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Guidance on

Electrical Safety Testing

in the Hire Industry

HAEEST 2012 Code of Practice

This Code of Practice (CoP) recommends good working practices for the management of in-service electrical equipment for hire companies

Contents

Introduction

This Code of Practice has been produced to assist companies that hire electrical equipment and appliances to the general public or businesses. This Code of Practice (CoP) recommends good working practices for the management of in-service electrical equipment for hire companies.

The Association would like to thank those who contributed to the content of this Code of Practice:

Acutest
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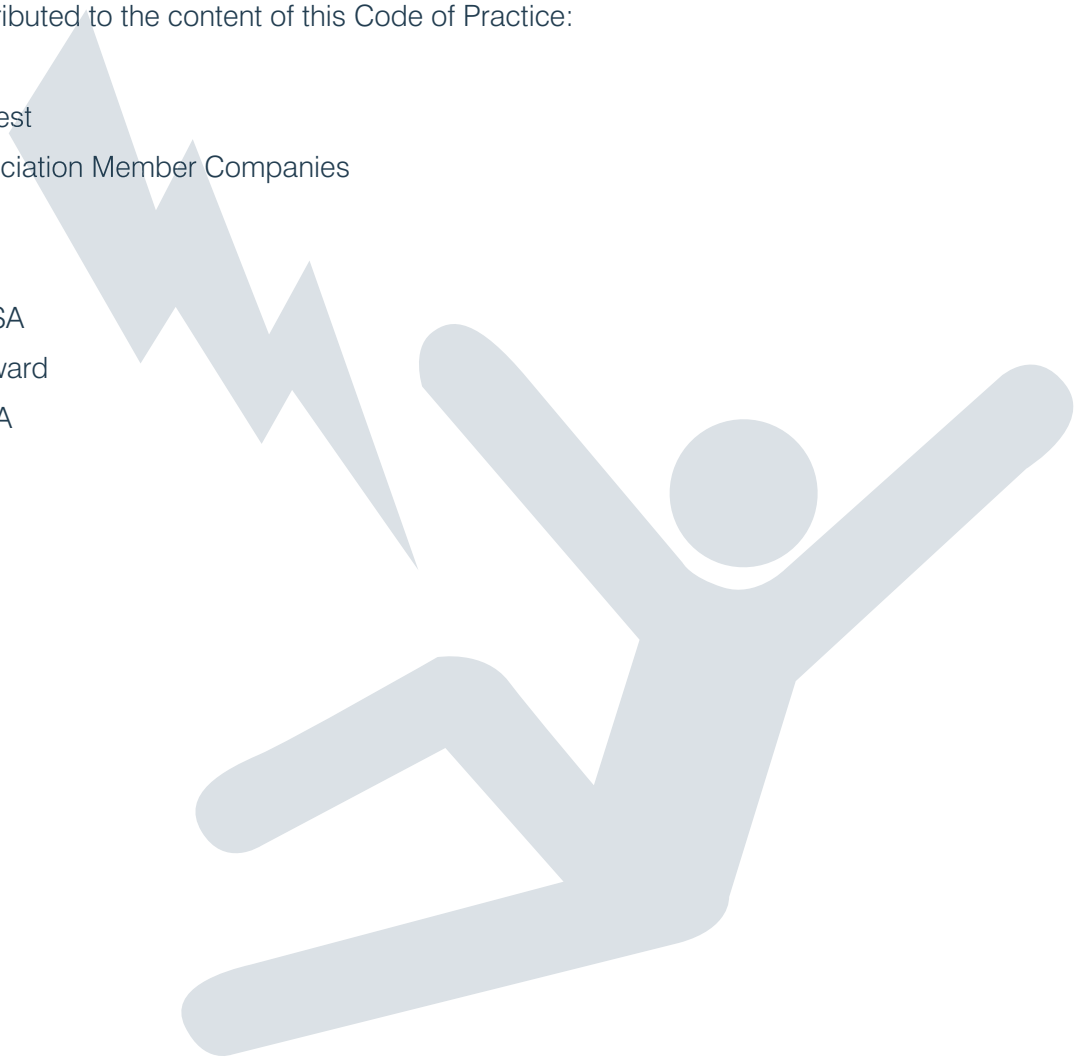

> “Code of Practice (CoP) recommends good working practices for the management of in-service electrical equipment for hire companies.”

1 Scope

This Code of Practice is applicable to all electrical equipment and appliances to be hired to the general public or businesses.

This Code of Practice applies to:

- **testing the electrical safety of single or multi-phase electrical equipment with rated voltage up to 1000 V a.c and 1500 V d.c for;**
- **hiring of equipment; and**
- **after repair.**
- **the requirements of the test procedures applied for the verification of electrical safety;**
- **the permissible limits for compliance; and**
- **mechanical parts of electrical equipment, whose proper form is a prerequisite for the electrical safety including;**
- **electrical parts of the equipment, which cannot explicitly be named as electrical equipment (e.g. gas fired hot water installations).**

Hire equipment falling within the scope of this Code of Practice includes;

- **Class I, Class II and Class III appliances and equipment;**
- **IT equipment supplied by plug and socket;**
- **Portable equipment and movable equipment e.g hand-held equipment;**
- **Fixed equipment e.g cookers, heaters, air conditioning equipment, luminaires, fluorescent fittings; and**
- **110V equipment.**

This Code of Practice does not apply

- **to equipment, for which special legislation, regulations and standards should be noted for corrective maintenance, modifications and/or verifications (for example devices for EX-zones, for mining or for medical electrical devices); and**
- **to medical electrical equipment according to IEC 60601-1;**

2 The Law

2.1 The legislation

Electrical equipment is required to be properly maintained so as to prevent danger, therefore, inspections are necessary and testing may also be required. Although reference is made to legislation, this chapter should not be considered as legal advice. In case of doubt, the specific legislation mentioned should be consulted and legal advice obtained.

