.3.2.7 Risk assessment for existing appliances /equipment

- Risk assessment should not be encouraged as the necessity of using such appliances /equipment is not very essential in schools

1.3.2.8 Rectification of Un-solicited tappings and extensions

- Proper action should be taken by the Principal/Sectional Head before making any tappings & extensions for the purpose of getting electricity for special occasions such as sports meets, religious festivals etc.

- Any such tapping & extensions should be done in accordance with BS 7671 (2008), IEE Wiring Regulations 17th Edition or the latest.

1.3.2.9 Electrical safety inspection check list

- All power outlets and switches should be checked before commencement of the school year. For details, please refer annexure 05.

- If the school is outsourced for a function to a third party, an inspection should be carried out before commencing school, to ensure electrical safety.

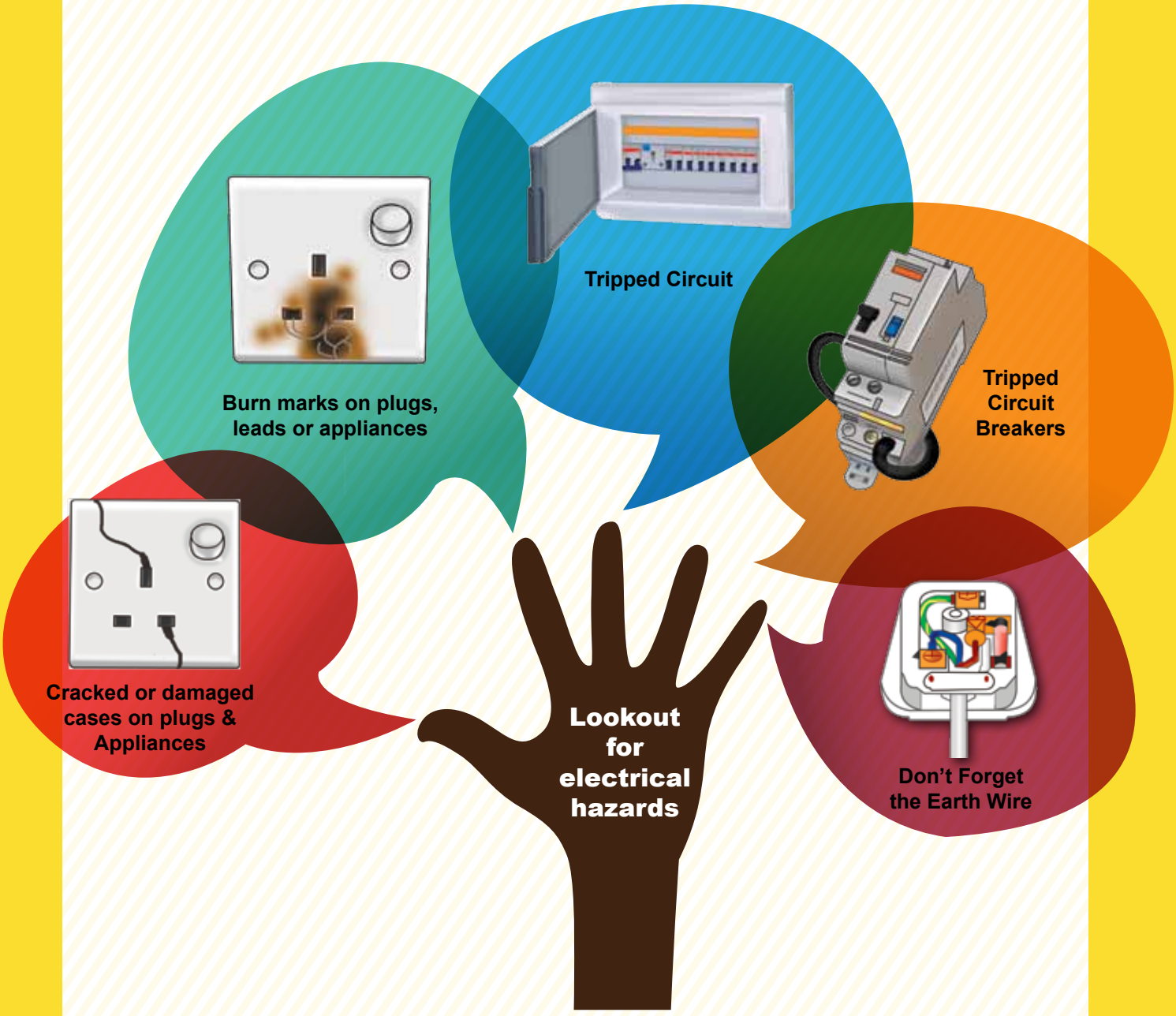
Do not forcefully switch on a tripped MCB without identifying and rectifying the fault.

