University Code of Practice for Electrical Safety

PART C - Live Working

This part of the University Code of Practice on Electrical Safety provides guidance on the precautions to be taken during work activities in which there is the potential for exposure to electrical conductors at dangerous voltages, i.e. exceeding 50 volts AC or 120 volts DC under dry conditions.

Most electrical accidents occur when individuals are working on or near equipment which is:

(a) thought to be dead but which is in fact live;

(b) known to be live but those involved are without adequate training or appropriate equipment or they have not taken adequate precautions.

Equipment which is correctly designed, constructed and maintained, as outlined by Parts A and B of this Code, should not give rise to electrical hazards during normal use. Hazardous situations however may be created under non-routine circumstances such as commissioning, fault finding, maintenance and repair.

Due to the serious risks arising out of work involving exposure to conductors energised to dangerous voltages, the equipment or circuitry to be worked on should usually be made safe by isolation. Live working should be the exception rather than the rule. Where work on or near exposed live conductors is envisaged, this course of action needs strong justification and the provision of suitable precautions (including facilities, equipment, individual competence and a safe working procedure).

C1 Justification for live working

Work on dead equipment should always be the preferred option from the point of view of safety. However the Electricity at Work Regulations recognise that under some circumstances this course of action may be unreasonable. One such situation arises where the nature of any electrical testing which is required cannot be accommodated without the conductors being energised. Another situation recognises the arguments of cost and capacity to disrupt, for example during repair work to the electrical supply where shutdown of the system could cause damage, introduce other dangers or cause disruption which is grossly disproportionate to the risk and complexity of the work involved. The former situation is likely to affect a number of Departments, whereas the latter would only arise exceptionally within the University and would be related to the site infrastructure which is under the responsibility of the Senior Engineer.

A further aspect for consideration is the need for the work to be performed in proximity to the exposed live conductors. For example, any work which does not need to be

carried out near the conductors should not be done. Likewise anyone whose presence in the vicinity of the live conductors is not necessary should also be excluded.

C2 General Precautions

All work on electrical systems must be carried out by people who are competent to do so. They should possess the knowledge and experience to enable the type of live working to be carried out safely.

Where possible the person carrying out the work should be provided with information about the electrical system being worked upon, including circuit diagrams. This is particularly important with complex systems so that any necessary isolations can be correctly carried out and spurious supplies can be avoided. Where work on high voltage power distribution systems takes place, a permit-to-work system must be used to formalise the isolation requirements and other safety precautions involved.

Testing to establish whether a circuit is live or dead should always be done on the assumption that it may be live. If the circuit is to be manipulated by hand, for example to affect a repair, then the test meter should be proved both before and after testing the circuit.

Manipulation of conductors should only be done on dead circuits unless the criteria for justification and consequential precautions have been met. Isolation implies physical separation of the circuit to be worked on from any electrical supply. This involves unplugging, removing fuses or links to a secure place, or locking of isolators with the key retained by the person doing the work, as appropriate.

For much equipment the work will be performed close to the supply socket and it will be sufficient to simply unplug it. However, where the work is carried out remote from the supply then the plug or socket should be labelled to warn that the appliance is being worked upon and the fuse should be removed.

Where live conductors are exposed then access to the work area should be restricted to authorised persons only. In the field this may involve the erection of barriers around the work area and/or the presence of other persons to supervise restricted areas. Barriers should carry appropriate warning signs.

Insulated or non-conducting tools, e.g. double-insulated soldering irons and equipment, and protective clothing should be used as appropriate.

Suitable instruments and test probes should be provided. Guidance on these is contained on HSE Guidance Note GS 38 "Electrical Test Equipment for use by Electricians". The essential features are that the equipment is appropriate for the test to be carried out, that it is designed for the loads likely to be imposed and that probes have the minimum amount of exposed metal with the connectors at the instrument end of the leads being shrouded.

The people carrying out the electrical work should be accompanied by others if such additional presence can contribute significantly to ensuring injury is prevented. Examples of such situations are where the accompanying person can intervene to isolate power supplies during high risk activities and render first aid, or by excluding others from the

work area. Under these circumstances the accompanying person should be competent to recognise danger and, if necessary, to render assistance, e.g. first in the event of an emergency.

There should be sufficient space around the work to allow the people working on the equipment to move around the conductors without hazard and to allow people to pass one another with ease, and without the risk of colliding with others, or with the conductors. As a guide there should be a minimum clearance of 1 metre around exposed conductors up to 650 volts. A clearance of at least 1.5 metres is necessary where there are conductors at either side of the workplace. If this cannot be achieved, other precautions such as temporary insulation, barriers or screens will be needed.

The work area should also be well lit with an average luminance exceeding 200 lux or 500 lux where the perception of fine detail is needed.

C3 Specific precautions for testing live equipment

The level of precautions should match the degree of associated risk. Two broad categories of electrical work can be identified, that carried out in a workshop and that carried out elsewhere. Where possible, equipment which requires electrical testing involving work on exposed live conductors should be carried out in a designated, suitably designed workshop. Appendix 1 defines the standard to which these should be designed and constructed.
By its nature a correctly designed workshop will substantially reduce the risks arising from the work. However, where the apparatus cannot be taken to the workshop and thereby has to be tested in the field, the work becomes more hazardous. The predominant feature of a suitable workshop, an earth-free area, is obviously lost within the field, hence additional precautions need to be selected according to the nature of the task. Appendix 2 provides guidance on these.