The responsibilities for safety of persons at work and the maintenance of electrical equipment are detailed in legislation as follows:

- **Health and Safety at Work etc. Act 1974;**
- **Management of Health and Safety at Work Regulations 1999;**
- **Provision and Use of Work Equipment Regulations 1998;**
- **Electricity at Work Regulations 1989; and**
- **Workplace (Health, Safety and Welfare) Regulations 1992.**

2.1.1 The Health and Safety at Work. Act 1974

puts a duty of care upon both employer (sections 2, 3, 4 and 6) and employee (section 7) to ensure the safety of all persons using the work premises. This includes the self-employed.

2.1.2 The Management of Health and Safety at Work Regulations 1999

state: 'Every employer shall make a suitable and sufficient assessment of:

a) **(a) the risks to the health and safety of his employees to which they are exposed whilst they are at work, and**
b) **(b) the risks to the health and safety of persons not in his employment arising out of or in connection with the conduct by him of his undertaking'. (Regulation 3(1));**

2.1.3 The Provision and Use of Work Equipment Regulations 1998 state:

'Every employer shall ensure that work equipment is so constructed or adapted as to be suitable for the purpose for which it is used or provided'. (Regulation 4(1)).

The Provision and Use of Work Equipment Regulations 1998 (PUWER) cover most risks that can result from using work equipment. With respect to risks from electricity, compliance with the Electricity at Work Regulations 1989 is likely to achieve compliance with PUWER regulations 5 - 9, 19 and 22.

PUWER only applies to work equipment used by workers at work. This includes all work equipment (fixed, portable or transportable) connected to a source of electrical energy. PUWER does not apply to the fixed installations in a building.

The electrical safety of these installations is just one of the issues dealt with by the Electricity at Work Regulations.

2.1.4 The Electricity at Work Regulations 1989

puts a duty of care upon both employer (sections 2, 3, 4 and 6) apply to electrical equipment as defined in the Regulations which includes every type of electrical equipment from, for example, a 400 kV overhead line to a battery-powered hand lamp. It is appropriate for the Regulations to apply even at the very lowest end of the voltage or power spectrum because the Regulations are concerned with, for example, explosion risks which may be caused by very low levels of energy igniting flammable gases even though there may be no risk of electric shock or burn. Thus no voltage limits appear in the Regulations. The criteria of application is the test as to whether 'danger' (as defined) may arise.

Electrical equipment (as defined) includes conductors used to distribute electrical energy e.g cables, wires and leads and those used in the transmission at high voltage of bulk electrical energy, as in the national grid.

Table 2.1 provides a list of the Regulations in the EAWR that are particularly important to the issues surrounding in service inspection and testing of electrical equipment.

Table 2.1 Regulations in the Electricity at Work Regulations

Regulation 4	Systems, work activities and protective equipment
Regulation 6	Adverse or hazardous environments
Regulation 8	Earthing or other suitable precautions
Regulation 10	Connections
Regulation 14	Work on or near live conductors
Regulation 16	Persons to be competent to prevent danger and injury

2.1.5 Workplace (Health, Safety and Welfare) Regulations 1992

That every employer shall ensure that the workplace equipment, devices and systems are maintained. This includes keeping the equipment devices and systems in an efficient state, in efficient working order, and in good repair. Where appropriate, the equipment, devices and systems shall be subject to a suitable system of maintenance.

The scope of the Workplace (Health, Safety and Welfare) Regulations is somewhat different to the Electricity at Work Regulations. The Electricity at Work Regulations are basically concerned with ensuring an electrical installation is in a safe condition and ensuring work performed on an electrical installation is done in a safe manner. They do not deal with the consequences of maloperation of the electric system. However, the Workplace Regulations are concerned with the consequences of equipment and system failures. For example, whilst a malfunctioning emergency lighting system may not in itself be an electrical hazard, there is a potential hazard if there is no emergency lighting. These regulations impose maintenance regimes upon such systems as emergency lighting, fire alarms, powered doors, escalators and moving walkways that have electrical power supplies. The regulations are not limited to electrical systems but also include equipment e.g fencing, equipment used for window cleaning, devices to limit the opening of windows etc. The approved code of practice to the Workplace Regulations states that the maintenance of work electrical equipment and electrical systems is also addressed in other regulations. Electrical systems are clearly well addressed in the Electricity at Work Regulations and the maintenance of work equipment in the Provision and Use of Work Equipment Regulations 1992.

2.2 Who is responsible?

Everyone at work has responsibilities including, in certain circumstances, trainees. However, because of the all-embracing responsibilities of all persons this does not minimize the duties of particular persons. (Regulation 3 of the Electricity at Work Regulations)

Regulations recognize a responsibility (control) that employers and many employees have for electrical systems.

It shall be the duty of every employer and self employed person to comply with the provisions of these Regulations in so far as they relate to matters that are within his control.

It shall be the duty of every employee while at work:

a) to co operate with his employer so far as is necessary to enable any duty placed on that employer by the provisions of these Regulations to be complied with; and

b) to comply with the provisions of these Regulations in so far as they relate to matters which are within his control".

The Provision and Use of Work Equipment Regulations 1998 requires every employer to ensure that equipment is suitable for the use for which it is provided (Reg 4(1)) and only used for work for which it is suitable (Reg 4(3)). They require every employer to ensure equipment is maintained in good order (Reg 5) and inspected as necessary to ensure it is maintained in a safe condition (Reg 6).

2.3 Maintenance

Regulation 4(2) of the Electricity at Work Regulations 1989 states:

As may be necessary to prevent danger, all systems shall be maintained so as to prevent, so far as is reasonably practicable, such danger.

Regulation 5 of the Provision and Use of Work Equipment Regulations 1998 states:

Every employer shall ensure that work equipment is maintained in an efficient state, in efficient working order and in good repair.

The Approved Code of Practice and Guidance document to the Provision and Use of Work Equipment Regulations 1998 (L22) states that 'efficient' relates to how the condition of the equipment might affect health and safety; it is not concerned with productivity.

2.4 Inspection

The Provision and Use of Work Equipment Regulations 1998 include a specific requirement that where the safety of work equipment depends on installation conditions, and where conditions of work are liable to lead to deterioration, the equipment should be inspected in accordance with hirers risk assessment.