1.3.2.10 Fault Diagnosis

Look out for the danger signs:

- Frayed, cut or damaged leads.
- Cracked or damaged cases on plugs or appliances.
- Moisture or water on electrical appliances.
- Burn marks on plugs, leads or appliances.
- Damaged or removed distribution board enclosures
- Blowing fuses.
- Loose cord grips in plugs or appliances.
- Fallen or damaged overhead power lines.
- Unsafely drawn temporary power lines.
- Vibrations in DBs
- Light shocks on wet walls
- Electrical sparks at switching or plugging

If you notice any of these danger signs, stop using the appliance and report the problem to the principal/key teacher immediately.


Tripped Circuit
Burn marks on plugs, leads or appliances
Tripped Circuit Breakers
Cracked or damaged cases on plugs & Appliances
Lookout for electrical hazards
Don't Forget the Earth Wire

2 Responsibilities:

2.1 Responsibilities of Principal

- Nominate a teacher with his or her concurrence to ensure electricity related safety of the school occupants. This nominated teacher should carry out the responsibilities assigned for the “Key Teacher” in this guideline.

- Depending on the size of the school, the principal may appoint a committee consisting members of staff, senior students and maintenance staff as required to effectively ensure electrical safety in the school environment.

- Take necessary action to register competent persons from the area to undertake electrical repairs and equipment testing of the school electrical installation. This includes testing and tagging of relevant appliances & equipment and testing of extension cords and multiple-socket outlets. Selection of competent persons can be done with the consultation of School Works Branch (Annexure 06) of the Education Ministry.

- Make sure contractors, sub-contractors and other service providers have required qualification and adhere to procedures specified in this guideline under section 2.5.

- New construction or extension to existing installation must be coordinated with School Works Branch of the Education Ministry. Such projects may be direct

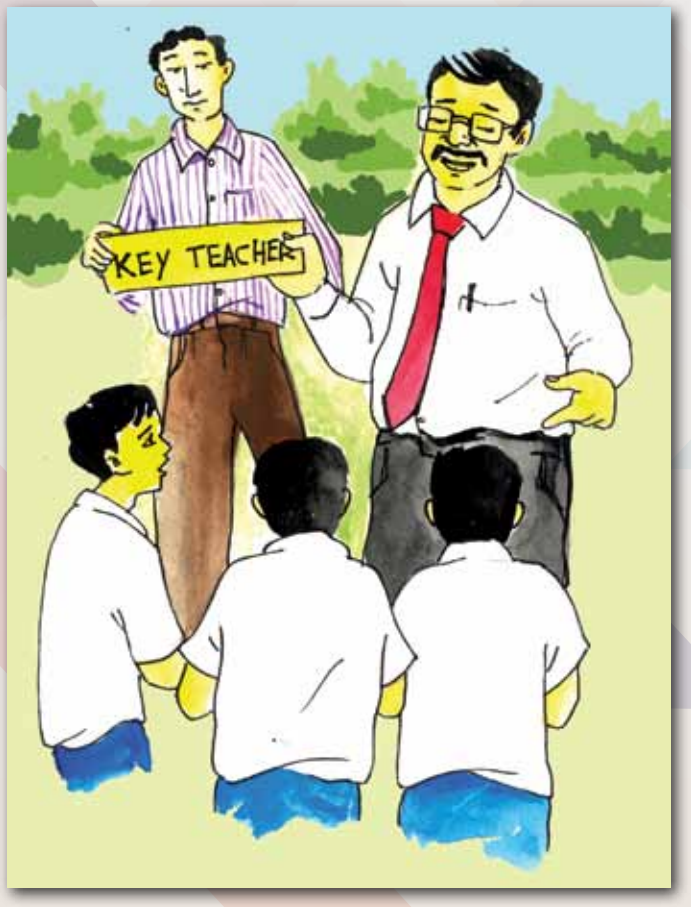
grant of the government, an old pupil's donation or any other means but, proper approvals must be taken for the design. It is advisable to have close coordination with engineers to verify designs and materials. Principal and key teacher shall keep samples of important items such as switchgears, cables, light fitting etc., in a safe place until project completion.

