

HSE GUIDANCE

MAINTAINING PORTABLE ELECTRICAL EQUIPMENT



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The content of this publication is of general interest and is not intended to apply to specific circumstances or jurisdiction. It does not purport to be a comprehensive analysis of all matters relevant to its subject matter. The content should not, therefore, be regarded as constituting legal advice and not be relied upon as such. In relation to any particular problem which they may have, readers are advised to seek specific advice from their own legal counsel. Further, the law may have changed since first publication and the reader is cautioned accordingly. © 2014 Zywave, Inc. All rights reserved.

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This guidance provides sensible advice on maintaining portable electrical equipment to prevent danger for managers, electricians, technicians and users. It covers equipment that is connected to the fixed mains supply or a locally generated supply. In this document the term 'portable' is used to mean movable or transportable.

The maintenance plan described in this guidance is based on a straightforward, inexpensive system of user checks, formal visual inspection and testing. User checks and formal visual inspections can be carried out by a competent employee. In this context 'competent' means having suitable training, skills and knowledge for the task to prevent injury to themselves or others. This guidance also makes it clear when testing is needed. When testing is necessary, a greater degree of competence will be required. However, people in control are free to take other action or use alternative control measures that achieve the same standard of safety.

There is no legal definition of portable equipment. However, in this guidance it means equipment that is intended to be connected to a generator or a fixed installation by means of a flexible cable and either a plug and socket or a spur box, or similar means. This includes equipment that is either hand-held or hand-operated while connected to the supply, intended to be moved while connected to the supply or likely to be moved while connected to the supply.

Extension leads, plugs and sockets, and cord sets that supply portable equipment are classified as portable equipment because they operate in the same environment and are subject to the same use as the equipment they serve. Portable equipment also includes appliances which have been fixed for a security purpose, such as those in public areas of hotels and changing rooms—eg kettles, hair dryers, hand dryers, lamps etc. The electrical supply to the equipment is assumed to be at a voltage that can give a fatal electrical shock—ie more than 50 volts of an alternating current or 120 volts of a direct current.

Portable electrical equipment should only be used in accordance with the manufacturer's instructions, for its intended purpose, and in the environment it was designed and constructed for.

Scope

The scope of this guidance is limited to Class I and Class II equipment:

- Earthed Equipment (Class I): This equipment relies on the metallic (exposed conducting) parts of the equipment being effectively earthed. If this earth connection is lost, there is a possibility of the exterior of the equipment becoming live, with a potentially fatal result. Anyone touching live metal will be in contact with electricity.
- Double Insulated Equipment (Class II): This equipment is constructed with high-integrity insulation and does not have nor need an earth connection to maintain safety. If you do not see a Class II symbol (below), you should assume that the electrical equipment is a Class I appliance.



This guidance covers portable equipment that is connected to the fixed mains supply or to a locally generated supply; for example, a local diesel generator. The safety of portable electrical equipment depends on the continued integrity of the earthing and correct connections of the fixed electrical installation. This includes the wiring, fuse box/consumer unit, and switches up to and including the socket supplying the equipment.

Main Risks

Portable electrical equipment could cause an electric shock or burn, or fire due to damage, wear or misuse. This guidance covers most electrical portable equipment used in all environments—eg electric drills, extension leads, office equipment, portable grinders, pressure water cleaners, floor cleaners, electric kettles and similar equipment used in all environments. Major items of plant, such as vehicles, cranes and generators, are beyond the scope of this guidance, as are electromedical equipment, electrostatic spraying equipment, and equipment used below ground in mines, for which there are special requirements.

Business equipment (such as computers, printers, photocopiers, etc) does not present the same level of risk as other equipment (such as electric drills) provided that the leads and plugs are protected from mechanical damage or stress. Movement, and therefore damage through being moved, is less likely to occur, and the equipment is often double-insulated and used in a dry, clean environment with non-conducting floors.

What is Required by Law?