3 Electrical Equipment

3.1 Portable appliance

A portable appliance is defined as an appliance that is intended to be moved while in operation or an appliance which can easily be moved from one place to another. e.g Spotlight, Extension Lead, Heater, Lighting Control Desk etc (Fig 3.1)

Fig 3.1

3.2 Movable equipment (sometimes called transportable)

An item of movable equipment is equipment which is not fixed or, equipment with Wheels, Castors or other means to facilitate movement by the operator as required to perform its intended use. e.g Catering Oven, Chilled Air Mover, Dimmer Rack, Welders etc. (Fig 3.2)

Fig 3.2

3.3 Hand-held appliances or equipment

A hand-held appliance or equipment is portable equipment intended to be held in the hand during normal use. Electric shock can kill or seriously injure and is one of the hazards that electrical safety legislation is intended to protect against. Many serious shocks occur when the current flow is from hand to hand as the route the current follows is through or near the heart. Hand-held appliances present a particular danger as the appliance is gripped in one hand and it is quite possible the other hand could be in contact with earthed metal. Being gripped, it becomes almost impossible to let go of the appliance under shock conditions. If the person using the appliance is sweating, e.g a construction worker using an angle grinder, then the contact resistance is significantly lowered and a larger current would flow. In addition, hand-held equipment can be the most prone to suffer misuse. Equipment used outdoors may be used under wet conditions or when the person has wet footwear thereby once again reducing contact resistance.

Examples of Hand Held equipment could be Angle Grinder, Mains Powered Drill, Soldering Iron, Heat Gun etc (Fig 3.3)

Fig 3.3

3.4 Stationary equipment or appliances

An item of stationary equipment or an appliance is equipment that has a mass exceeding 18 kg and is not provided with a carrying handle, e.g Saw Bench, Split Air Conditioning Unit, Vending Machines etc. (Fig 3.4)

Fig 3.4

3.5 Fixed equipment or appliances

An item of fixed equipment or an appliance is equipment fastened to a support or otherwise secured in a specified location. E.g Personal Radio Charging Station, Hand Dryers, Portable Washrooms, Water Coolers etc. (Fig 3.5)

Fig 3.5

3.6 Information technology equipment

Information technology equipment includes electrical business equipment e.g computers and mains powered telecommunications equipment, and other equipment for general business use, e.g, printers, photo-copiers, power packs etc (Fig 3.6)

Fig 3.6

4 Requirements for testing

The requirements for inspection and testing of hired electrical equipment should be determined by performing a risk assessment. Risk assessment requires knowledge of several factors, including the user of the equipment and environment in which it is used. In many cases it may be difficult to ascertain who used the equipment or the environment in which it has been whilst on hire.

It is therefore recommended that the electrical equipment returned from hire is subjected to a combined inspection and test before it is re-hired.

Equipment may be subject to retest after prolonged storage or changing conditions.

Note should be taken of any frequently recurring damage and corrective action taken. Corrective action to be considered, such as, replacement of the equipment with a more rugged type or further investigation into the suitability of the damaged equipment.

NOTE - The requirement for subsequent testing before hire should be determined by individual company risk assessment.

These tests should only be performed by an electrically skilled or instructed person. Competency to carry out testing should include training on the subject, knowledge, experience and acquaintance with the relevant technologies, standards and local regulations. Qualifications from external or internal training providers can be included within experience gained.

The persons assessing safety should be able to recognise possible consequences and risks arising from non-conforming equipment.

Additionally requirements from the product safety standard may need to be taken into account. e.g. for the mechanical safety or for fire protection etc.

Precautions need to be taken while carrying out load tests on equipment with moving components or exposed operating surfaces e.g flanges to be removed from rotary equipment, awareness of hot surfaces, sharp blades etc.

If when testing the equipment, additional knowledge or additional test and measurement equipment is required, e.g. for microwave leakage tests, tests should be done according to the instructions of the manufacturer.

All tests should be performed in such a manner that no hazards arise for testing personnel or other individuals.

The applicable tests as listed in 6.1 of the CoP should be used to determine that

- **there are no visible faults on safety related parts, which are accessible by the user; and**
- **the intended use of the equipment, and its environment presents no hazard to the user.**

If during the in-service test it is recognized that,

- **damage, unintended use or modification leading to a reduced safety level are present; and**
- **functional hazards could occur.**

the test procedure should be interrupted and marked as failed.

5 In-Service inspection and testing

5.1 Inspection

In-service inspection and testing of equipment is essential to ensure safety. A regime of risk assessment based inspections and tests should be implemented.

A properly carried out inspection can identify many faults which will not necessarily be apparent from electrical tests, e.g a cracked case, a loose connection, a damaged flex and evidence of overheating.

5.2 Categories of inspection and testing

Two categories of in-service inspection and testing are referred to in this Code of Practice:

(i) Formal Visual Inspection. The formal visual inspection is performed by a skilled or instructed person. Equipment failing the formal visual inspection must be removed from service, labeled and quarantined.

(ii) Combined Inspection and Test. The combined inspection and test, which includes a Formal Visual Inspection, is performed by a skilled or instructed person and includes the tests described in 6.1 of this CoP. Equipment failing the Combined Inspection and Test must be removed from service, labeled and quarantined.

6 Procedures for in-service inspection and testing

6.1 General requirements

The sequence of testing should be as defined in this Code of Practice. Each individual test should be passed, before proceeding to the next test. If it is not possible to perform a specific test in the list, a skilled or instructed person must decide what the alternate suitable test procedure must be. The decision should be explained and should be documented.

If measured values are outside the limits specified in this Code of Practice, the manufacturer of the equipment under test should be consulted for further guidance.

The combined inspection and test should comprise some or all of the following of:

a) Visual Inspection;
b) Earth continuity tests (for Class I equipment);
c) Insulation resistance testing (which may be replaced by a protective conductor/touch current measurement);
d) Flash Testing (or Hi-Pot testing);
e) No Load (Run) Test;
f) Polarity Check (extension or detachable lead sets only); and
g) Functional checks.