- For any sizable project, principal may coordinate with School Works Branch of the Education Ministry to check whether existing power supply is adequate to cater the incoming demand. Otherwise suitable precautions should be taken to separate the electricity supply for construction to avoid overloading the existing setup.
- A competent person shall be employed for temporary electrical work such as sports festivals, festival seasons, exhibitions etc., and such extensions shall be equipped with all protective measures.
- Coordinate with contactor to give necessary facilities to him to avoid accidents. Contactor shall be informed to arrange his work without affecting safety of the students and staff.
- Inform students and staff of any maintenance or construction activities to be taken place.
- Keep records, test reports, warrantee cards and as built drawings of new constructions, alterations and extensions. Refer section 1.3.2.6 for more details on record keeping.
- The principal may provide copies of the electrical designs to the nominated key teacher/committee as required to further ensure effective implementation
- Keep records of contractors and sub-contractors and take timely action to rectify any defects observed. Within the defect liability period contractors are fully responsible for such partial or complete repair.
- Arrange comprehensive annual inspections with the help of all staff and registered competent persons to ascertain the healthiness of the installation.
- If any defect or defects are identified during above inspections, or by the key

teacher or by any other means, immediately record these defects and take action to rectify the defect to ensure safety. If the repair is beyond the principal's authority level, such affected section or sections shall be isolated from the electrical supply until the defect has been rectified. If unable to isolate the particular section, the entire system will need to be de-energized until rectification is completed.

- Arrange training programs to the nominated key teacher with the support of PUCSL, Electricity Licensees and Education Ministry.

2.2 Responsibilities of Nominated Key Teacher



- Share responsibilities of the safety of occupants and maintenance of electrical system with the supportive teacher.
- Any defects in the system shall be informed to the principal to take most appropriate action to ensure safety and reduce down time.
- Participate in regular awareness programs conducted by PUCSL, Licensees and Education Ministry. If the key teacher is unable to participate, a nominated person shall represent him on behalf of the school.
- Ensure that testing and tagging of electrical appliances is carried out periodically and records are being maintained
- Ensure that any faulty equipment is dealt with in the most appropriate manner
- Act as a point of contact for the electrical testers, contract workers, sub contract workers, etc

- Inspect other staff members adhere to procedures specified in this guideline under respective sections

- Inform principal of any electrical hazards, incidents or damages in the electrical system

2.3 Responsibilities of Sectional Heads and Class Teachers

- Carryout visual inspections in their class rooms/sections as per the checklist provided in annexure 05 to this guideline and report such defects to nominated key teacher or principal.

- Adhere to electrical safety procedures listed under 1.3.2 of this guideline related to use of the school electrical system.

Always guide students when in need of using electrical appliances and carrying out work involving the electrical system.

2.4 Responsibilities of Students

- Always use electricity under the supervision of Class teacher/Sectional Head
- Any lapses being noted should be informed to Class teacher or sectional Head.
- Students shall not switch ON any MCB or RCD at OFF state. Such situations observed must be informed to relevant class teacher/sectional head and the services of a competent person must be obtained to rectify such errors.
- Students shall not be engaged in any sort of maintenance or repairing activities involving electricity
- Students shall not move in to construction areas.

2.5 Responsibilities of Contractors/Sub-Contractors/Service Providers

- Proper authority should be taken from the Principal and Sectional head/ Class teacher before commencing any work. Such work should be undertaken by a competent and approved contractors and should be carried out after ensuring the safety of students.
- Commence construction or maintenance work only after respective drawings/ procedures are approved by the School Works Branch of the Education Ministry.
- Contactor shall obtain third party insurance cover as per the ICTAD conditions.
- Before starting work contractor shall take all precautions such as fencing, netting, safety notice, etc, to avoid any kind of accidents.
- Contractor must arrange his temporary electrical systems for stores, workers huts, temporary toilets etc., in a very safe manner without affecting routine activities of the school.
- Contractor shall obtain separate construction supply if contract is sizable.
- For small contracts, power should be taken via neatly done distribution boards after getting the approval from principal. If principal decides to have internal metering to measure usage during construction period contractor is obliged to do so.
- Contractors will not be allowed to use damaged extension cords, unprotected temporary circuits, wires with joints etc.,

