Lothian Operational Standard

LB-HS-118 Electrical Safety

This Standard details the minimum requirements for ensuring compliance with health and safety legislation and implementation of the Lothian Buses' H&S Policy Statement.

1. INTRODUCTION

Each year there are approximately 20 deaths in the workplace as a result of electrical accidents involving either electric shock or burns, most of which preventable.

Electric shock is not the only hazard. Where electrical arcing occurs, perhaps as a result of accidental short circuit, the heat generated can be intense causing deep seated and slow healing burns. Intense ultra violet radiation from arcing can cause damage to the eyes and arcing, overheating and electrical leakage can cause fire or explosion causing injury and death, loss and damage of property and other assets.

Most accidents occur because people are working on or near electrical systems that are:

- Thought to be dead but are live;
- Known to be live but those involved do not have adequate training or the appropriate equipment, or they have not taken adequate precautions

2. POLICY STATEMENT

Lothian are committed to ensuring the safety of employees working on or near electrical equipment[1] and electrical systems[2] and will take reasonable steps to ensure equipment and systems are maintained in good condition in order to prevent danger.

3. SUMMARY OF REQUIREMENTS

The Health and Safety at Work Act, and more specifically the Electricity at Work Regulations, require that employers provide a safe and healthy working environment by ensuring that precautions are taken against personal injury from the use of electricity in work activities including:

- Ensuring the risks from work activities involving electricity are properly assessed and managed.
- Providing electrical equipment which is safe to use, suitable for the task and the environment it is to be used in.

[1] **Electrical equipment** - includes anything used, intended to be used or installed for use, to generate, provide, transmit, transform, rectify, convert, conduct, distribute, control, store, measure or use electrical energy
[2] **Electrical Systems** – An electrical system in which all the equipment is, or may be, electronically connected to a common source of electrical energy, and includes such source and such equipment

- Designing, constructing and installing electrical systems so as to prevent damage.
- Electrical systems are maintained in a safe condition and necessary preventative maintenance is carried out.
- Developing and implementing safe system of works for the maintenance, inspection and testing of equipment.
- Prohibiting work on or near live conductors unless absolutely necessary and certain precautions are in place
- Ensuring employees and contractors who carry out electrical work are competent to do so and have sufficient information and instruction
- Reducing supply voltage and installing safety devices e.g. residual current devices (RCD) wherever possible to reduce risk of personal injury

4. WHAT NEEDS TO BE DONE

Risk Assessment

4.1 Lothian must ensure arrangements are in place to identify sources of electrical energy and that risks involved in the operation, inspection and maintenance of electrical systems and equipment are properly assessed and measures to control risks are fully implemented.

4.2 The risks can increase if equipment is used in hash conditions, wet environments, outdoors where it is prone to damage, in cramped spaces with a lot of earthed metalwork such as inside a tank. The risk assessment should indicate what action will be taken to use and maintain electrical installations and equipment and the frequency of the maintenance.

4.3 A further and more specific risk assessment will be necessary prior to work commencing on or near electrical systems and equipment and where there is risk of injury. (See restrictions on Live Working).

Safe Electrical Systems and Equipment

4.4 Electrical installations and equipment must be designed, constructed and installed by a competent electrician in accordance with statutory requirements and IEE Wiring Regulations (BS7671 Requirements for Electrical Installations) and so as to prevent damage.

4.5 Electrical equipment must not be connected into a system if there is a chance that its strength and capability may be exceeded in such a way as to cause danger.

4.6 All electrical equipment and electrical systems provided must be suitable for where and how it is to be used and it must be adequately protected if exposed to

potentially harsh conditions e.g. adverse weather, wet, dirty, flammable or explosive environments.

4.7 Suitable arrangements must be in place to ensure electrical systems are maintained in a safe condition and necessary preventative maintenance is carried out.

4.8 Lothian must have arrangements in place to ensure fixed electrical systems are tested by a competent electrician[3] at least every 5 years and any remedial actions addressed.

Safe Systems of Work – Isolated Systems

4.9 All electrical equipment (except power sources themselves) must have secure and safe means of isolation from all sources of electrical energy.