Note: Care should be taken when applying above tests to sensitive electronic equipment e.g. Audio Visual Equipment.

6.2 Formal visual inspection

The visual inspection should take place after the item has been cleaned and dried thoroughly to detect external defects and should include the following:

- **any damage;**
- **all cables and plugs / connectors are of a suitable standard for their intended use;**
- **condition of the mains plug and the mains connectors and conductors;**
- **condition of anchorage, cable clip, accessible fuse insert;**
- **damage of the housing and protective cover;**
- **signs of overload or overheating or unintended use;**
- **signs of improper change or modification;**
- **signs of contamination, corrosion and aging;**
- **blockage of cooling inlets / vents / filters;**
- **servicability of switches, control and setup equipment;**
- **all fuses accessible from the outside are complying with both data given by the MANUFACTURER and relavent British Standards (rated current, characteristics);**
- **safety related marking, labels and labelling is legible and complete;**
- **the integrity of mechanical parts i.e Guard; and**
- **assess the relevant ACCESSORIES together with the EQUIPMENT (e.g. detachable or fixed POWER SUPPLY LEADS).**

6.3 Earth Continuity Test (Class I equipment only)

This test is the measurement of the resistance of the path between the protective earth pin of the plug and any accessible exposed conductive parts of the equipment that could become live through a single fault condition.

If the equipment is supplied without a plug the resistance will be measured from the end of the supply lead to the accessible exposed conductive parts.

One of the following two tests should be carried out:

- **'Hard' Test – A measurement made with a maximum of 25A for a period of 5 – 20 seconds. Not recommended for electronically sensitive devices.**
- **'Soft' Test - A measurement made with a maximum of 200mA.Whilst there is no defined time period, the cable should be flexed while the test is carried out to ensure no internal breaks in the earth conductor.**

The measured resistance should not exceed the values given in table 6.1

The values and worked example for the calculation for 'R' can be found in *Appendix A* - Nominal resistance of appliance supply cable protective conductors.

Table 6.1	
For appliances with a supply lead	(0.1 + R) ohm where R is the resistance of the protective conductor of the supply lead
For appliances without a supply lead	0.1 ohm.

6.4 Insulation Resistance Test

This test is the measurement of resistance between the live conductors and the protective earth (Class I equipment) or the live conductors and the external casing (Class II equipment).

To include the insulation of all live parts, all switches, controls etc must be in the ON position and / or at maximum setting during the measurement.

Equipment fitted with a No Volt switch will not be thoroughly tested with an Insulation Resistance test. In this case, the insulation should be tested by measuring the protective conductor current and/or touch current. (see section 6.5 or 6.6).

This test normally applies 500Vdc and measures the resistance value. In the case of equipment containing surge protection or some electronic devices, 250Vdc may be applied in the place of 500Vdc.

It should be confirmed that the insulation resistance is not below the limits of Table 6.2.

6.5 Protective Conductor Current Measurement (Class I only)

This test, sometimes referred to as an Earth Leakage Test, measures the current on the protective earth conductor while the unit is powered up and operational.

The equipment must be set to the maximum setting, if applicable.

NOTE – The equipment under test will be energised and any dangers associated with the operation of the equipment must be assessed and controlled.

Measured values will not exceed those in table 6.3.

NOTE – Equipment with a protective conductor current designed to be above 3.5mA should be installed in accordance with the current edition of BS 7671.

Table 6.2 Appliance Class	Insulation Resistance
Class I heating and cooking equipment with a rating to 3 kW	0.3 Megohm
All other Class I equipment	1.0 Megohm
Class II equipment	2.0 Megohm

Table 6.3 Type of equipment	Maximum current limit
Portable or Hand-Held Class I equipment	0.75 mA
Class I heating appliances	0.75 mA or 0.75 mA per kW, whichever is the greater, with a maximum of 5 mA
Other Class I equipment	3.5 mA

6.6 Touch Current Measurement (Class II only)

This test, sometimes referred to as a Touch Leakage Test, measures any current on the external casing while the unit is powered up and operational.

The equipment must be set to the maximum setting, if applicable.

NOTE – The equipment under test will be energised and any dangers associated with the operation of the equipment must be assessed and controlled.

Confirm that the TOUCH CURRENT does not exceed 0.25mA for all Class II types of equipment.

6.7 Flash Testing or Hi Pot Testing (Dielectric Strength Testing)

This test applies a specified voltage between the live conductors and the protective earth (Class I) or the live conductors and the external casing (Class II) to ensure that there is no insulation breakdown.

To include the insulation of all live parts, all switches, controls etc must be in the ON position and / or at maximum setting during the measurement.

Equipment fitted with a No Volt switch will not be thoroughly tested with an Insulation Resistance test. In this case, the insulation should be tested by measuring the protective conductor current and/or touch current. (see section 6.5 or 6.6).

The minimum test voltage applied should be in accordance with the values shown in table 6.4.

No breakdown should occur. Breakdown is assumed to occur when the current in the test circuit exceeds 5mA.

However this may be increased for appliances with high leakage currents in accordance with manufacturers guidelines.

Typically test voltages are as below.

**Note 1– Testers from various manufacturers may have nominal voltages that differ. The above table represents the minimum required test voltage. Commonly used units may use voltages around 1250V (Class I) or 3750V (Class II).*

Note 2 – The area where flash testing is carried out should comply with BS EN 50191.

Table 6.4 Construction	Test Voltage*	Limit**
Class I	1000v	>5mA
Class II	2500v	>5mA

6.8 Confirmation of the compliance of additional protective measures

If the equipment includes additional protective measures for electrical safety (e.g. RCD, PRCD, insulation monitoring devices, over voltage protective devices) and it is visible for the person performing the test, an (electrically) skilled person has to decide how to perform the testing.

Instructions from the manufacturer should be taken into account.

The operation of an RCD should be confirmed by

- **Connecting the RCD to a mains supply and then pushing the test button. The RCD should operate and disconnect the supply;**

  and

- **Measuring the trip time at the rated residual operating current using an RCD test instrument according IEC 61557-6**

6.9 Appliance Lead Tests

An appliance with a detachable power supply flex should be tested with the lead set plugged into the appliance.