Ensure safety of the environment and all parties when engaged in electricity related construction and maintenance work

- All new and renovated electrical installations shall be tested and commissioned by a chartered electrical engineer and a certified copy of the test report shall be submitted to the principal.
- Comprehensive and accurate as built drawings shall be submitted to the principal.
- Any amendment/changes to the installation should be informed to the principal in writing together with the drawings.
- Test reports, warrantee cards and as built drawings of new constructions, alterations and extensions shall be submitted to the principal.
- If peripheral illumination is required in construction sites, such wiring shall be done through electrical conduits.
- Remove the old wiring before installation of new wiring
- Remove all temporary installations before handing over the site

2.6 Responsibilities of Maintenance staff

- Maintenance group should be headed by a competent work supervisor and he should take necessary permits ensuring to follow the electrical regulations, safety of staff and equipment.
- Arrange such work during after school hours, weekends or school holidays .
- Get the “Work Permit” indicating the work to be attended together with the names of competent persons (approved competent personnel).
- Switch off the Main switch and take off fuses, switch off MCBs and earth the system

- Put up the Sign Boards “Men at Work”/ “ Do not switch ON” / “Danger”
- Use double – insulated tools for live line repairs
- After completing the work all the workers who attended the work should acknowledge in writing that the system is no longer safe to work, remove earth from live parts and normalize the system by the work supervisor.
- It is recommended to employ a permenant electrician if the electrical installation of the school is complex and require highly competent staff for routine maintenance

Employ a competent electrician for electrical installation and repairs.

2.7 Responsibilities of Supporting staff and security personnel

- Visually inspect all appliances/equipment and wiring in the class rooms and around
- Visually inspect all electrical appliances/equipment before use
- Remove any appliances/equipment with frayed cords, missing ground prongs, cracked tool casings, etc. from service
- Attach warning tags to any defective appliances/tools and do not use them until they have been repaired by a competent person.
- Ensure that outdoor lights, garden lights, security lights, temporary lights for festive seasons and sport activities etc. are in safe condition. These shall be switched off during day time. All such circuits shall be obtained via separate RCDs having 30mA sensitivity.

2.8 All users of Electrical appliances/ Equipment /Apparatus

- All users of Electrical appliances/ Equipment /Apparatus should adhere to mandatory operational requirements listed under 1.3.2 of this guideline.

3 Safety & First Aid

3.1 Safety

Clearance requirement for the Distribution Low Voltage Power Line (230Volts to Ground) is as follows:

Location	Clearance in Meters
Crossing of Public Road	5.5
Other than crossing of Public Road	5.2
Places where vehicle is not accessible	4.6
Service wire(insulated) to Buildings or between Buildings where vehicle is accessible	3.7
Service wire(Insulated) to Buildings or between Buildings where vehicle is un accessible	2.7
Above the building(avoid this situation in the school bldgs.)-Vertical clearance	2.45
Near the building-horizontal Clearance	1.83
Erection location of any Post/Mast/Antenna(TV, Radio etc)	Always, distance from the erected point of the Post/Mast to the power line, should be more than the height of the post or a Mast

Table 2: Clearance requirements for distribution low voltage power lines

Note-All High voltage lines (More than 230volts to ground) should not be allowed to cross the School premises (Buildings. Playgrounds, etc.)

How You Can Protect Yourself

The fundamental rule is "Hazardous"live" parts shall not be accessible and accessible conductive parts shall not be hazardous."

Simple it may sound but complicated it gets.

That's why you need to be extremely careful when dealing with electricity.

3.2 First Aid

During an Electric Shock

- Muscles tighten up, making it almost impossible to pull away from the circuit.
- Lungs constrict, making it hard to breathe.
- Heartbeat is interrupted and blood vessels tighten.
- Burns occur where the electricity enters and leaves the body.
- Anyone who touches someone who is being electrocuted can become part of the circuit as well.
- That's why you should never grab on to anyone who's been shocked.