The legal requirements relating specifically to the use and maintenance of electrical equipment are contained in the Electricity at Work Regulations 1989 in England, Wales and Scotland. The Electricity of Work Regulations (Northern Ireland) 1991 apply in Northern Ireland. These regulations apply to all work activities involving electrical equipment. They place duties on employers, the self-employed and employees (subsequently referred to as 'duty holders'). These duties are intended to control risks arising from the use of electricity.

The regulations require that electrical systems and equipment must be maintained, so far as **reasonably practicable**, to prevent danger. This means balancing the level of risk against the measures needed to control the real risk in terms of money, time or trouble. However, you do not need to take action if it would be grossly disproportionate to the level of risk. This requirement covers all items of electrical equipment including fixed or portable equipment.

The regulations do not specify what needs to be done, by whom or how frequently—for example, they do not make it a legal requirement to test all portable electrical appliances every year. This allows the duty holder to select precautions appropriate to the risk rather than having precautions imposed that may not be relevant to a particular work activity. Note that even if a contractor is used to carry out maintenance procedures, the duty holder still has overall responsibility for complying with the law.

There are also legal duties on manufacturers and suppliers covering the initial integrity (safety) of new work equipment. There are general duties covering the use and maintenance of work equipment that are designed to ensure it remains in a safe condition.

Controlling the Risk

Failure to maintain equipment is a major cause of electrical accidents involving portable 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 it is used in.

Control of risks arising from the use of portable electrical equipment should be based on a risk assessment. A risk assessment is about identifying hazards and taking sensible and proportionate measures to control the risks in the workplace. Risks can be managed and controlled by setting up an appropriate maintenance plan.

Factors to consider when making the risk assessment include:

- Type of equipment—the vast majority of which will be either earthed equipment or double-insulated equipment;
- Whether it is hand-held or not. Equipment that is held by hand or handled when switched on will present a greater degree of risk because if it does develop a dangerous fault, the person holding it will almost certainly receive an electric shock;
- Manufacturer's recommendations;
- Initial integrity and soundness of the equipment;
- Age of the equipment;
- Working environment in which the equipment is used (eg wet or dusty) or likelihood of mechanical damage;
- Frequency of use and duty cycle of the equipment;
- Foreseeable misuse of the equipment;
- Effects of any modifications or repairs to the equipment; and
- Analysis of previous records of maintenance, formal visual inspection, combined inspection and testing.

Portable Equipment and Cables

Portable equipment and the electrical connections to it (eg the plug and flexible cable and its terminations) are likely to be subjected to, and more vulnerable to, physical damage and wear or harsh treatment in use than equipment which forms part of the fixed installation. The fixed installation is usually provided with a significant degree of protection against damage by the fabric of the building or fixed enclosure. However, floor boxes containing socket outlets can easily trap and damage cables if not properly used. It is important to remember that the same legal requirement to maintain systems applies to the fixed installation and all electrical equipment connected to it.

The risk of receiving an electric shock will be greater when the user of portable electrical equipment is standing on a surface that is a good electrical conductor (such as a wet floor, the ground outside, a concrete floor or on scaffolding) than if they are standing on a wooden floor or dry carpet and not in contact with earthed metalwork.

The most vulnerable item of any portable equipment is often the cable (sometimes called the cord, lead or flex) that supplies the equipment. Most portable equipment is supplied by a flexible cable, which is made up of thin, flexible wires covered in insulation and then enclosed in an overall sheath. The cable may deteriorate due to ageing or environmental effects, abuse or misuse, or it may fail because of repeated flexing, or suffer mechanical damage. The most obvious examples of mechanical damage include the cable being struck or penetrated by objects.

Repeated or excessive flexing of the cable will eventually cause the conductor to fracture and the sheath to crack. Damage usually occurs first at the cord grip or gland where the cable enters the equipment or its plug. The damage is typically apparent at the user check and should be reported. The cable should be replaced before a dangerous fault develops, such as exposure of conductors, or possibly arcing between broken conductor ends.