The lead set should be labelled and tested separately from the appliance as follows:

- **3-core lead sets as a Class I appliance;**
- **2-core lead sets as a Class II appliance (not to supply an earthed socket outlet or Class I appliance).**

The following inspections and tests should be made:

- **Visual inspection;**
- **Class I - Earth Continuity, Polarity and Insulation Resistance tests;**
- **Class II - Polarity and Insulation Resistance tests.**

The reason that the lead set is inspected and tested separately is that it could be used for a different piece of equipment.

6.10 Extension leads including 110V junction boxes

Where extension leads are fitted with a 3-pin plug and socket(s) these should be tested as Class I appliances with the addition of a polarity check. Any such extension leads that are found to be without an earth wire should be removed from service and marked as defective.

Extension leads fitted with 3-pin plug and socket(s) should never be wired with two-core cables as there will always be the possibility that the lead will be inadvertently used to supply a Class I appliance which, as a consequence, would not be earthed.

The polarity throughout should be verified.

Coiled extension leads should always be fully uncoiled before use and during testing.

All outlet sockets are to be tested for Earth Continuity and Polarity.

6.11 Functional test

A functional test of the equipment should be carried out only after the equipment has successfully passed the combined inspection and test.

Note – The equipment will be operational during this test, please note that relevant safety protocols are adhered to including any PPE required.

6.12 Test equipment

Test equipment will be needed that will perform as a minimum, an Earth Continuity test and an Insulation Resistance test to permit testing, as necessary, of all the types of Hire Electrical Equipment likely to be encountered so that necessary maintenance and repair are identified.

Following inspection and testing, necessary maintenance, repairs and re-testing must be carried out or the equipment must be removed from use.

Some tests, particularly insulation resistance tests, may damage such equipment. If there is doubt, minimum tests, such as the 'soft tests' in 6.3 and 6.4 of this CoP should be carried out.

Test equipment should be calibrated as per the manufacturer's recommendations. Ongoing accuracy should be confirmed at regular intervals in between calibration.

NOTE – Proprietary check boxes may be used for ongoing accuracy checks. Refer to 8.5 of this CoP.

6.13 Documentation

The Provision and Use of Work Equipment Regulations 1998 (PUWER) contain no specific requirement to keep maintenance records, but the Health and Safety Executive recommend a maintenance record for all hire equipment.

Although there is no requirement in the Electricity at Work Regulations 1989 to keep records of equipment and of inspections and tests, the HSE Memorandum of Guidance on these Regulations advises that records of maintenance including tests should be kept throughout the working life of equipment. These records are a useful management tool for reviewing the frequency of inspection and testing, and without such records duty holders cannot be certain that the inspection and testing has actually been carried out.

These records may be retained on paper or on electronic media providing reasonable precautions are taken with respect to security. Previous test results must be made available to subsequent Test Engineers. Previous test results need to be made available to permit observation of any deterioration.

The following records should be maintained by the organization carrying out the inspection and testing.

(i) copy of the formal visual inspection and combined inspection and test results; and

(ii) Register of all equipment repaired.

6.14 Inspection And Test Labelling

Labelling of equipment is a useful management control tool. Although there is no requirement within the Electricity at Work Regulations 1989 to label equipment, duty holders may find it useful to label equipment to indicate that the equipment has been tested satisfactorily, i.e has been passed as safe and the date of the test.

Any labels should consist of an identification code to enable the equipment to be uniquely identifiable even if several similar items exist within the same premises. An indication of the current safety status of the equipment should also be included (e.g. whether the item has PASSed or FAILed the appropriate safety inspection/test) along with the date on which the equipment was last tested.

The provision of the above information will enable non technical users to become aware that equipment has been inspected and tested. During any hire period the equipment inspection and test schedule will become the responsibility of the hirer. Responsibilities of hirers are covered by the latest edition of the IET's Code of Practice for In-Service Inspection and Testing.

Additional information may also be included e.g the hire company name or logo. Labels may either be pre printed and filled in by hand or be machine readable e.g. barcoded. Pass/fail information and date should be in text format so that it is readable by others.

Labels may take many forms but should be such that they can be reliably applied to a variety of surfaces. They should be durable and capable of surviving the period between re tests without undue degradation. In industrial environments the demands on the label are high since it may be subject to contact with oils, solvents, moisture and abrasion. On larger equipment the label should be fixed in a prominent position where it will be clearly seen.

In order to keep proper records, items e.g extension leads which may not have serial numbers, should be identified with a unique reference number or code fixed to or marked on the equipment.

6.15 Damaged or faulty equipment

Equipment found to be unsafe must be immediately removed from use.

Following repair all equipment should undergo combined inspection and test as described in chapter 6.1 of this CoP.

If equipment is repeatedly found to be damaged or faulty on inspection or test, an assessment must be made by a competent person as to the suitability of the equipment for the use in that particular environment.

NOTE – All equipment should be fit for purpose in the expected environment.

6.16 User responsibilities

Staff and users of equipment must be advised that it is their legal responsibility to comply with the Health and Safety at Work Act and the Electricity at Work Regulations by assisting in the maintenance of equipment.

Equipment must be regularly inspected.

Such inspections should initially be carried out at the initial frequencies indicated in the latest edition of the IET's Code of Practice for In-service Inspection and Testing of Electrical Equipment.

- **Faulty equipment must NOT be used;**
- **Faulty equipment must be withdrawn from service, labeled and reported to the hire company.**

7 Training

Personnel should be trained and / or have relevant experience to be competent to inspect and test a specific piece of equipment.

8 Test instruments

8.1 Safety of test equipment

Test equipment complete with suitable probes and leads is required to carry out the required tests.

All test instruments should be safe. The current safety standard is BS EN 61010: Safety requirements for electrical equipment for measurement, control, and laboratory use. All new equipment should comply with this or an equivalent standard. Equipment pre dating this standard is not necessarily unsafe.