Procedure to follow in case of an accident/shock due to Electricity

- While seeking assistance, immediately switch off the power and if it is not possible, try to remove the patient from the power supply in the most appropriate safe manner (rescue person should use Tested and approved gloves or dry wooden plank/dry etc. as an insulator in order to avoid contacting with the electrical supply through the affected person).

- Keep in mind that only one person should be in command in the rescue operation.

- After rescuing the patient shake his shoulders gently and speak to him to test whether he is conscious or unconscious (Figure 01)

Figure 01

- If the casualty does not show any response, place the fingertips on casualty's forehead and the chin and back his head to open the air way. (Figure 02)

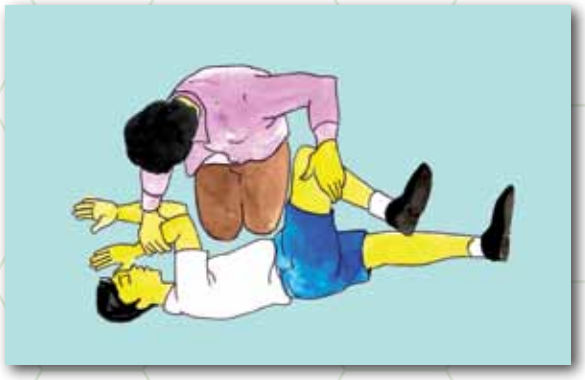
Figure 02

- Check the breathing for 10 seconds. Respiratory process can be confirmed by look, listen and feel. (Figure 03).

Figure 03

- If the casualty is breathing, treat the casualty as an unconscious person and place him in recovery position.

Step-1



Step-2

Step-3

- If the casualty is not breathing,
- Place the heel of your first hand on top of the other hand, and interlock your fingers. Leaning well over the casualty, with your arms straight, press down vertically on the breastbone and depress the chest by about 4-5 cm (1 ½ in.). Release the pressure without removing your hands from his chest. Compress the chest 30 times at a rate of 100 compressions per minutes. The time taken for compression and release should be about the same.

- Tilt the head back, lift the chin, and take a deep breath to fill your lungs with air and place your lips around the casualty's mouth, making sure you have a good seal. Blow steadily in to the casualty's mouth until the chest rises. Give two rescue breaths.

- Continue this cycle of alternating 30 chest compressions with two rescue breaths.

- Continue this procedure until the patient is provided medical assistance from a doctor

3.2.1 First Aid for Burns

i. Keep him away from fire and smoke
ii. Smother any flames by covering them with a blanket
iii. Drench burnt area immediately with cold running water
iv. Give fluids if patient is able to swallow
v. Never give alcohol to the patient
vi. Direct patient to correct medical treatment

3.2.2 First Aid for Fractures

i. Do not move the casualty until the injured part is secured and supported, unless he is in immediate danger.
ii. Do not allow the casualty to eat or drink, because an anaesthetic may be needed.
iii. Do not press directly on a protruding bone end.
iv. Arrange removal for medical treatment, supporting comfortably during transport.

3.2.3 First Aid for Dislocated Joints

i. Do not try to replace a dislocated bone into its socket as this may cause further injury
ii. Do not move the casualty until the injured part is secured and supported, unless he/she is in immediate danger
iii. For hand or arm injury remove bracelets, rings and watches in case of swelling.
iv. Do not allow the casualty to eat or drink because an anaesthetic may be needed.
v. Arrange removal for medical treatment, supporting comfortably during transport.

3.2.4 Emergency Practices

3.2.4.1 Action to be taken in an emergency

- Switch off the electricity supply, if supply proves to be dangerous.
- Inform all people of the emergency (by sounding the emergency alarm)
- Discontinue work engaged in
- Do not panic
- Assemble at a previously known safe location.
- Ensure all persons arrive at the safe location.

3.2.4.2 Firefighting

- Firefighting equipment should be available and it should be marked for the type of fire.

