Health and Safety Unit

Health and Safety Codes of Practice

Safety Codes

Electrical Safety

THIS CODE OF PRACTICE FORMS PART OF THE UNIVERSITY'S HEALTH AND SAFETY POLICY AND REPLACES ALL PREVIOUS ISSUES

INDEX

1. OBJECTIVE

The objective of this Code is to provide guidance on the use of electricity in the University and to ensure that all work with electricity is undertaken under the best practicable conditions and in accordance with the Electricity at Work Regulations 1989 and its Approved Code of Practice, Health and Safety Executive Guidance, and the Institution of Electrical Engineers (IEE) Guidance.

2. BACKGROUND

Electricity can kill. Each year about 1,000 accidents at work involving electric shock or burns are reported to the Health and safety Executive (HSE). Around 30 of these are fatal. Most of these fatalities arise from contact with overhead or underground power cables.

Even non-fatal shocks can cause severe and permanent injury. Shocks from faulty equipment may lead to falls from ladders, scaffolds or other work platforms. Those using electricity may not be the only ones at risk: poor electrical appliances can lead to fires, which may also cause death or injury to others. Careful planning and straightforward precautions can avoid most of these accidents.

3. DEFINITIONS

3.1 Electrical Appliance

All appliances and devices using electric energy regardless of the voltage, or a power source.

3.2 Portable Appliance

All equipment that is not part of a fixed installation, but is intended to be connected to a fixed installation, or a generator, by means of a flexible cable and plug and which is normally moved around or can easily be moved from place to place. This includes equipment that is either hand-held or hand-operated while connected to the supply e.g. vacuum cleaners, kettles, heaters, fans, televisions and desk lamps, and also equipment that can be moved e.g. desktop computers, photocopiers and fax machines.

3.3 Distribution System

All systems designed for the transport of electrical energy to a point of use or connection to the user’s appliances regardless of source, strength, or potential of the system.

3.4 Competent Person

A person with adequate knowledge, experience, and understanding of electricity to enable him/her to understand the hazards and recognise unsafe conditions.

4. ELECTRICAL DISTRIBUTION SYSTEMS

4.1 Installation

All systems must be planned by a competent engineer and approved by Property Services, who will specify who will carry out the installation in accordance with HSR25 Memorandum of Guidance on the Electricity at Work Regulations and current IEE standards, and maintain a list of approved electrical contractors qualified to current IEE standards.

4.2 Modification of Systems

All modifications to distribution systems must be approved by Property Services and carried out as in 4.1 above. This will be taken to include changing socket outlets.

Note: 4.2 above applies to **all** modifications no matter how small and regardless of the competence of the staff making the modification. Failure to comply with this instruction may render the persons responsible to disciplinary action.

4.3 Installation Standards

All installations and modifications will be in accordance with the current IEE Codes, and include the appropriate protection devices as per the IEE Codes.

4.4 Examinations of Distribution Systems

(a) All systems will be examined by a competent person at intervals of not more than 5 years.
(b) Systems which are in "hostile environments" or liable to speedy deterioration will be tested at shorter intervals as decided by the person in 4.1 above.
(c) A record of examination is to be held by Property Services' Statutory Compliance Officer.

Property Services will appoint a Statutory Compliance Officer, giving clear powers and authority, for all electrical systems and make the necessary arrangements for compliance with this instruction.

5. PORTABLE APPLIANCES (Including fixed equipment/plant powered by electricity)

5.1 Responsibility

The Departmental Head responsible for the purchase and use of portable appliances is in all respects also responsible for the testing and maintenance of the equipment. **Property Services** will provide advice on how the duties are met where users have insufficient "in house" knowledge or expertise.

5.2 Purchase

All newly acquired portable appliances must be marked with the symbol of, and/or have a certificate of approval in accordance with, the current British or European Union standard. Purchasers are strongly advised to quote this requirement on all orders.

5.3 Modification/Repair

Any alteration, modification or repair must be carried out by a competent person and pass all the appropriate testing requirements in Appendix I before use.

5.4 'Home Made' Appliances

Any equipment produced 'in house' must satisfy all the criteria required for approval by the appropriate British/European Standard and be tested by a competent person before use.

