Portable Appliance Testing (PAT)
College Policy, Code of Practice and Guidance notes

There are legal duties on manufacturers and suppliers covering the initial integrity (safety) of new electrical appliances. There are general duties on the College, as an employer, covering the use and maintenance of its appliances, designed to ensure that they remain in a safe condition.

The particular legal duties relating to the use and maintenance of electrical appliances are contained in the Electricity at Work Regulations (1989). These apply to all work activities and place requirements on both employers and employees (duty holders), in order to control risks which can arise from the use of electricity. The Regulations require certain safety objectives to be achieved but do not prescribe the measures to be taken. This allows the duty holder to select precautions appropriate to the risk rather than have precautions imposed which may not be relevant to a particular work activity.

The best means by which to control risks in the use and maintenance of electrical appliances is to establish a system of regular Portable Appliance Testing (PAT).

The PAT test includes:

- Preliminary visual inspection
- Using a PAT device:
  - Earth continuity tests (for Class 1 equipment)
  - Insulation testing (which may sometimes be substituted by earth leakage measurement)
  - Functional checks.

Visual inspection can be carried out by all users of portable appliance, ideally each time the appliance is used. However electrical testing with a PAT device must only be performed by a person who is competent in the safe use of the test equipment and who knows how to interpret the test results obtained. This person must be capable of inspecting the equipment and, where necessary, dismantling it to check the cable connections.

All Colleges & Services are required by the University to have a PAT testing system in place

College Policy statements

1 General Health and Safety Policy

1.1 Exeter College undertakes to comply with all statutory health and safety requirements.

1.2 The College wishes to adopt all other reasonably practicable means to eliminate hazards and reduce the risk of injury to its employees, students, visitors and contractors, and the risk of damage to its property.

1.3 The College will ensure that resources are made available to provide:

a. plant, equipment and systems of work that are safe and without risks to health;
b. safe arrangements for the use, handling, storage and transport of articles and substances;
c. a safe place of work with safe access to it and safe egress from it;
d. a healthy working environment;
e. adequate welfare facilities and arrangements;
f. sufficient information, instruction, training and supervision to ensure all employees are aware of the hazards at their workplace together with the necessary measures to be taken to protect against these hazards, if they are at risk;
g. a monitoring, inspection and auditing procedure to ensure the effective management of health and safety throughout the University.

2 Policy on Portable Electrical Appliance Inspection and Testing

2.1 The College undertakes to comply with the Electricity at Work Regulations (1989) made under the Health and Safety at Work Act (1974) and all future statutory requirements concerned with the inspection and testing of portable electrical appliances.

2.2 The College wishes to adopt all other reasonably practicable means to eliminate hazards and reduce the risk of injury or damage arising from portable electrical appliances.

Code of Practice

3 Duties under the law
3.1 Relevant Statutory Provisions
3.2 Summary

3.2.1 There are legal duties on manufacturers and suppliers covering the initial integrity (safety) of new electrical appliances. There are general duties, covering the use and maintenance of appliances, designed to ensure that they remain in a safe condition.

3.2.2 The particular legal duties relating to the use and maintenance of electrical appliances are contained in the Electricity at Work Regulations (1989). These apply to all work activities and place requirements on employers, self-employed and employees (duty holders), designed to control risks which can arise from the use of electricity. The Regulations require certain safety objectives to be achieved and do not prescribe the measures to be taken. This allows the duty holder to select precautions appropriate to the risk rather than have precautions imposed which may not be relevant to a particular work activity.

4 Responsible Parties
4.1 Policy

4.1.1 The Health and Safety Committee is responsible for determining the College policy on Portable Electrical Appliance Inspection and Testing.

4.2 Advisory

4.2.1 **The Deputy Bursar** is responsible for advising the Health and Safety Committee and members of the College on the statutory requirements.

4.2.2 **The Deputy Bursar** is responsible for advising the Health and Safety Committee and members of the College on the arrangements for Portable Electrical Appliance Inspection and Testing.

4.3 Executive

4.3.1 **The Governing Body** has the ultimate responsibility to ensure that the College complies with all statutory health and safety requirements. He may share this responsibility with:

4.3.2 **The Health and Safety Officer** is responsible for statutory compliance

They may delegate the implementation of the Departmental arrangements for Portable Electrical Appliance Inspection and Testing to the Deputy Bursar although they retain the responsibility for ensuring that Inspection and Testing is carried out and remedial action is taken where necessary. They may share this responsibility with:

4.3.3 **Supervisors** who are responsible for statutory compliance in their areas of responsibility, eg of technical staff, students.