Some portable equipment (such as floor polishers, hedge trimmers, saws and soldering irons) is capable of causing damage to the sheath, or even to the insulation of its own flexible cable. The cable should be secured in such a way that it does not come into contact with parts that are moving or hot. The users of such equipment should always be alert to avoid such damage. If damage does occur, they should stop using the equipment and report it to their manager.

An example of a high-risk activity is the use of a pressure water cleaner, powered by a 230-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 expose the operator or others to the risk of electric shock.

Similar risks result when electrical equipment such as drills or portable grinders are used in a harsh and sometimes wet environment such as at a construction site. There is a high probability of mechanical damage, and in some circumstances the metal casing of equipment can become live.

Sometimes 'unauthorised' equipment is brought to work by employees (eg electric heaters, kettles, coffee percolators, electric fans). Use of such equipment should be controlled and it may need to be included in the maintenance plan (particularly the formal visual inspection if its use is allowed). Equipment that fails a user check, a formal visual inspection, or where relevant, a combined inspection and test, should not be used until it is repaired by a competent person.

Lower risks result from floor cleaners or kettles that are generally used in a more benign environment—eg offices and hotels. But such equipment can still be subject to intensive use and wear. This can eventually lead to faults that can also result in a shock, burns or, more rarely, a fire.

Next Steps

Having identified the hazards, the next stage of the risk assessment is to consider what action is needed to manage the risks responsibly. Generally, everything reasonably practicable must protect people from harm.

The Management of Health and Safety at Work Regulations 1999 (2000 in Northern Ireland) require that a record is made of the significant findings of the risk assessment and what is already in place to control those risks. Any record produced should be simple and focused on controls. If there are fewer than five employees, it does not need to be written down. However, it is useful to do this so it can be reviewed at a later date if something changes. By law, if there are five or more employees, the risk assessment must be written down.

Although a good initial level of safety can be achieved by correct selection and use of equipment and its connectors and cables, lasting safety can only be attained by ongoing and effective maintenance.

An electrical accident can lead to a potentially fatal electric shock or fire affecting the whole premises. The maintenance plan should therefore be designed to be proactive and planned to prevent incidents arising, rather than reactive, where action is taken following an incident or accident. The action taken should be appropriate to the risk, for instance the frequency of inspections and any necessary testing will depend on the type of equipment in use, how it is used, how often and where it is being used. Maintenance will need to be carried out more frequently where the risk is higher, for example on construction sites, and less frequently where the risk is lower, such as in offices.

Effective maintenance of portable electric equipment can be achieved by a combination of:

- Checks by the user;
- Formal visual inspections by a competent person; and
- Where necessary, a combined inspection and test, also known as a portable appliance test (PAT), by an electrically competent person.

The aim of these checks is to determine whether the equipment is fully serviceable or whether remedial action is necessary to make sure it is safe to use.

Managers should follow up these procedures by monitoring the effectiveness of the system and taking action where faults are found, particularly when faults are frequent.

User Checks

The person using the equipment should be encouraged to look at it before use and check for signs that it may not be in sound condition, for example:

- Damage (apart from light scuffing) to the supply cable, including fraying or cuts;
- Damage to the plug or connector, eg the casing is cracking or the pins are bent;
- Inadequate joints, including taped joints in the cable;
- The outer sheath of the cable is not effectively secured where it enters the plug or the equipment. Evidence would be if the coloured insulation of the internal cable cores were showing;
- The equipment has been subjected to conditions for which it is not suitable, eg it is wet or excessively contaminated;
- Damage to the external casing of the equipment;

- Loose parts or screws; or
- Evidence of overheating (burn marks or discolouration).

These checks also apply to extension leads, plugs and sockets. A user check should be made when the equipment is taken into use and during use. Any faults should be reported to the relevant manager and the equipment should be taken out of use immediately. Managers should take effective steps to ensure that the equipment is not used again until it is repaired by a person competent to carry out the task (eg the defective equipment could be labelled as 'faulty' and if it has a rewirable plug, this could be removed).