5.5 Testing of Portable Appliances (includes fixed appliances, refer to Appendix I)

(a) All portable appliances should be tested or inspected in accordance with Appendix I or a written test procedure for non-standard equipment where the tests outlined are inappropriate.

(b) Procedure for testing is as follows:

i) Each School/Service is to create an inventory of portable appliances owned or used.

ii) A competent person should decide the frequency of tests/inspections for each class or group of appliances, as outlined in Appendix 1 of this document.

iii) Tests/inspections should be carried out by a competent person. There are two levels of competency:

- The first level is where a person not skilled in electrical work routinely uses a simple 'pass/fail' type of portable appliance tester (PAT), where no interpretation of readings is necessary. The person would need to know how to use the PAT tester correctly. Providing the appropriate test procedures are rigorously followed and acceptance criteria are clearly defined, this routine can be straightforward.

- The second level is where a person with appropriate electrical skills uses a more sophisticated instrument that gives actual readings requiring interpretation. Such a person would need to be competent through technical knowledge or experience related to the type of work.

Note: Property Services must be satisfied that the equipment, its location and testing arrangements are satisfactory and will provide expert guidance and advice where necessary. Schools/Services will advise Property Services' Statutory Compliance Officer of the arrangements for their equipment and its testing.

iv) School/Service Health and Safety Officers will create a record capable of:

- Identifying each appliance and showing the frequency of test/ inspection
- Recording the test result, and marking the appliance
- Programming the next test
- Identifying safe and unsafe appliances

Such records must be available for inspection/audit by Property Services, Health and Safety Unit and relevant enforcing authorities.

APPENDIX 1

Guidance on tests and inspections and their frequency (extract from Health and Safety Executive Guidance HS(G)107 Maintaining Portable and Transportable Electrical Equipment)

Appendix 1 sets out the suggested frequency of formal visual inspections and combined inspections and electrical tests for portable and transportable electrical equipment.

It gives suggested starting intervals when implementing a maintenance programme. Where one figure is given, this is a guide for anticipated average use conditions; more demanding conditions of use will require more frequent formal visual inspections, and/or combined inspections and tests. Where a range is shown, the small interval is for more demanding conditions of use and the longer interval is for less demanding ones.

It is up to the duty holder, with appropriate advice where necessary, to assess the conditions affecting equipment, which may lead to potential damage and/or deterioration and should determine the maintenance regime.

Note: the test of equipment supplied under contract such as photocopiers and vending machines are to be specified as the responsibility of the provider in the drawing up of contracts. The School/Service negotiating such contracts will be responsible for this being carried out.

Type of business	User Checks	Formal visual inspection	Combined inspection and test
Equipment hire	N/A	Before issue/after return	Before issue
Construction (for indication only. See Electrical safety on construction sites for more detail)	110 V weekly 230 V mains – daily/every shift	110 V -monthly 230 V mains - weekly	110 V – before first use on site then 3-monthly. 230 V mains – before first use on site then monthly
Light industrial	Yes	Before initial use then 6 - monthly	6 -12 months
Heavy industrial/high risk of equipment damage	Daily	Weekly	6 -12 months
Office information technology, eg desktop computers, fax machines, photocopiers	No	1 - 2 years	None if double-insulated, otherwise up to 5 years
Double-insulated equipment not hand-held, e.g. fans, table lamps	No	2 – 3 years	No
Hand-held, double-insulated (Class II) equipment, eg some floor cleaners, kitchen equipment and irons	Yes	6 months – 1 year	No
Earthed (Class 1) equipment, eg electric kettles, some floor cleaners	Yes	6 months – 1 year	1 – 2 years
Equipment used by the public, eg in hotels	By member of staff	3 months	1 year
Cable and plugs, extension leads	Yes	1 year	2 years

APPENDIX II

Health and Safety Executive Guidance GS23 Electrical Safety in Schools (extract)

Electrical installations

1. The Institution of Electrical Engineers publishes a Code of Practice known as the Regulations for Electrical Installations (commonly called the IEE Wiring Regulations).