Type of fire		Extinguisher Type
A	Solid (wood, paper, plastics etc.)	Water/Foam/Powder
B	Liquid (Oil, Petrol or spirit type liquids, paint etc.)	Foam/CO2/Powder
C	Gases (LP Gas, Accetiline, etc.)	CO2/Powder
D	Metal (Aluminium, Led, etc.)	Special Fire Extinguishers
E	Electricity	CO2/Powder
F	Cooking oil	Wet Chemical

Table 3: Types of fires and extinguisher types

4 Accident reporting

4.1 Legal requirement

- Fill out the relevant forms and forward to the doctor who is attending to the patient
- Inform all fatal accidents due to electric shocks to the nearest Police Station of the area and relevant electrical supply authority. Form 10 should be filled and sent to labour department after employee reports back to work
- Inform the Chief Factory Inspecting Engineer. Department of labour as per Factories Ordinance
- Inform the Commissioner for Workmen's Compensation as applicable.

4.2 Institutional requirement

- Anybody who suffers from an electric shock should seek immediate first aid and medical attention as this could cause long term effects. Inform all fatal and major accidents due to electric shocks to the Zonal Education Office and keep a record of the incident.
- Get the installation, outlets and appliances checked by a chartered engineer. Any equipment that caused an accident should be checked before re-use
- Appropriate corrective action has to be taken to prevent such incidents in future
- Hold the preliminary inquiry and forward to the Zonal Education Office for the formal enquiry
- If there is severe damage to persons or property or in the event of a fatal accident, This will need to be informed to the labour department/police/electrictiy supplier/ PUCSL

4.3 Report/record keeping of accidents

- All the reports & records in connection with the accident should be maintained under the custody of the Principal

4.4 Compensation

- Arrangements should be made to pay compensation (if applicable) to the affected party based on the instructions of the compensation commissioner.


Annexures

Following are the commonly identified shortcomings and defects in school electrical installations. PUCSL would like to draw the attention of principals, school development committees, old pupils associations and parents associations etc., to conduct a proper investigation on a school's electrical installation in consultation with the School Works Branch of the Education Ministry or any other technically competent person or organization to rectify any such defects in the system.

Poor practices and poor house keeping

- There is no nominated person to look after the electrical system
- No competent person identified to investigate poor maintenanace or counduct poor maintenance
- New constructions, extensions and alterations are not properly coordinated.
- No records available on breakdowns, as built drawings, test reports and warrantee cards etc.,
- Safe practices are not followed properly during new constructions, extensions and alterations.
- Safe practices are not followed properly during temporary wiring for sport festivals, festive seasons and exhibitions etc.,
- Exsistence of HT lines running close to school premises.
- Unattended, poorly maintained and broken electrical systems.

Shortcomings in installation

o Main Switch Board

- Location of main panel board
  - No satisfactory ventilation
  - No protection from extreme weather conditions, dust etc.
  - No easy access to maintenance work
  - No provisions for future expansions
  - Possible access for rodents
  - No easy access in case of emergency
  - Having flammable items within switch board room
  - No enclosure/cover plate

- Protection
  - No proper discrimination with downstream breakers
  - No proper spacing to enable heat dissipation
  - Loose connection
  - Multiple circuits originated from one terminal
  - Improper selection of breaker class
  - Improper breaker cable coordination
  - No considerations for future expansions
  - Trip switches have been by passed
  - No recurrent checking or testing to ensure proper operations of these protective devices
  - Use of trip switches with unsuitable leakage currents (100mA or above)
  - Nonfunctional trip switches and breakers
  - Use of incorrectly rated wires unbalanced cases

- Earthing
  - Earth wire observed is physically disconnected from earth electrode since no proper consideration is given for mechanical protection.
  - Earth wire has not been taken via shortest straight path. This is very significant when system is protected with Surge Protective Devices (SPDs).
  - Use of underrated earth cables at main panel earthing

- Outgoing Sub-main cables
  - Outgoing sub-main cables are not protected for over current (over loading and short circuits) and are directly feeding from bus bars of main panel.
  - No safe routes used or proper mechanical protection is not provided for most of the cables
  - Selected cables cannot maintain voltage within specified tolerances due to changes being made from time to time without a competent person being consulted.
  - Cables (some phases) found heavily degenerated due to excessive overloading & aging.