4.3.4 **All Staff** have a duty to take reasonable care for the health and safety of themselves and others who may be affected by their work. They also have a duty to comply with the University's arrangements for health and safety.

4.3.5 **Students**, although not employees of the College, are offered the same health and safety protection as employees with respect to Portable Electrical Appliance Inspection and Testing and are similarly required to comply with its arrangements.

4.3.6 **Persons carrying out Portable Electrical Appliance Inspection and Testing** do so on behalf of the College and do not carry any personal liability for the results obtained. It is the Deputy Bursar's responsibility to ensure the tests are satisfactorily carried out and any remedial action promptly taken.

5 Arrangements

5.1 Introduction

5.1.1 Portable Electrical Appliances must be regularly inspected and tested by Competent Persons to ensure that they can continue to be used safely.

5.1.2 The planned inspection and testing will include:

- Visual Inspection for signs of damage or deterioration; and
- Electrical Tests, ie;
  - an Earth Continuity test; and
  - relevant Insulation tests.

5.1.3 The test results will be recorded to allow for future comparison, for written identification of defects to be remedied and to provide information for an assessment of risk.

5.1.4 Exeter College will be responsible for making its own inspection and testing arrangements. If the College does not have the resources to carry out these arrangements, a reputable external contractor should be used.

5.1.5 The College allows its staff to use their own appliances, eg kettles, coffee percolators, electric fans. Theses appliances are included in the inspection and testing arrangements. If they are found to fail in any way they must be removed from the premises and repaired at the owner's expense. The use of personal electric heaters is not permitted.

5.2 Definitions

5.2.1 **A Portable Electrical Appliance** is, literally, any electrical equipment capable of being carried and, in general, connected to the mains supply by a flexible lead and a plug. The definition includes appliances with their own power sources, eg, "intrinsically safe" equipment used in potentially explosive environments and equipment designed to operate at 110 volts. The definition does not include equipment which is "hard" wired, eg, heavy equipment supplied by a fixed armored power cable, which is tested using other regimes.

5.2.2 **Class I appliances** rely on earthing of the conductive case and one layer of insulation covering its live internal parts for protection against electric shock.

5.2.3 **Class II appliances** are "double insulated", ie they rely on two layers of insulation between live internal parts and the user for protection against electric shock.

5.2.4 **Competent Person** is a person who is employed or contracted by the University who has received suitable and sufficient training in Portable Electrical Appliance Inspection and Testing (see Section Training)

5.3 Schedule of Inspection and Testing

5.3.1 Visual Inspection: Since over 80% of electrical faults are discovered by visual inspection, this is the most important element of Inspection and Testing. The following schedule is recommended.

P.T.O.

Component	Common Fault
Plug	Cracked casing, bent pins
	Incorrectly rated fuse
	Incorrectly connected wires
	Loose connections
	Loose cable clamp
Mains Lead	Cuts, fraying, brittle
	Kinked, coiled
	Taped joints
	Overloaded (overheated)
	Male connector (if fitted), non-standard (IEC 320, BS4491, CEE22)
	Not secured by grommet/clamp on appliance
Appliance	Damage/faulty operation of off/on switch
	Damage to casing
	Loose parts
	Missing screws
	Evidence of overheating

Component	Common Fault
	Evidence of moisture
	Missing double insulation mark on insulating casing (where appropriate)
	Accessible fuse holders: damage or removal of carrier permits live part to be touched
	Exposed output connections have marked voltage rating >50V

5.3.2 Electrical Testing: A commercially available **Portable Appliance Tester (PAT)** is required for electrical testing of robust appliances. Some PATs have a facility for testing 110 V equipment. A PAT **must not be used** on sensitive electronic equipment such as computers, as permanent damage may be caused by the high test voltages and currents.

The following schedule is recommended, carried out in the order as written:

Class I Appliances	
Earth Continuity / Bonding Test	This test is for checking the earth lead continuity and earth connection (or bonding) to the metal casing of an appliance. A voltage is established between the appliance's mains supply earth pin and its case. There are usually two tests available: (I) 4 A / 300 mW for light duty supply cables (up to 6 A); and (II) 25 A / 300 mW for heavy duty supply cables. The resistance between the earthed case and the earth pin on the mains plug must not be more than 300mW.
Insulation test	This test checks the integrity of the appliance's insulation. For Class 1 appliances the test voltage is applied between the appliance's mains supply plug P (phase) and N (neutral) pins connected together, and the E (earth) pin which is held at earth potential. The insulation resistance must withstand a high voltage (500V dc / 2 MW) for five seconds.