Users must always read and understand the operating instructions and follow the advice given before using test instruments.

Generally, specific electrical safety testers offer the most convenient means of providing the required test facilities but this does not preclude the use of suitable individual general test instruments.

Test probes and leads, in particular those used to apply or measure voltage over 50 V a.c. and 100 V d.c. should comply with the recommendations given in HSE Guidance Note GS 38.

Test probes should:

- **Have finger barriers or, alternatively, be shaped to guard against inadvertent hand contact with the live conductors under test;**

  and
- **Be insulated to leave an exposed metal tip not exceeding 4 mm measured across any surface of the tip. Where practicable it is strongly recommended that this is reduced to 2 mm or less, or that spring loaded retractable screened probes are used.**

Leads should:

- **Be adequately insulated and the choice of insulating material may be influenced by the environment in which the leads are to be used;**
- **Be coloured so that one lead can be easily distinguished from the other;**
- **Be flexible and of sufficient capacity for the duty expected of them;**
- **Be sheathed to protect against mechanical damage;**
- **Be long enough for the purpose; and**
- **Not have accessible exposed conductors other than the probe tips or have live conductors accessible to be touched if a lead becomes detached from a probe, indicator or instrument when in use.**

8.2 Specific Electrical Safety Test instruments

Most electrical safety test instruments provide the following facilities:

(i) Measurement of earth continuity with one or more pre-set test currents up to a maximum of the order of 25A; and

(ii) Measurement of insulation resistance normally using a test voltage of 500 V d.c. Electrical safety test instruments may offer additional test facilities e.g:

(iii) Measurement of earth continuity using a low value of current, typically 200 mA, known as a ‘soft test’;

(iv) Insulation resistance measurement by the protective conductor/touch current method;

(v) Flash testing; and

(vi) Load test.

8.3 Flash testing (also known as Dielectric strength or Hi -Pot Testing)

Dielectric strength testing can be broken down into two common types

1) Dielectric Withstand Voltage Test. A standard test voltage is applied (below the established Breakdown Voltage) and the resulting leakage current is monitored. The leakage current must be below a preset limit or the test is considered to have failed. This test is non-destructive when conducted in accordance with manufacturers instructions and is usually required by safety agencies to be performed as a 100% production line test on all products before they leave the factory.

A Dielectric Withstand Voltage Test is the suggested test when referring to testing repaired or in service equipment. This test is more arduos and can detect faults where a standard 500v Insulation resistance test sometimes cannot.

2) Dielectric breakdown Test. This test IS NOT recommended for in service testing, this is more commonly used for the manufacturers type test of the equipment. The test voltage is increased until the dielectric fails, or breaks down, allowing too much current to flow. The dielectric is often destroyed by this test so this test is used on a random sample basis. This test allows designers to estimate the breakdown voltage of a product's design.

Dielectric strength testing should only be performed in a safe environment where no hazard will be created.

8.4 Instrument accuracy

The accuracy of a test instrument should be verified and recorded annually or in accordance with the manufacturer's instructions. Many test instruments are calibrated on an annual basis, and issued with a certificate stating the level of accuracy at that time. Further adjustment may be required.

8.5 Ongoing accuracy and maintaining records

One method of assessing the on-going accuracy of test instruments is to maintain records, over time, of measurements taken from designated reference circuits or items of equipment e.g a resistance box or voltage source.

In each instance, the designated circuit or item of equipment must be used for every subsequent assessment.

Before such a system is implemented, the accuracy of each test instrument must be confirmed and this could only be carried out by a formal calibration house. Test leads should be assessed at the time of calibration.

To avoid ambiguity, the relevant testing points should labeled allowing other operatives, who may not usually be charged with the task of test instrument assessment, to follow the system. Should the results be inconsistent the instrument may need to be recalibrated.

It is worth noting that changes to the electrical supply network could affect the actual supply characteristics at the installation.

Many test instrument manufacturers produce proprietary "checkboxes", that incorporate many testing functions, e.g high and low resistance, earth fault loop impedance and RCD testing.

9 Definitions and explanations

Appliance.
An item of current-using equipment.

Basic insulation.
Insulation applied to live parts to provide basic protection against electric shock and which does not necessarily include insulation used exclusively for functional purposes.

Bonding conductor.
A protective conductor providing equipotential bonding.

Circuit.
An assembly of electrical equipment supplied from the same origin and protected against overcurrent by the same protective device(s).

Class I equipment.
Equipment in which protection against electric shock does not rely on basic insulation only, but which includes means for the connection of exposed conductive parts to a protective conductor in the fixed wiring of the installation. Refer also to BS 2754 and BS EN 61140.

Class II equipment.
Equipment in which protection against electric shock does not rely on basic insulation only, but in which additional safety precautions such as supplementary insulation are provided, there being no provision for the connection of exposed metalwork of the equipment to a protective conductor and no reliance upon precautions to be taken in the fixed wiring of the installation. Refer also to BS 2754 and BS EN 61140.

Class III equipment.
Equipment in which protection against electric shock relies on supply at SELV and in which voltages higher than those of SELV are not generated. See definition of SELV. Refer also to BS 2754 and BS EN 61140.

Current-using equipment.
Equipment which converts electrical energy into another form of energy, e.g light, heat or motive power.

Danger.
Risk of injury to person.

Double insulation.
Insulation comprising both basic insulation and supplementary insulation.

Earth.
The conductive mass of the Earth, whose electric potential at any point is conventionally taken as zero.

Earthing.
Connection of the exposed-conductive-parts of electrical equipment to the main earthing terminal of an electrical installation. Metal parts of an electrical installation or appliance may become electrically charged if there is a fault. The purpose of earthing is to minimise the risk of electric shock should anyone touch those metal parts when a fault is present. This is achieved by providing a path for fault current to flow safely to earth which also causes the protective device to disconnect thereby removing the danger.

Earthing conductor.
A protective conductor connecting the main earthing terminal of an installation to an earth electrode or to other means of earthing.

Electric shock.
A dangerous physiological effect resulting from the passing of an electric current through a human body or livestock.