4.10 All work on electrical systems and equipment must be carried out while it is isolated from the power supply and all conductors discharged. In order to prevent injury, Lothian must develop procedures for the disconnection and isolation of systems prior to the commencement of work to ensure:

- The source of electrical energy is isolated
- The system cannot be re-energised
- Persons isolating and working on the system are competent to do so and able to declare/sign off the isolation certificate
- The isolation certificate indicates the following status:
    - The means by which the competent person has isolated the circuit(s) he/she is working on (fuse/switch/other mean disconnection as appropriate),
    - That there is no secondary source and the energy cannot easily be turned on or that circuit re-energised,
    - Notices have been posted/displayed to that effect

4.11 Similarly, work on electric or hybrid vehicles is specialised and must only be undertaken by competent vehicle technicians with comprehensive knowledge of the electrical systems, appropriate precautions in place, and only when the system has been isolated.

4.12 Additional precautions must be taken for the isolation of high voltage systems, coordinated by a written safe system of work and controlled by full electrical permit to work.

[3] Competent electrician – working to IEE Regulations NICEIC approved

Restrictions on Live Working

4.13 Live working[4] is not considered 'normal' practice and is strictly prohibited unless it is absolutely necessary.
The need for the work must be justified to a Senior Manager or Director and item 4.12 MUST be fully satisfied.

4.14 Work on or near live conductors is only permitted where ALL three of the following criteria can be met:

i. It is unreasonable in all circumstances for the system to be dead
ii. It is reasonable for the work to be carried out live
iii. Suitable precautions can be taken, specifically:

- A permit to work is in place
- Only qualified and competent persons will carry out the work
- Special tools[5] including rubber mats and gloves are used
- There is a second person present who understands the activity and can deal effectively with an emergency
- Physical restrictions are in place which will prevent unauthorised entry to the working area

4.15 A separate detailed risk assessment must be carried out and documented prior to commencement of any work.

4.16 Robust arrangements must be established for adequate supervision of the work. The level of supervision will depend on the level of risk, competence, technical knowledge and experience of those carrying out the work.

Safe Use of Portable Electrical Appliances

4.17 Portable and transportable electrical equipment[6] must be inspected and tested as often as required by the risk assessment, guidance on typical frequencies is given in Table 1.

4.18 Portable and transportable electrical equipment should be operated at reduced voltage i.e. 110 volts supplied from socket outlets suitably located and fed from a transformer, with the 110-volt secondary output winding centre-tapped to earth.

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4 Live Working – Work that is undertaken on or near a live conductor
5 Special tools – Insulated tools and shrouded equipment
6 Portable and transportable electrical equipment i.e. not part of a fixed installation but intended to be connected to a fixed installation or generator by means of a flexible cable and plug and socket, spur box, or similar, including equipment that is hand-held or hand-operated while connected to the supply, or moved while connected to a power supply assumed to be at a voltage capable of giving a fatal electrical shock, i.e. more than 50 V ac or 120 V dc.

4.19 Where a reduced voltage supply is not practicable and a 230-volt supply to portable tools has to be used, 'double-insulated' or 'all-insulated' tools must be supplied. A 230V supply must not be used in wet environments.

4.20 Sockets for equipment in wet or damp environments e.g. pressure washers, must be suitably rated at least IP54 (preferably IP57) and further protected by a residual current device (RCD). The RCD must be trip-tested during pre-use checks by the operator and subject to a defect reporting process.

4.21 In order to reduce the risk of electric shock all hand lamps must be either:

- Reduced voltage, 110 volts transformed, centre-tapped to earth
- Separated extra-low voltage (SELV), which does not exceed 50 volts ac supplied from a double wound transformer
- 120 volts dc (ripple-free)

Only totally enclosed hose proof hand lamps operating at 24V from a double wound transformer are suitable in wet environments.

Pre-Use Checks, Defect Reporting and Records

4.22 Operators must be trained to make checks and test the operation of any RCD's before use similar to the following:

- Check that the equipment and any associated leads or extensions have a valid and current PAT test label attached
- Check that the plug is not damaged and that the cable is properly secured with no internal wires visible
- Check the electrical cable is not damaged and has not been repaired with insulating tape or an unsuitable connector
- Check that the outer cover of the equipment is not damaged in a way that will give rise to electrical or mechanical hazards
- Check for burns/staining that suggests the equipment is overheating
- Position any trailing wires so that they are not a trip hazard and are less likely to get damaged

4.23 Arrangements must be in place to ensure electrical equipment found to be defective is removed immediately and defects reported to a line manager.

4.24 In addition to user checks, a competent person should carry out formal visual inspection of the equipment and installation regularly.