Class I Appliances	
Earth Leakage test	This test shows the level of leakage current in the appliance by monitoring the difference in currents flowing in the phase and neutral connections; any difference must be flowing to earth. This provides a useful way of predicting approach of appliance breakdown since the level of leakage current is a guide to the condition of insulation. Since many appliances are designed with earth leakage, this test is not mandatory; faults are indicated in the Insulation Test described above.
Flash test	This test shows the response of the insulation to ac voltage (indicating problems due to excessive capacitive current) and gives an early warning of insulation problems. There is normally a choice of two flash tests; low and high voltage. Since the high voltage test may stress the insulation and cause degradation, it is recommended that the low voltage flash test only is used.
Operation VA test(optional)	This test indicates that the appliance is in good working order and not drawing excessive current.

Class II Appliances

Test as for Class I Appliances, except with the omission of the Earth Continuity / Bonding Test.

Sensitive Electronic Equipment

Earth Continuity / Bonding Test ONLY

Do NOT use a PAT device

Using a multimeter able to read to 300 mW, the resistance between the earth pin and exposed metal (not signal sockets) should be less than 300mW.

Three phase equipment

The inspection and testing of three phase equipment is a specialist task which must be carried out, either:

- under service contract; or
- by Buildings and Estates Division, Electrical Section.

5.4 Frequency of Inspection and Testing

5.4.1 There is no statutory frequency of inspection and testing. The frequency should reflect the risk of the appliance causing damage or injury. This increases with amount of appliance use and the harshness of its working environment. The following is recommended as a minimum standard:

5.4.2 **Visual Inspection:** On initial use and after moving the appliance and regularly during its lifetime.

5.4.3 **Visual Inspection and Portable Appliance Testing**

Type of business	**User checks**	**Formal visual inspection**	**Combined inspection and test**
Equipment hire	N/A	Before issue/after return	Before issue
Construction	110V – Weekly 230V mains – Daily/every shift	110V – Monthly 230V mains – Weekly	110V – Before first use on site then 3-monthly 230V 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, photocopiers, fax machines	No	1-2 years	None if double insulated, otherwise up to 5 years
Double-insulated equipment ***not*** hand-held, eg fans, table lamps	No	2-3 years	No
Hand-held, double insulated (Class II) equipment, 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
Cables and plugs, extension leads	Yes	1 year	2 years

5.5 Recording of Inspection and Testing Results

5.5.1 When new electrical appliances are purchased it is a good idea to label them with a date of purchase. No PAT test is required initially but the date of the first PAT test, based on risk, can be easily determined from reading the label.

5.5.2 A dated test label indicating PASS or FAIL and its identification (eg departmental inventory number) must be affixed to the appliance (and to the plug, if the lead is detachable).

5.5.3 The inspection and test results must be kept in written form; on record cards, sheets or in a book. Computers may aid record keeping.

5.5.4 The Deputy Bursars office will keep the results centrally, as the Enforcing Authorities (eg the Health and Safety Executive) may wish to inspect them.

5.6 Monitoring of Inspection and Testing Results

5.6.1 College should keep a summary of the results centrally, ie;

- number of appliances tested; and
- test result (pass or fail),

This will provide important information on the number and condition of appliances held.

5.7 Remedial Action

5.7.1 If inspection and testing show the appliance is faulty, it is **unsafe** and it **must be taken out of service until remedial action is taken**.

5.7.2 Unless remedial action is immediate a "DO NOT USE" label must be attached to the appliance and plug.

5.8 Training

5.8.1 Inspection and Testing must be carried out by Competent Persons ie staff who have received suitable and sufficient training.

5.8.2 The decision as to whether an individual is competent to undertake a particular task is left to the Deputy Bursar. It is necessary to weigh up the job's skill content against the individual's attributes, taking into account:

- electrical knowledge;
- electrical experience;
- understanding of the system/equipment to be worked on:

- understanding of the hazards which could arise; and
- the ability to recognise at any time whether it is safe to continue to work.

5.8.3 Both formal theoretical training and practical "on the job" training, using the test equipment, are normally necessary. The former can be arranged with a training provider. The latter carried out within the Department under direct supervision of a Competent Person.

5.8.4 Where external electrical contractors are employed, University staff should request written evidence of their competence.

Guidance notes

Nearly a quarter of all reportable electrical accidents involve portable equipment. The majority of these accidents result in electric shock; others result in fires, eg nearly 2000 fires in 1991 were caused by faulty leads to appliances. A major cause of such accidents is failure to maintain the equipment. The likelihood of accidents occurring and their severity will vary, depending on the type of electrical equipment, the way in which it is used, and the environment in which it is used.