- Drawing excessive amount of wires through conduits
- Wrong selection of cables (Eg. For three phase applications contractors are using 300/500V cable to reduce cost.)

o Sub-main panel
  - Almost similar observations made as above

o Consumer Units 60A –Three Phase
  - In some cases instead of placing minimum 16mm2 cable contractors use 10mm2 cables. (Depending on length cable cross section may need to be further increased)
  - Observed 60A Isolators instead of 60A MCB
  - Observed 40A, 30mA,2pole RCD being used under 60A MCB or 60A Isolator .
  - Observed 40A, 100mA,2pole RCD being used under 60A MCB or 60A Isolator.
  - Observed 60A, 100mA,2pole RCD being used to protect socket circuits.
  - Observed 60A, 30mA,4pole RCD being used to protect socket circuits, even though wrong which generated lots of practical difficulties.
  - Observed multiple circuits originating from one MCB
  - Observed 16A,20A perhaps even larger MCB used to protect 1mm2 cables
  - Observed 10mm2, 6mm2, 4mm2 and 2.5mm2 earth cables to establish earthing.
  - Observed some MCBs and RCDs are not functioning properly
  - Observed internal contact points of some MCBs and RCDs are welded with no making or breaking action.
  - Observed that RCDs are bypasseed to avoid tripping

o Consumer Units 40A –Three Phase
  - In some cases instead of placing minimum 10mm2 cable, contractors use 6mm2 cables. (Depending on cable length, cross section may need to further increase)

- Sometimes observed, 40A Isolators instead of 40A MCB
- Sometimes observed, 40A, 100mA,2pole RCD use to protect socket circuits.
- Sometimes observed, 40A, 30mA,4pole RCD used to protect socket circuits.
- Observed, multiple circuits originating from one MCB
- Observed, 16A,20A perhaps even larger MCB used to protect 1mm2 cables
- Observed, 6mm2, 4mm2 and 2.5mm2 earth cables to establish earthing.
- Observed, that some MCB and RCD are not functional.
- Observed, that in some MCB and RCD internal contact points are welded and there is no making or breaking action
- Observed, that RCDs bypass to avoid tripping

o Consumer Units 30A –Three Phase

- Observed, 40A Isolators instead of 32A MCB
- Under above condition 6mm2 cables are used. (Depending on length of cables cross section may need to be further increased)
- Observed 40A, 100mA,2pole RCD being used to protect socket circuits.
- Observed, 40A, 30mA,4pole RCD being used to protect socket circuits.
- Observed, multiple circuits originating from one MCB
- Observed, 16A,20A perhaps even larger MCBs being used to protect 1mm2 cables
- Observed, 4mm2 and 2.5mm2 earth cables establish earthing.
- Observed, that some MCBs and RCDs are not functioning
- Observed, that in some MCBs and RCDs internal contact points are welded and there is no making or breaking action.
- Observed, that RCDs are bypassed to avoid tripping

o Observed broken switches, Fan regulators, Socket outlets connected to the live circuits

o Observed Non-conducting metal based parts such a roofs, gutters, handrails, cable trays, ladders etc., not properly earthed.

Shortcomings in Management

- No responsible person is appointed to ensure electrical related safety of the occupants
- No warning tags are attached for malfunctioning equipment
- No persons from the area have been selected to undertake electrical repairs and equipment testing of the school electrical installation.
- No procedure to evaluate competency of contractors, sub-contractors and other service providers
- No proper coordination with School Works Branch of the Education Ministry for new constructions and other sizable electricity related projects.
- A competent person is rarely employed for temporary electrical work such as sport festivals, festive seasons, exhibitions etc.
- Records, test reports, warrantee cards and as built drawings of new constructions, alterations and extensions are not available.
- No inspection program is arranged to identify defects of the electrical installation
- Lack of supervision for students when engaged in electricity related activities
- Students sometimes engaged in maintenance or repairing activities involving electricity
- No procedure for getting the drawings and designs approved by School Works Branch of the Education Ministry before commencing construction
- No insurance is taken for construction/renovation projects
- Before starting work, contractor shall take all precautions such as fencing, netting, safety notice, etc, to avoid any kind of accidents
- Temporary electrical systems for stores, workers huts, temporary toilets etc., are not drawn in a safe manner.
- No mechanism is implemented to commission building electrical installation after a major renovation or new construction.
- No proper work permit is obtained and no proper work procedure is been followed by maintenance staff.
- Outdoor lights are left on during day time

All such observations are deviations from the regulations and can cause electrical hazards. The scale of the damage may range from small fire, equipment damage etc., to sizable fire, damage to entire building and loss of lives. Therefore, it is very important to be vigilant about electrical systems and maintaining them in compliance with standards.Further, it is equally important to understand how to handle electricity safely, limitations and maximum current levels that humans can tolerate.