Formal visual inspections

An important part of a maintenance regime is the formal visual inspection. Such inspections are necessary because they can reveal most potentially dangerous faults. They can normally be carried out by a member of staff who has sufficient information and knowledge of what to look for, what is acceptable and who has been given the task of carrying out the inspection (that is, they are competent to do the task). To avoid danger, trained people should know when the limit of their knowledge and experience has been reached. Simple, written guidance relating to the formal visual inspection can be produced that summarises what to look for and which procedures to follow when faults are found or when unauthorised equipment is in use. This guidance can also help equipment users.

These inspections can help to control the risks and to monitor the user checks. A competent person should carry out regular inspections that include checks similar to user checks but that are undertaken in a more formal and systematic manner.

As part of the visual inspection, you should also consider whether:

- The electrical equipment is being used in accordance with the manufacturer's instructions;
- The equipment is suitable for the job;
- There has been any change of circumstances;
- The user has reported any issues.

Additional checks could include removing the plug cover to ensure:

- There are no signs of internal damage, overheating or water damage to the plug;
- The correct fuse is in use and it is a proper fuse, not a piece of wire, nail, etc;
- The wires including the earth, where fitted, are attached to the correct terminals;
- The terminal screws are tight;
- The cord grip is holding the outer part (sheath) of the cable tightly; and
- No bare wire is visible other than at the terminals.

For moulded plugs, the fuse can be checked. The formal visual inspection should not include taking the equipment apart. This should be confined, where necessary, to the combined inspection and testing.

The formal visual inspections should be carried out at regular intervals. The period between inspections can vary considerably, depending on the type of equipment, the conditions of use and the environment. For

example, equipment used on a construction site or in a heavy steel fabrication workshop will need more frequent inspections than equipment such as computers in an office. However, in all cases, the period between inspections should be reviewed in the light of experience. Faulty equipment should be taken out of service and not used again until properly repaired. If necessary, it should be tested.

The pattern of faults can help managers decide what action to take, depending on whether the faults show:

- The wrong equipment is being selected for the job;
- Further protection may be necessary in a harsh environment; or
- The equipment is being misused.

Combined Inspection and Test (PAT)

The checks and inspections outlined above should reveal most potentially dangerous faults. However, some faults, such as loss of earth integrity (eg broken earth wire within a flexible cable), deterioration of insulation integrity, or contamination of internal and external surfaces, cannot be detected by visual examination alone. Such faults can only be reliably detected by a combined visual inspection and test. This should be carried out periodically to back up the checks and inspections, and is likely to be justified:

- Whenever there is reason to suspect that the equipment may be defective and this cannot be confirmed by visual examination;
- After any repair, modification or similar work; or
- At periods appropriate to the equipment, the manner and frequency of use and the environment.

The inspection carried out in conjunction with testing should usually include checking:

- The correct polarity of supply cables;
- The correct fusing;
- Effective termination of cables and cores; and
- That the equipment is suitable for its environment.

Combined inspection and testing requires a greater degree of competence (in terms of knowledge, training and experience) than for inspection alone, because appropriate electrical knowledge is needed to undertake the tests and interpret the test results. However, it can often be carried out by a competent employee.

The people testing portable electrical equipment should be appropriately trained. It is the employer's duty to make sure that they are competent for the work they are expected to carry out. There are two levels of competency:

- Level 1: A person not skilled in electrical work who routinely uses a simple 'pass/fail' type of portable appliance tester where no interpretation of readings is necessary. The person would need to know how to use the test equipment correctly. Provided that the appropriate test procedures are rigorously followed and acceptance criteria are clearly defined, this routine can be straightforward.
- Level 2: A person with appropriate electrical skills who uses a more sophisticated instrument that gives readings which require interpretation. Such a person would need to be competent through technical knowledge or experience related to this type of work.