Electrical equipment.
(abbr: Equipment). Any item for such purposes as generation, conversion, transmission, distribution or utilisation of electrical energy, e.g machines, transformers, apparatus, measuring instruments, protective devices, wiring systems, accessories, appliances and luminaires, connected by plug or permanently connected to a final circuit of the distribution system.

Electrical installation.
(abbr: Installation). An assembly of associated electrical equipment supplied from a common origin to fulfil a specific purpose and having certain co-ordinated characteristics.

(Electrically) Skilled Person – (referred to as skilled person in this CoP)
person with relevant education and experience to enable him or her to perceive risks and to avoid hazards which electricity can create

[IEV 195-04-01]

(Electrically) Instructed Person – (referred to as Instructed person in this CoP)
person adequately advised or supervised by electrically skilled persons to enable him or her to perceive risks and to avoid hazards which electricity can create.

[IEV 195-04-02]

Electronic Switch.

See No Volt Switch.

Emergency switching.
An operation intended to remove, as quickly as possible, danger, which may have occurred unexpectedly.

Equipotential bonding.
Electrical connection maintaining various exposed¬conductive-parts and extraneous-conductive-parts at substantially the same potential.

Exposed conductive-part.
A conductive part of equipment which can be touched and which is not a live part but which may become live under fault conditions.

Fault.
A circuit condition in which current flows through an abnormal or unintended path. This may result from an insulation failure or a bridging of insulation. Conventionally the impedance between live conductors or between live conductors and exposed- or extraneous-conductive-parts at the fault position is considered negligible.

Final circuit.
Electric circuit intended to supply directly electric current to current using equipment or socket outlets.

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Fixed equipment.
Equipment designed to be fastened to a support or otherwise secured in a specific location e.g. bathroom heater or towel rail.

Flexible cable.
Cable whose structure and materials make it suitable to be flexed while in service.

Fuse.
A device which by the melting of one or more of its specially designed and proportioned components, opens the circuit in which it is inserted by breaking the current when this exceeds a given value for a sufficient time. The fuse comprises all the parts that form the complete device.

Hand-held appliance or equipment.
This is portable equipment intended to be held in the hand during normal use, e.g. hair dryer, drill, soldering iron.

Hired.
To engage the temporary use at a price (In this case, *Electrical Equipment*)

Information technology equipment.
Information technology (IT) equipment includes electrical business equipment e.g computers and mains powered telecommunications equipment, and other equipment for general business use, e.g. PC's, laptops, printers, sensitive electronic devices.

In-service test.
A test performed at a defined time interval for the assessment of safety.

Insulation.
Suitable non conductive material enclosing, surrounding or supporting a conductor.

Isolation.
An assembly consisting of a detachable flexible cable or lead fitted with a plug and a connector intended for the connection of electrical equipment to the electrical supply.

Lead set.
(abbr: Installation). An assembly of associated electrical equipment supplied from a common origin to fulfil a specific purpose and having certain co-ordinated characteristics.

Leakage current.
Electric current in an unwanted conductive path under normal operating conditions.

Live part.
A conductor or conductive part intended to be energised in normal use, including a neutral conductor.

Luminaire.
Equipment which distributes, filters or transforms the light from one or more lamps, and which includes any parts necessary for supporting, fixing and protecting the lamps, but not the lamps themselves, and, where necessary, circuit auxiliaries together with the means for connecting them to the supply. For the purposes of the EAW Regulations a lampholder, however supported, is deemed to be a luminaire.

Main earthing terminal.
The terminal or bar provided for the connection of protective conductors, including equipotential bonding conductors, and conductors for functional earthing, if any, to the means of earthing.

Movable equipment
Equipment which is either:

- 18 kg or less in mass and not fixed, e.g. small welding set, transformer or
- equipment with wheels, castors or other means to facilitate movement by the operator as required to perform its intended use, e.g. air conditioning unit.

Neutral conductor.
A conductor connected to the neutral point of a system and contributing to the transmission of electrical energy.

No Volt (Zero volt or Electronic) switch.
A switch that requires mains power in order to energise. Without voltage applied the switch will fail to remain closed.

Phase conductor.
A conductor of an a.c. system for the transmission of electrical energy other than a neutral conductor.

Portable appliance.
An appliance of less than 18 kg in mass that is intended to be moved while in operation or an appliance which can easily be moved from one place to another. i.e extension lead, food mixer.

Portable equipment.
Electrical equipment which is moved while in operation or which can easily be moved from one place to another while connected to the supply.i.e Vacuum cleaner, lawn mower.

PPE.
Personal Protective Equipment relevant to individual equipment and job type, e.g. Eye protection, gloves, ear defenders etc

Protective conductor.
A conductor used for some measures of protection against electric shock and intended for connecting together any of the following parts:

- Exposed Conductive Parts
- The Main Earth Terminal
- Earth Electrodes

Protective conductor current.
Electric current (leakage) which flows in a protective conductor.

Reinforced insulation.
Single insulation applied to live parts, which provides a degree of protection against electric shock equivalent to double insulation under the conditions specified in the relevant standard. The term ‘single insulation’ does not imply that the insulation must be one homogeneous piece. It may comprise several layers which cannot be tested singly as supplementary or basic insulation.

Residual current device (RCD).
A switching device or association of devices intended to cause the opening of the contacts when the residual current attains a given value under specified conditions.

SELV (Separated Extra-Low Voltage).
An extra-low voltage system which is electrically separated from Earth and from other systems in such a way that a single fault cannot give rise to the risk of electric shock.

Socket-outlet.
A device, provided with female contacts, which is intended to receive a plug. A luminaire track system is not regarded as a socket-outlet system.

Stationary equipment or appliance.
Electrical equipment which is either fixed, or equipment having a mass exceeding 18 kg and not provided with a carrying handle e.g. refrigerator, vending machine.

Supplementary insulation.
Independent insulation applied in addition to basic insulation in order to provide protection against electric shock in the event of a failure of basic insulation.

Touch current.
Electric current through a human body when it touches one or more accessible parts of equipment.