2. Fixed electrical installations which have been installed in accordance with the present or earlier editions of the IEE Regulations for Electrical Installations should be safe for general purposes, provided that they have been adequately maintained. It is recommended that management ensure that electrical installations are inspected and tested by a competent person AT LEAST every 5 years (3 years in the case of agricultural/horticultural installations). Experience may show that fixed installations in some schools are subject to damage and abuse: this also applied to some installations in temporary (portacabin) classrooms. In such cases more frequent inspection and testing will be necessary. Guidance on inspection and testing may be found in the IEE *Regulations for Electrical Installations.*

3. All electrical equipment, including socket outlets and other fittings such as lights, radiant heaters etc., should be chosen bearing in mind the use and abuse to which it may be subjected. This advice applies to alterations, even of a minor nature. Items that are close to where pupils sit are likely to be meddled with and should be selected and located with this in mind.

4. The IEE *Regulations for Electrical Installations* cover all electrical installations, including temporary systems (for example stage lighting and its control gear etc.) The Regulations recommend that such temporary installations be tested and inspected initially and at least every 3 months thereafter.

5. Experience has shown that the fixed electrical installation associated with stages/theatre halls may be altered, modified, extended or otherwise changed, often by people with limited electrical knowledge and competence. It is strongly recommended that these changes are inspected and tested before being energised and that these fixed installations are inspected and tested annually (see paragraph 2 above).

Apparatus

6. Most of the electrical equipment used in the University will be of normal domestic or commercial pattern. Modern apparatus designed to comply with the Low Voltage Electrical Equipment (Safety) Regulations 1989 should be safe in normal use. Apparatus complying with the Electrical Equipment (Safety) Regulations 1975, which have now been revoked by the 1989 Regulations, may continue to be used and should be safe in normal use when properly maintained.

7. It is recommended that users should prepare an inventory of all electrical apparatus used in the University. This may be taken room by room or department by department or by some other similar means of identification. When the inventory is prepared, and during subsequent updating, a competent person should examine the apparatus so that obsolete, redundant or defective apparatus can be removed from service or store and be properly repaired or disposed of.

8. Some electrical apparatus for special purposes may not have been constructed to modern safety standards. For example, some pottery kilns may have exposed electrical elements that are live at mains voltage and can be touched. Similarly, radiant heaters of older designs may be inadequately guarded to prevent shock, burns or fire. Such

equipment need not necessarily be brought up to more modern standards published since the equipment was manufactured, but it must be made safe, for example by guarding and/or interlocking etc. as appropriate, to prevent access to the conductors when they are live. Guidance may be found in BS5304: 1988 *Code of practice for safety of machinery.*

9. Particular care is needed with modified or 'home made' equipment, whether for general use or for use in science laboratories. During 1989, for instance, a student received a 240-v ac shock while connecting a video lead to a television because of the holes drilled into the television casing by the technician when mounting the set on a stand. Modifications should be made only by a competent person working to manufacturer's instructions. All homemade apparatus should be robustly constructed and properly protected to prevent electric shocks. The design of such equipment is important: it should be inspected and tested before use by a competent person.

10. All portable electrical apparatus should be routinely inspected or tested. It is recommended that a register be kept, e.g. a logbook or record card system, and that each item of portable apparatus for use at more than 50 v be given identification. Each school term (preferably before terms starts) all such apparatus should be visually inspected and any defects rectified. Experience may dictate that some apparatus in some schools will need more frequent inspection. It is strongly recommended that when new or replacement equipment is purchased (e.g. hand lamps, soldering irons) consideration should be given to equipment operating voltages of 50 v ac or less.

11. All class 1 (earthed) hand-held portable electrical equipment such as drills, saws, irons, hand lamps, etc. should be subject to a detailed inspection and test (see Appendix 1) by a competent person, who should record the results in the register, at least every 12 months. The earth connections should be examined and tested. Earth continuity tests should be made using proprietary test equipment at not less than twice the current rating of the fuse protecting the equipment.

12. All Class II (double insulated) hand-held portable electrical equipment should be visually inspected for damage or defect by the lecturer or technician before use. This equipment should be subject to a detailed inspection and test (see Appendix 1) based upon experience and the usage of the equipment.

13. Portable apparatus test units are available and can be used for these tests.

14. For all other items of equipment, such as bench mounted heaters, centrifuges, instruments, microscopes etc., not hand-held, the following should be observed.