Some combination of the actions in user checks and visual checks (above) should ensure, so far as reasonably practicable, that equipment will be maintained in a safe condition wherever it is used. The more extensive inspection and testing described here can be carried out less frequently if the maintenance system includes formal visual inspections and monitoring of the user checks.

Maintenance, Test Records and Labelling

There is no legal requirement to keep maintenance logs for portable electrical equipment. However, a suitable log is useful as a management tool for monitoring and reviewing the effectiveness of the maintenance plan.

The log can include faults found during inspection, which may be a useful indicator of places of use or types of equipment that are subject to a higher-than-average level of wear or damage. This will help monitor whether suitable equipment has been selected. Entries can also highlight any adverse trends in test readings that may affect the safety of the equipment, and as a result enables remedial action to be taken. Be careful when interpreting trends where a subsequent test may be done with a different instrument, as differences in the results may be due to differences in the instruments rather than deterioration in the equipment being tested.

While not required by law, duty holders with large amounts of equipment may find it useful to label equipment to indicate that the equipment has been tested satisfactorily—ie when it was tested and whether it was passed as 'safe'. If a label is applied, then there should not be a next test due date on it. The person carrying out the testing should not assess when the next test is due as this decision should be made by the duty holder based on a risk assessment.

Frequency of Examinations

Determining the frequency of inspection and testing is a matter of judgement by the duty holder, and should be based on an assessment of risk. It is recommended that this is carried out as part of the general risk assessment.

Table 1 sets out the suggested initial frequency for the various types of checks on portable electrical equipment. It gives suggested starting intervals when implementing a maintenance plan. 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 shorter interval is for more demanding conditions of use and the longer interval is for less demanding conditions. Alternatively, the duty holder may wish to seek advice from a competent person who has the knowledge and experience to make the necessary judgement—eg original appliance manufacturers or suppliers, or relevant trade associations.

Note that the suggested initial frequencies for inspection and testing given in Table 1 are not legal requirements. 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. This information should determine the maintenance plan. Over time, and with practical maintenance experience, it may be possible to extend maintenance intervals if results of checks, inspections or tests show that few faults are found. However, if faults are common it may be necessary to reduce intervals or take other action to improve maintenance and reduce risk.

Type of Business		User Checks	Formal Visual Inspection	Combined Inspection and Test
Equipment hire		N/A	Before issue/after return	Before issue
Battery-operated equipment (less than 40 V)		No	No	No
Extra low voltage (less than 50 V ac), telephone equipment, low-voltage desk lights		No	No	No
Construction	110 V equipment	Yes, weekly	Yes, monthly	Yes, before first use on site, then quarterly
	230 V equipment	Yes, daily/every shift	Yes, weekly	Yes, before first use on site, then monthly
	Fixed RCDs	Yes, daily/every shift	Yes, weekly	Yes, before first use on site, then quarterly (portable RCDs – monthly)
	Equipment-site offices	Yes, monthly	Yes, bi-yearly	Yes, before first use on site, then yearly
Heavy industrial/high risk of equipment damage (not construction)		Yes, daily	Yes, weekly	Yes, 6 to 12 months
Light industrial		Yes	Yes, before initial use, then bi-yearly	Yes, 6 to 12 months
Office information technology rarely moved (desktop computers, copiers, fax machines etc)		No	Yes, 2 to 4 years	No if double-insulated, otherwise up to 5 years
Double-insulated (Class II) equipment moved occasionally (not hand-held), eg fans, table lamps		No	Yes, 2 to 4 years	No

Hand-held, double insulated (Class II) equipment, eg some floor cleaners, some kitchen equipment	Yes	Yes, 6 months to 1 year	No
Earthed (Class I) equipment, eg electric kettles, some floor cleaners	Yes	Yes, 6 months to 1 year	Yes, 1 to 2 years
Cables, leads and plugs connected to Class I equipment, extension leads and battery-charging equipment	Yes	Yes, 6 months to 4 years depending on type of equipment it is connected to	Yes, 1 to 5 years depending on type of equipment it is connected to

Notes for Table 1:

Cables, leads and plugs connected to Class II equipment should be maintained as part of that equipment. Cables leads and plugs not dedicated to an item of equipment should be maintained as individual items as appropriate.