Under no circumstances should a person use electrical apparatus if they have any doubts as to its safety. If in doubt they should consult their Supervisor/Tutor/ Maintenance team/ Deputy Bursar or Health and Safety Assistant as appropriate.

Specialised appliances frequently require special precautions to be taken and reference should always be made to the manufacturer's instructions.

In this guidance:

Electrical Hazards

Personal injury

Electric shock

Electric shock is the effect produced on the body, particularly its nervous system, by an electrical current passing through it. The extent of injury depends upon the current strength which in turn depends upon the voltage, the path the current takes through the body, the surface resistance of the skin (much reduced when wet) and several other factors. A voltage as low as 15V can produce discernible shock effects and 70 V has been known to cause death. But, generally speaking, fatalities involve domestic voltages (240Vac) and currents of 25-30 milliamps. The most common cause of death from shock is suffocation and

accordingly it is highly desirable that those dealing with electricity should be trained in resuscitation. Minor shocks in themselves may not be serious but they can lead to serious consequences; for example, the associated muscle contraction may lead to falls from working platforms or ladders.

Burns

These are caused by the passage of heavy current through the body or by direct contact with an electrically heated surface. They may also be caused by the intense heat generated by arcing from a short circuit. Electrical burns are a very unpleasant form of burn and require immediate medical attention.

Explosions

The main causes of electrically induced explosions are:

- In situations where flammable gases or vapours are present so that a spark could initiate an event. In such environments all electrical equipment should be flame-proofed.
- Where electrical arcing takes place in a confined space causing intense local heating with consequent bursting of the enclosure by the expansion of trapped air.

Fires

A large percentage of fires are of electrical origin, caused by one or more of the following:

Sparks

A spark arises from a sudden discharge through the air between two conductors, or from one conductor to earth. The current produced is usually small so that serious fires are unlikely unless explosive gases or vapours are present, or highly flammable material is in contact with the conductor.

Arcs

An arc is a much larger and brighter discharge where the current flow may be hundreds of amps. It usually arises when a circuit is broken or when a conductor melts or fractures leaving a gap across which the current continues to flow. When an arc is struck, the air in the vicinity becomes ionised and forms a conductor which may allow current to flow to a nearby metal framework. Any combustible material in the vicinity could therefore lead to a fire.

Short circuits

A short circuit is formed when the current finds a path from the outward conductor wire to the return wire other than through the equipment to which it is connected. The current flow may be large because of the

low resistance of the leads and arcing often occurs at a contact between the conductors. Insulation may therefore be burned and set fire to adjacent flammable material.

Assessment of risk

High Risks	would result from the use of an electrically powered pressure water cleaner outside, powered by 240 volt electrical supply, with the cable trailing on the ground where it can be damaged by vehicles and other equipment, and where water is present. Damage to the cable or other parts is likely to result in the operator or others receiving an electric shock. Similar risks result when other electrical equipment such as drills and portable grinders are used in harsh environments, eg construction sites, where there is a high probability of mechanical damage resulting in danger.
Medium Risks	would result from floor cleaners, kettles, hand held office equipment, which are usually used in a more benign environment, eg offices, but can be subject to intensive use and wear. This can eventually lead to faults which can also result in a shock, burns or fire.
Low Risks	would result from infrequently moved but reasonably regularly used items such as desk lamps analytical instruments, vacuum pumps, heaters)
Very Low Risks	arise from specialised equipment, eg information technology (IT) equipment (computers and printers), photocopiers, fax machines etc. They are usually double insulated, are used in dry clean environments and are hardly ever moved or insulation stressed.

Equipment which is held by hand or is handled when switched on will present a greater degree of risk because, if a dangerous fault occurs, then the person holding it will almost certainly receive an electric shock.

The risk of receiving an electric shock will be greater when the equipment user is standing on the ground outside or a concrete floor, scaffolding or similar which is a good conductor, than if standing on a wooden floor or dry carpet and not in contact with earthed metal work (ie using double insulated appliances or 110 volt tools which have a centre tapped transformer to give 55 volts between live and earth).

Because the consequences of an accident are so serious – potentially fatal electric shock, or fire affecting the whole premises – the inspecting and testing system is designed to be proactive , ie planned to prevent incidents arising, rather than reactive where action is taken following an incident/accident. The frequency of inspection and testing is directly related to risk.

The greatest overall reduction of risk will take place when the inspection and testing regime is first put into practice. Thereafter it will take time to establish the appropriate test frequency based on experience. A low failure rate would indicate that the test interval can be increased and a high failure rate that the interval should be shortened.