15. Audio-visual and other equipment with exposed metalwork that can be touched should be treated as Class 1 (earthed) equipment and the metal work earthed unless the manufacturer specifically claims that the apparatus is double insulated. (Class II) he earth continuity test should not be less rigorous than that described in Paragraph II.

16. It is important that external metalwork of Class II (double insulated) apparatus is not earthed. Test units are available and can be used to test such equipment.

17. Where it is necessary to connect together equipment of Class I and Class II construction, it is essential that proper provision is made to ensure the efficient and effective connection of the Class I equipment to earth.

18. Where computers, television sets and other monitors are connected in networks, the filter-network currents within the individual items of equipment may summate to potentially dangerous levels. Danger may arise if there are defects in the protective

(earth) conductor system. In all such cases the advice of the manufacturers of the equipment should be sought and followed.

19. Flexible cables should be selected, maintained and used so that there is adequate protection against foreseeable mechanical damage.

Laboratories and other practical areas

20. Standard socket outlets, suitably positioned and used in conjunction with properly maintained mains voltage equipment, are generally acceptable for use in School laboratories. The positions chosen for socket outlets should however be such as to minimise penetration by water. If the situation is excessively damp or if, for example, washdown facilities are required, special socket outlets may be required.

21. For installations where water outlets are in close proximity to electrical socket outlets the provision of a high standard of electrical protection is important. Users of re- locatable laboratory service systems should take care that sinks are not moved so close to electrical outlets that safety is impaired.

22. A higher standard or electrical protection can be achieved through the use of residual current devices (RCDs), isolating transformers, or earth free areas.

23. Where RCDs are provided for personnel protection, the rated trip current should not exceed 30 mA and the RCD should comply with the requirements of BS 4293:1983 Specification *for residual current operated circuit breakers.* Isolation transformers should comply with the requirements of BS 3535:1987 *Specification for safety isolating transformers for industrial and domestic purposes.*

24. The provision of RCDs, also known as current operated earth leakage circuit breakers, is referred to in the IEE *Regulations for Electrical Installations.* RCDs may be used to provide additional backup protection against fire and shock. If RCDs are used they should be tested frequently by means of the test button. If the test fails, the system should not be used until it has been inspected and tested by a competent electrician. When the installation is routinely tested (see paragraph 2) the tripping current and timing of RCDs should be checked.

25. Where electrically operated hand-held portable equipment is used outdoors, the source of supply should be controlled by an RCD (see paragraph 22). 110-v centre- tapped earthed systems should be used, in conjunction with appropriate equipment wherever possible.

26. Where 1:1 isolating transformers are used to provide a supply that is not referenced to earth, a frequent maintenance procedure including tests should be established to ensure that no earth fault exists on the unearthed system.

27. Earthing the centre tapping of the secondary winding of a 1:1 isolating transformer supplied from the mains does not give a safe system - 120 V to earth can still be lethal. Such supplies need to be fused in both poles and if fused plugs are used THESE SHOULD NOT be of the domestic type (to BS 1363) that has a fuse only in the live pole. This implies the use of non-standard plugs and sockets with the resulting problem of flexibility of use in other parts of the school. Double pole switches will also be necessary. The centre-tapped to earth system may be combined with the use of an RCD if desired, in which case paragraph 14 also applies.

28. If a 1:1 transformer is fitted with a centre tapping with a high impedance connection to earth, this must be associated with sensitive earth leakage detection. The impedance must be not less than 12,000 ohms and the nominal tripping current of

the earth leakage device not more than 5mA. Standard plugs and sockets may be used with this system.

29. Plugs and sockets should be chosen to prevent accidental or inadvertent connection to the wrong supply, e.g. it should not be possible to plug 110-V apparatus into a 240- V socket outlet.

30. Where 240-V ac electrically operated equipment is used outdoors, appropriate plugs and sockets complying with BS 4343 should be used. IT SHOULD BE NOTED that standard 13-A plugs and sockets are not proof against the ingress of moisture/water/dirt.