Zero Volt switch
See No Volt Switch

Appendix A.

Nominal resistance of appliance supply cable protective conductors.

Nominal conductor csa	Nominal conductor resistance at 20 °C Length	Length	Resistance at 20 °C	Maximum current-carrying capacity
(mm2)	(Ω/m)	(m)	(Ω)	(A)
0.5	0.039	1	0.039	3
		1.5	0.0585	
		2	0.078	
		3	0.117	
		4	0.156	
		5	0.195	
0.75	0.026	1	0.026	6
		1.5	0.039	
		2	0.052	
		3	0.078	
		4	0.104	
		5	0.130	
1.0(0.75)) *(See Note*	0.019	1	0.0195	10
		1.5	0.0293	
		2	0.039	
		3	0.0585	
		4	0.078	
		5	0.0975	
1.25	0.015	1	0.0156	13
		1.5	0.0234	
		2	0.0312	
		3	0.0468	
		4	0.0624	
		5	0.078	
1.5	0.013	1	0.0133	15
		1.5	0.020	
		2	0.0266	
		3	0.0399	
		4	0.0532	
		5	0.0665	
2.5	0.008	1	0.008	20
		1.5	0.012	
		2	0.016	
		3	0.024	
		4	0.032	
		5	0.040	
4	0.005	1	0.005	
		1.5	0.0075	
		2	0.010	
		3	0.015	
		4	0.020	
		5	0.025	

NOTE – Where manufacturers' flex is less than 2 metres in length and has a csa of 0.75mm² and is fitted with a non rewirable plug, it may be rated at 10A and be fused to 13A in accordance with BS 1363 Table 2 Note C

Worked example of maximum resistance measurement calculation (R):

25M cable with Cross-Sectional Area (CSA) of 1.5mm²
Resistance per Metre – 0.0133Ω

So,

25M x 0.0133Ω= 0.3325Ω
Don't forget to add the appliance resistance of 0.1Ω.
0.3325Ω + 0.1Ω = 0.4325Ω

This can rounded to two figures so the maxixmum resistance of the cable in this example is 0.43Ω

Bibliography (by management discipline)

For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Corporate governance

FINANCIAL REPORTING COUNCIL. *Internal control. Revised guidance for directors on the combined code.* London: Institute of Chartered Accountants, 2005.

GREAT BRITAIN. Companies Act 2006. London: The Stationery Office.

GREAT BRITAIN. The Employer's Liability (Compulsory Insurance) Act 1969. London: The Stationery Office.

GREAT BRITAIN. The Employer's Liability (Compulsory Insurance) General Regulations 1972. London: The Stationery Office.

Business risk management

BS 31100:2008, *Risk management – Code of practice*

BS 25999, *Business continuity management*

HSE. Principles of sensible risk management: http://www.hse.gov.uk/risk/riskmanage.pdf

INSTITUTE OF DIRECTORS. Investors in People: its impact on business performance. London: IoD, 2001.

Investors in People: www.investorsinpeople.co.uk

PAS 99, *Specification of common management system requirements as a framework for integration*

Health, safety and welfare

Priced publications, also available for free download at: http://www.hse.gov.uk/pubns/books/index.htm

GREAT BRITAIN. The Health and Safety at Work etc Act 1974. London: The Stationery Office.

GREAT BRITAIN. The Management of Health and Safety at Work Regulations 1999. London: The Stationery Office.

GREAT BRITAIN. The Construction (Design and Management) Regulations 2007. London: The Stationery Office.

GREAT BRITAIN. The Control of Asbestos at Work Regulations 2002. London: The Stationery Office.

GREAT BRITAIN. The Control of Substances Hazardous to Health Regulations 2002. London: The Stationery Office.

GREAT BRITAIN. The Control of Vibration at Work Regulations 2005. London: The Stationery Office.

GREAT BRITAIN. The Dangerous Substances and Explosive Atmospheres Regulations (DSEAR) 2002. London: The Stationery Office.

GREAT BRITAIN. The Electricity at Work Regulations 1989. London: The Stationery Office.

GREAT BRITAIN. The Fire Precautions (Workplace) Regulations 1997 as amended 1999. London: The Stationery Office.

GREAT BRITAIN. The Health and Safety (Consultation with Employees) Regulations 1996. London: The Stationery Office.

GREAT BRITAIN. The Health and Safety (Display Screen) Equipment Regulations 1992. London: The Stationery Office.

GREAT BRITAIN. The Health and Safety (First Aid) Regulations 1981. London: The Stationery Office.

GREAT BRITAIN. The Health and Safety (Safety Signs and Signals) Regulations 1996. London: The Stationery Office.

GREAT BRITAIN. The Health and Safety (Young Persons) Regulations 1997. London: The Stationery Office.

GREAT BRITAIN. The Highly Flammable Liquids and Liquefied Petroleum Gases Regulations 1972. London: The Stationery Office.

GREAT BRITAIN. The Lifting Operations and Lifting Equipment Regulations 1998. London: The Stationery Office.

GREAT BRITAIN. The Management of Health and Safety at Work Regulations 1999. London: The Stationery Office.

GREAT BRITAIN. The Management of Health and Safety at Work and Fire Precautions (Workplace) (Amendment) Regulations 2003 and the Regulatory Reform (Fire Safety) Order 2005. London: The Stationery Office.

GREAT BRITAIN. The Manual Handling Operations Regulations 1992. London: The Stationery Office.

GREAT BRITAIN. The Noise at Work Regulations 2005. London: The Stationery Office.

GREAT BRITAIN. The Provision and Use of Work Equipment Regulations (PUWER) 1998. London: The Stationery Office.

GREAT BRITAIN. The Personal Protective Equipment Regulations 1992. London: The Stationery Office.

GREAT BRITAIN. The Reporting of Injuries Diseases and Dangerous Occurrence Regulations 1995. London: The Stationery Office.

GREAT BRITAIN. The Work at Height Regulations 2005. London: The Stationery Office.

GREAT BRITAIN. The Workplace (Health Safety and Welfare) Regulations 1992. London: The Stationery Office.

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