Testing & Tagging of electrical equipment is required only for equipment in workshops, construction sites or used in hostile operating environments.

Given below are examples of equipment requiring testing and tagging.

Nature of Equipment	Example
Hand held equipment	Hand held power tools Hairdryers Kitchen appliances Laboratory equipment
Portable equipment	Floor polishers Vacuum cleaners Portable lighting equipment Pedestal Fans Heaters
Electrical equipments that is moved between operation in such a manner that could damage the flexible supply lead(Portable equipment with cabling system)	Overhead projectors Laptop computers Welding equipment/Machine Extension cords Power boards Battery charges Portable RCDs Portable outlet devices Isolation transformers
Equipment used in workshops, hostile operating environments- Operating conditions that are like to result in mechanical damage to the equipment or exposure to moisture, heat, vibration, corrosive substances or dust or fumes could damage the function of the equipment	Electrical appliance/equipment used in ☐ Wet or dusty areas ☐ Outdoors ☐ Kitchens ☐ Laboratories with chemical fumes/liquid environment ☐ Workshops

Note:-

New electrical equipment is not necessary to be checked in accordance with the principle of safe design and manufacture. However,visual inspection is necessary to ensure that no damage has occurred during transportation. However, if future testing is necessary, then the tag has to be incorporated.

School Name……..……

Location/room …….……. Date of Inspection…….……

Description of the Equip./Appliance	Building & Room No.	Requirement of Tag	Visual Inspection	Tested by Instrument	Observation	Inspected Date

Tested By:…….……. Next Date of Inspection:.....…….

Annexure 03

Maintenance and record keeping of appliances/equipment

School Name…….....……

Location/room …….....…. Date of Inspection…….....…….

Location	Description of the equip.	Danger Tag	Comments	Action Repair Dispose

Tested By: ..... Next Date of Inspection: .....

NB: Disposal should be done as per government circular

Annexure 04 Maintenance and record keeping of appliances/ equipment

Location/room:…….. Date……..				
"Space"	Fault	Yes	No	Comments
Distribution Board	Trip switch not working			
	Trip switch is not RCD type			
	Tripped MCBs			
	MCBs not working			
	An emergency power shut off is present			
	Not easily accessible			
	Adequately ventilated			
Wiring	Exposed wiring			
	Broken conduits			
	Incorrectly sized			
	Temporary Wiring			
Lamps	Burnt/Not installed			
	Not fixed properly			
	Broken Lamp holder/ceiling rose			
Fans	Fan regulator not working			
	Fan not working			
	Regulator not fixed properly			
	Fan not fixed properly			
Plug Sockets	Burn Marks on plug sockets			
	Not Fixed properly			
	At an unsafe location			
Extension Cords	frayed cords			
	cracked tool casings			
	Discolored and heated outlets			
	Loosen plugs at outlets			
Switches	Hard to switch on/off			
	Not fixed properly			
	Single switch to multiple items			
Appliances	Damaged Cords/insulation			
	Located in wet conditions			
	Damaged/Removed Ground Pins			
Earthing	Integrity of Earth Wire			
	Insulation failures of earth wire			
Outdoor	Power lines are at a safe distance			
	Exposed temporary wiring			
	Electrical safety at water features			
Service Wire & Meter				
Tested By: …….. Next Date of Inspection: ……..				

- Selection of competent electricians/contractors to carryout renovation or construction activities related to electrical system of schools
- Recommend electrical products to be used for new constructions and renovations related to electrical system in schools.
- Coordinate with schools and verify designs and materials to safely carry out new construction or extensions to existing installation.
- Check whether existing power supply is adequate to cater the incoming demand incurring through new constructions/extensions.
- Assist in arranging training programs to the nominated key teacher with the support of PUCSL and Licensees.
- Coordinate with principals to carry out a risk assessment of present electrical installations and assist in the rectification process.
- Initiate periodic electrical safety inspections in schools to ensure safety.
- Make specifications addressing electrical safety, efficiency for electrical appliances to be bought for constructional and operational activities in schools.
- Work with PUCSL to further improve electrical safety in schools by ensuring this guideline is properly implemented and propose measures to strengthen & enhance the scope of this guideline.