31. A risk assessment must be carried out before this condition arises.

Live working

32. Where there is a possibility of a person, student or other, coming into contact with live conductors at voltages above 245 V or where large short-circuit currents could flow, for example from lead/acid 12 V batteries or similar, in experiments, the teachers and technicians involved should be electrically competent. This competence will necessitate technical knowledge or experience including:

- adequate knowledge of electricity
- adequate experience of electrical work
- adequate understanding of the system to be worked on a practical experience of that class of system
- an understanding of the hazards which may arise and the precautions which need to be taken
- ability to recognise at all times whether it is safe for work to continue

33. Advice on any special electrical facilities e.g. for evening classes, visiting musicians etc. is outside the scope of this guidance note. Such facilities that might be a danger to students should be removed before normal teaching begins or kept in a part of the building to which students do not have access.

34. Where setting up a project, experiment etc. is part of the learning process and if there is any possibility that the student might come into contact with parts live at more than 25V, special precautions must be taken, unless the apparatus is incapable of inflicting a dangerous electric shock. Such experiments and practical exercises must be checked for potential hazards and supported by written instructions that draw attention to the possible risks and the precautions to be taken, and a written risk assessment made by the supervising competent person.

35. Before the electrical supply is connected the lecturer should be satisfied that the equipment has been set up so that there will be no danger when the supply is connected (see paragraph 32). Connection to the supply should be made only by the teacher using plug and socket, a fused safe-block or similar connector with double pole switch or switch-fuse with the operating handle interlocked with the cover and all live terminals shrouded to prevent accidental contact.

36. Experiments and exercises of this type should be devised so that the student is not required to change connections in the course of the exercises.

37. Interconnecting leads having plugs with retractable shrouds are now available; they should be used where the voltage exceeds 50 V. If a fault occurs the equipment or exercises should be completely isolated from all supplies before the fault is investigated.

38. Lecturers and technicians who construct, assemble, modify or maintain equipment should do so in such a way that neither they nor the students are put at risk.(see paragraph 24)If it is necessary for such lecturers and technicians to work on apparatus where parts live at more than 50 V are exposed (e.g. for fault finding or calibration), this should be done in an area set apart, where a second competent person is present to render assistance in the event of an emergency such as electric shock. General advice on precautions on electrical testing is contained in HS(G)13 - Safety in Electrical Testing. (see also Paragraph 9)

IMPORTANT NOTE

All 'live' working **must** be subject to a written risk assessment before work starts. Carrying out this assessment is the responsibility of the supervising person. **The task can be delegated, the responsibility cannot.**

APPENDIX III

Basic measures to control the risks from the use of electricity at work
(extract from Health and Safety Executive's INDG231 Electrical Safety and You)

What are the hazards?

The main hazards are:

- Contact with live parts causing shock and burns (normal mains voltage 230 volts AC can kill)
- Faults, which could cause fires
- Fire or explosion where electricity could be the source of ignition in a potentially flammable or explosive atmosphere, e.g. in a spray paint booth

Assessing the risk

When carrying out a risk assessment:

- Identify the hazards
- Decide who might be harmed, and how
- Evaluate the risk arising from the hazards and decide whether existing precautions are adequate or more should be taken
- If you have five or more employees, record any significant findings
- Review your assessment from time to time and revise it if necessary

The risk of injury from electricity is strongly linked to where and how it is used. The risks are greatest in harsh conditions, for example:

- In wet surroundings – unsuitable equipment can easily become live and can make its surroundings live
- Out of doors – equipment may not only be come wet but may be at greater risk of damage
- In cramped spaces with a lot of earthed metalwork, such as inside a tank or bin – if an electrical fault developed it could be very difficult to avoid a shock

Some items of equipment can also involve greater risk than others. Extension leads are particularly liable to damage – to their plugs and sockets, to their electrical connections, and to the cable itself. Other flexible leads, particularly those connected to equipment, which is moved a great deal, can suffer from similar problems.

Reducing the risk

There are many things you can do to achieve this; here are some.