Further information:

1 HSE publication HS(R) 25 - Memorandum of Guidance on The Electricity at Work Regulations 1989.

2 HSE publication HS (G) 85 - Electricity at Work - Safe Working Practices.

3 HSE Guidance Note GS 38 - Electrical test equipment for use by electricians.

Appendix C1

Design specifications for electrical testing areas

Unless inherently safe supplies are used for energising circuits under test, i.e. voltages up to 50 volts and currents limited to 5 mA, and then the following testing facilities should be provided.

1. The testing area should be set apart and designated as such and restricted to authorised persons only while live conductors are exposed. In most instances it will be possible to satisfy this by designating a test bench within a larger workshop. Alternatively the whole workshop could be designated, although this would only be appropriate where electrical testing was confined to a very small workshop or the testing workload of the workshop as sufficiently great to warrant a larger dedicated facility.

   Where a test bench is designated within a larger electrical or general workshop, this should be located to enable restriction of access to the area around the bench and to prevent the risk of someone carrying out electrical testing being collided with. For example, a bench close to a busy thoroughfare would be unsuitable. A suitable facility would be one in which the testing area was provided with a wooden barrier to the side and rear of the testing position.

2. The test area should be earth-free. The test bench should be constructed of insulating material and supported by non-conducting legs. There should be no extraneous earths such as metal-cased switches and plugs, conduits, radiators, heaters, window frames, water supply, pipes and taps etc. within reach of the operating positions at the test bench.

   Where these cannot be removed they should be screened, for example by boxing in with wood or plastic.

   A non conductive floor should be provided. A well maintained thermoplastic or wooden floor would be suitable. If the insulation of the floor cannot be relied upon, then rubber mats to British Standard 921: 1976 should be provided for the testing area.

3. Where there is extensive exposure of live conductors the supply to the unit under test and to all other equipment associated with the test, should be derived from a-double wound isolating transformer having an earthed screen interposed between the primary and secondary windings. Transformers complying with British Standard 3535 (1990) are suitable. Adjacent test positions should be supplied from different isolating transformers.

4. Where an earth-referenced supply is required, this should be protected by a residual current device (current operated earth leakage circuit breaker) complying with BS 4293: 1993 with a tripping current not exceeding 30 mA. This supply socket should be labelled and only used when such a source is essential. The test button on the RCD should be activated to prove the continued function of the device each time before use.

5. The test bench should be kept tidy with only the test equipment and any necessary components, instruments and tools to hand. A cluttered workstation is more likely to result in accidental contact with exposed live conductors. Service equipment should not be kept on shelves above the test bench since this encourages leaning over equipment under test, with the consequential risk of making an electrical contact.

6. An electric shock placard, which describes emergency and first aid procedures in the event of someone receiving an electric shock, should be displayed. These can be obtained from the British Safety Council (refM2159 A3) tel: 0181 741 1231.

7. One or more emergency isolators to disconnect the supply to the test area should be provided and arranged so as to be readily operable in any emergency. For small facilities a single isolator at the entrance to the room or the test area would be sufficient. This isolator should not disconnect lighting in the area. The emergency isolator should be clearly marked.

8. Only those conductors to which immediate access is required in order to carry out the Test should be exposed. Covers should not be removed unnecessarily. Where large areas of conductors are exposed then temporary screening or shielding should be provided if possible.

APPENDIX C2

Precautions for electrical testing in the field

1. Supplies to circuits under test should be derived from safety isolating transformers complying with BS 3535 (1990). Supplies derived from this arrangement provide no earth return to the transformer; hence avoiding the risk of shock should live conductors be touched.

   Alternatively the supply can be derived through a residual current device (also known as Earth leakage circuit breakers). Such devices do not prevent the shock from arising but trip out the supply sufficiently quickly to prevent injury from arising. RCDs should have a sensitivity such that the tripping current does not exceed 30 mA and should comply with BS 4293: 1993. RCDs are also provided with a test button since these devices can fail to danger. The operation of the device should be tested each time before use to check that it remains functional.

2. It should be borne in mind that neither of the above devices will protect the individual who bridges the circuit conductors by touching live and neutral simultaneously. The skill of the individual, availability of correct tools etc. and the minimisation of exposed conductors are crucial.

3. Exposed energised equipment must not be left unattended, however short the duration of absence of the people working on it. In the absence of covers which can be secured to prevent unauthorised or inadvertent access, then other physical means of restricting access should be provided, for example, by locking the room or the erection of barriers suitably labelled as to the nature of the hazard.

4. Work involving extensive exposure to *live conductors at dangerous voltages* should only be carried out within sight and sound of another person. The second person should be aware of the emergency procedures and should be able to quickly and safely isolate the electrical supply, summon help and initiate resuscitation equipment where necessary.