Table 1:
Suggested frequency of Inspection and Testing for Portable Appliances

ELECTRICAL APPLIANCE	USER CHECKS	FORMAL VISUAL	COMBINED INSPECTION AND TEST
Hire Equipment	N/A	Before issue/after return	Before Issue
Construction (for indication only)	110V weekly	110V monthly	110V before 1st use on site then 3 monthly
	230V mains daily/every shift	230Vmains weekly	230V mains before 1st use on site then monthly
Light Industrial	Yes	Before initial use then 6 monthly	6 – 12 months
Heavy Industrial	Daily	weekly	6 – 12 months
Battery Operated (<20V)	No	Not required	Not required
Extra Low Voltage (<50V AC/120V DC) e.g. telephone equipment etc.,	No	Not required	Not required
Desktop Computers, Monitors, Photocopiers, faxes, printers If hand held or moved often e.g. laptops, the frequency should be increased	No	1 - 2 years	Not required if double insulated otherwise up to 5 years
Double Insulated, NOT hand held (moved occasionally) e.g. table lamps, fans, projectors	No	2 - 3 years	Not required
Double Insulated, Hand Held (Class II) e.g. some floor cleaners, kitchen equipment	Yes	6 – 12 months	Not required
Earthed equipment (Class I) e.g. kettles, boilers, some floor cleaners, some kitchen equipment	Yes	6 – 12 months	1 - 2 years
Cables (leads) and plugs connected to any of the above and extension leads	Yes	1 year	Depends on type of equipment connected to 2 years

Electrical Equipment in Potentially Hazardous Areas

4.25 Where areas have been identified as hazardous due to likelihood of flammable or explosive atmospheres in the Fire risk Assessment e.g. areas for storing, mixing or spraying paints, body preparation areas where organic body fillers are sanded, battery charging areas and vehicle inspection pits where LPG or petrol vehicles are being worked on, electrical equipment must meet the requirements of the

Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations as follows:

- Category 1 Equipment must be used in Zone 0/20 Gases, vapours mists or dusts present continuously/for long periods/frequently
- Category 1 or 2 Equipment must be used in Zone 1/21 Gases, vapours mists or dusts likely to occur in normal operation, but only occasionally)
- Category 1, 2 or 3 Equipment must be used in Zone 2/22 – Gases, vapours, mists or dusts not likely to occur normally or is for short periods only.

Low-voltage or battery-operated equipment offers no additional protection against the risk of flammable vapours being ignited by electrical equipment.

Vehicle Battery Charging

During charging, hydrogen and oxygen gases are also produced inside a battery, creating an explosive mixture. If this is ignited, the battery may shatter, ejecting sharp fragments and corrosive chemicals.

4.26 Arrangements must be in place which will ensure safe charging and use of batteries and consider the following precautions to prevent personal injury:

- The charging area is in a well-ventilated area and designated "No Smoking, No Naked Lights" and it is away from the vehicle and other sources of ignition and the risk of ignition is reduced to a minimum.
- An automated charger is used which varies the current supplied according to the charge in the battery. As the battery becomes fully energised, the current drops to a trickle and gassing is greatly reduced. Batteries should not be charged at rates in excess of those stated by the manufacturer.
- The battery charger is switched off before connecting or disconnecting the clips from the charger. If possible, connect the clips remote from the battery terminals. Keep crocodile clips clean and free from corrosion and, except for the contact surfaces. Clean battery terminals before fixing charging clips.
- Battery discharge testers are not used immediately after charging, when false readings may be obtained.
- The battery charger transformer is either of the safety isolating type (with an earth screen or windings on separate limbs of the core) or one pole of the charging circuit is earthed and marked to prevent a short circuit when the charger is used with a vehicle battery on which a different pole is earthed.
- Metal finger and wrist jewellery is removed as contact with battery terminals causes burns and flash injuries and should never be worn when working with batteries. Metallic objects should be prevented from falling across terminals wherever batteries are handled, charged or stored

- Any battery-boosting sets that are used must be fit for purpose, positive and negative terminals or not in close proximity and jump leads are adequately insulated to prevent sparking.

Information Instruction and Training

4.27 Information, instruction and training must be provided to employees as necessary to enable them to carry out their duties without putting their health and safety at risk.

4.28 Records of training and the issue of information given to either employees or contractors must be retained and made available if requested.

4.29 Managers must ensure they obtain a record of any training or information given to either employees or contractors and that the records are readily accessible if requested.

4.30 To ensure continued competence in the safe use of work equipment employees must receive refresher training at regular intervals. Typically training should be repeated at intervals of 3 - 5 years depending on the outcome of the site-specific risk assessment.