Ensure that the electrical installation is safe

- Install new electrical systems to a suitable standard, eg BS7671 *Requirements for Electrical Installations*, and then maintain them in a safe condition
- Existing installations should also be properly maintained
- Provide enough sockets – overloading socket-outlets by using adaptors can cause fires

Provide safe and suitable equipment

- Choose equipment that is suitable for its working environment
- Electrical risks can sometimes be eliminated by using air, hydraulic or hand-powered tools. These are especially useful in harsh conditions
- Ensure that equipment is safe when supplied and then maintain it in a safe condition

- Provide an accessible and clearly identified switch near each fixed machine to cut off power in an emergency
- For portable equipment, use sockets-outlets which are close by so that equipment can be easily disconnected in an emergency
- The ends of flexible cables should always have the outer sheath of the cable firmly clamped to stop the wires (particularly the earth) pulling out of the terminals
- Replace damaged sections of cable completely
- Use proper connections or cable couplers to join lengths of cable. Do not use strip connector blocks covered in insulation tape
- Some types of equipment are double insulated. These are often marked with a 'double-square' symbol. The supply leads have only two wires – live (brown) and neutral (blue). Make sure they are properly connected if the plug is not a moulded-on type
- Protect light bulbs and other equipment, which could easily be damaged in use. There is a risk of electric shock if they are broken
- Electrical equipment used in flammable/explosive atmospheres should be designed to stop it from causing ignition. You may need specialist advice

Reduce the voltage

One of the best ways of reducing the risk of injury when using equipment is to limit the supply voltage to the lowest needed to get the job done, such as:

- Temporary lighting can be run at lower voltages, eg 12, 25, 50 or 110 volts
- Where electrically powered tools are used, battery operated are safest
- Portable tools are readily available which are designed to be run from a 110 volts centre-tapped-to-earth supply

Provide a safety device

If equipment operating at 230 volts or higher is used, an RCD (residual current device) can provide additional safety. An RCD is a device which detects some, but not all, faults in the electrical system and rapidly switches off the supply. The best place for an RCD is built into the main switchboard or the socket-outlets, as this means that the supply cables are permanently protected. If this is not possible, a plug incorporating an RCD, or a plug-in RCD adaptor, can also provide additional safety.

RCDs for protecting people have a rated tripping current (sensitivity) of not more than 30 milliamps (mA). Remember:

- An RCD is a valuable safety device, never bypass it
- If the RCD trips, it is a sign there is a fault - check the system before using it again
- If the RCD trips frequently and no fault can be found in the system, consult the manufacturer of the RCD
- The RCD has a test button to check that its mechanism is free and functioning. Use this regularly

Carry out preventative maintenance

All electrical equipment and installations should be maintained to prevent danger. It is strongly recommended that this includes an appropriate system of visual inspection and, where necessary, testing. By concentrating on a simple, inexpensive system of looking for visible signs of damage or faults, most of the electrical risks can be controlled. This will need to be backed up by testing as necessary.

It is recommended that fixed installations are inspected and tested periodically by a competent person.

The frequency of inspections and any necessary testing will depend on the type of equipment, how often it is used, and the environment in which it is used. Records of the results of inspection and testing can be useful in assessing the effectiveness of the system.

Equipment users can help by reporting any damage or defects they find.

Work safely

Make sure that people who are working with electricity are competent to do the job. Even simple tasks such as wiring a plug can lead to danger – ensure that people know whet they are doing before they start.

Check that:

- Suspect or faulty equipment is taken out of use, labelled 'DO NOT USE' and kept secure until examined by a competent person
- Where possible, tools and power socket-outlets are switched off before plugging or unplugging
- Equipment is switched off and/or unplugged before cleaning or making adjustments

More complicated tasks, such as equipment repairs or alterations to an electrical installation, should only be tackled by people with knowledge of the risks and the precautions needed.

You must not allow work on or near exposed live parts of equipment unless it is absolutely unavoidable and suitable precautions have been taken to prevent injury, both to the workers and to anyone else who may be in the area.

Underground power cables

Always assume cables will be present when digging in the street, pavement or near buildings. Use up-to-date service plans, cable avoidance tools and safe digging practice to avoid danger. Service plans should be available from regional electricity companies, local authorities, highways authorities, etc.

Overhead power lines

When working near overhead lines, it may be possible to have them switched off if the owners are given enough notice. If this cannot be done, consult the owners about the safe working distance from the cables. Remember that electricity can flash over from overhead lines even though plant and equipment do not touch them. Over half of the fatal electrical accidents each year are caused by contact with overhead lines. More detailed guidance on avoidance of danger from overhead electric lines is available from HSE.