Competent Persons

4.31 Where electrical work is necessary it must be carried out only by persons, employees or contractors who have received adequate training, instruction or information and are competent to do so. The level of competence required to carry out a task is dependent upon the complexity of that task and the amount of knowledge required.

4.32 Lothian must assess the suitability of an individual to do a task and seek evidence of:

- Training to an appropriate level in the area of work
- Experience of achieving a suitable standard in similar work
- Regular re-assessment

Persons who are unable to demonstrate the required competence should not be allowed to work unless they are fully supervised by someone who is competent.

5. WHO SHOULD DO IT

5.1 **Managing Director,** having overall accountability for safety must:

- Ensure that the requirements of this standard are fulfilled,

- Ensure responsibility is appropriately allocated for the installation, maintenance and management of electrical equipment and necessary resources are made available to enable duties under the Electricity at Work Regulations to be fully discharged and any remedial actions addressed.

5.2 Directors and Senior Managers must:

- Ensure arrangements for assessing and controlling risks, associated with working on or near electrical equipment or systems are in place at each location and managers allocated with duties have sufficient resource and competency to fulfil their duties
- Ensure that arrangements are in place for testing of fixed installations and systems and portable appliances and that any remedial actions are addressed in a timely manner
- Regularly monitor and review the effectiveness of the arrangements and in the light of changes to legislation, working practice or in the event of an incident or injury e.g. arrangements for assessing the competency of contractors and resources which will ensure provision of an adequate level of supervision and monitoring
- Ensure those supervising or managing work activities involving work on or near electrical equipment and systems and where there is personal risk of injury, have received an appropriate level of training, instruction and information and are competent

5.3 Line Managers e.g. Engineering, Operations other equivalent managers, must ensure:

- Risks from electrical equipment and systems are considered in the review of the general risk assessments and measures provided to eliminate or control risk are fully implemented
- New equipment requiring formal inspection is inspected before its first use and at regular intervals
- Electrical equipment is maintained in a safe condition and tested periodically i.e. testing of fixed installations and portable equipment is arranged and remedial actions are addressed in a timely manner
- Competency of employees is assessed and an appropriate level of training, instruction and information is provided and refreshed at regular intervals
- Competency of contractors working on or near electrical equipment is assessed and an appropriate level of instruction and information is provided to them and that an appropriate level of supervised and monitoring is provided
- All records and documents relevant to maintenance and inspection are retained and made available on request

- Defect reporting arrangements are in place, defective equipment removed from service and remedial action taken to rectify any faults

5.4 **Employees** must:

- Familiarise themselves with the risks associated with the use and maintenance of electrical equipment and systems and take the necessary precautions to protect themselves and others in the vicinity
- Carry out pre-use visual checks and ensure any damage or defects are reported to the line manager
- Adhere to control measures, safe systems of work, training and instructions observing all verbal or written instructions and make proper and full use of any safety devices and systems provided for their safety
- Stop, Think and 'Check' for potential hazards immediately before starting a task and to take into account changing circumstances throughout the task by carrying out a dynamic risk assessment[7]
- Cooperate with management, and others who have responsibility for ensuring precautions are in place to reduce risks and that these are maintained
- Not misuse or damage equipment which has been provided to reduce risks
- Report defects in control measures and work equipment and unsafe conditions immediately to the line manager
- Raise any other concerns they may have about their health and safety with their manager in the first instance

6. MEASURE

6.1 The requirements of this standard will be monitored by Lothian H&S to ensure effective implementation. Evidence of effective management will include:

- Records of testing of fixed installations and portable appliances
- Management action plans for addressing remedial work from testing and defect reporting regimes
- A process for ensuring competency of contractors and employees operating, maintaining and testing electrical equipment and systems

7. AUDIT

7.1 Compliance with the requirements of this H&S Standard will be audited periodically in accordance with the Lothian Audit Programme

7 Dynamic Risk Assessment – An ongoing mental assessment by the employee which takes into account changing hazards, circumstances and capabilities immediately before and throughout the task/activity/shift.

8. REVIEW

This H&S Standard will be reviewed every 2 years or in accordance with Lothian Management of Change following significant changes in the matter to which it relates

9. REFERENCES AND RESOURCES

- HSR25 Memorandum of Guidance on the Electricity at Work Regulations
- HSG107 Maintaining Portable and Transportable Electrical Equipment
- HSG85 Electricity at Work - Safe Working Practices
- INDG231 Electrical Safety and You
- BPG2 Guidance on the Management of Electrical Safety and Safe Isolation Procedures for Low Voltage Installations