Over time, when you look at the results of user checks, formal visual inspections and portable appliance tests, you will notice trends. These may tell you that you need to look at or test electrical equipment more or less often, depending on the number of problems being found.

If electrical equipment is grouped together for testing at the same time, you should use the shortest testing interval in the group rather than the longest. Alternatively, it may be appropriate to group your electrical equipment by testing interval.

Where portable electrical equipment is provided for public use, and where a duty holder does not have direct control over the way it is used, formal visual inspection may need to be done much more frequently. This could be carried out by a member of staff. This should be determined by knowledge of the likely risks and subsequently modified in the light of experience.

For many premises—eg health service facilities, educational facilities, hotels and offices—more than one inspection and test regime may apply to different equipment due to a mix of high-risk areas (eg kitchens, laundries) and low-risk areas (eg offices).

After the first few formal visual inspections, the information obtained can be used to revise the intervals between future inspections. The same is true for combined inspection and testing. A low failure rate would indicate that the interval can be increased, and a high failure rate would indicate that the interval should be shortened.

Repair and Replacement

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The repair of most portable electrical equipment requires specialist knowledge and expertise if the faulty or damaged equipment is to be restored to the necessary safe condition. However, you may prefer to replace items rather than repair them.

Where flexible cables have been in use for a long time, it is better to replace rather than repair them because conductor wires, insulation and sheathing materials deteriorate.

For long lengths of cable with the damaged part close to one end, the damaged section can be cut off. If the damage is not near one end, after removing the damaged section, use a proprietary cable coupler to join the healthy sections. If a coupler is used, the socket part must be on the section fed from the electricity supply side and the plug part should be on the cable connected to the equipment. Such repair work must be undertaken by a competent person. It may be easier to replace relatively short lengths of unsatisfactory cable rather than carrying out repairs.

Appendix:

Summary Checklist

You can use this checklist to check whether you are managing the risks from portable electrical equipment effectively.

ACTION	COMPLETE
Set up a maintenance plan for portable electrical equipment.	<input type="checkbox"/>
Identify which portable electrical equipment needs to be maintained and find out where it is used and how.	<input type="checkbox"/>
Decide what to do about unauthorised equipment brought in by employees.	<input type="checkbox"/>
Provide straightforward training and information for all users (including yourself) to help carry out user checks, including what to do if they find a fault.	<input type="checkbox"/>
Set up a formal visual inspection system and train someone to carry this out.	<input type="checkbox"/>
Consider producing brief, written guidance on the formal visual inspection, what to look for and procedures to follow when faults are found and when unauthorised equipment is in use.	<input type="checkbox"/>
Decide on and undertake the appropriate frequency for formal visual inspection. If records of formal visual inspections are kept, the findings can be reviewed and the records used to help you decide how frequently these inspections should be carried out.	<input type="checkbox"/>
Assign someone to do the combined inspection and test of equipment that:	<input type="checkbox"/>
<ul style="list-style-type: none">Is suspected of being defective (where this cannot be determined by visual examination);	<input type="checkbox"/>
<ul style="list-style-type: none">Has been repaired or modified (this may be a specialised activity);	<input type="checkbox"/>
<ul style="list-style-type: none">Is due for a combined inspection and test; or	<input type="checkbox"/>
<ul style="list-style-type: none">Has been in use for longer than the interval between combined inspections and tests but has never had one (for example, because you are just starting a maintenance system).	<input type="checkbox"/>
Make sure that the person carrying out combined inspection and testing has sufficient knowledge, training and experience as well as access to further information and advice where necessary.	<input type="checkbox"/>
Decide on an appropriate frequency for combined inspection and testing where this is necessary.	<input type="checkbox"/>
Review test results to decide how frequently you should carry out combined inspections and tests.	<input type="checkbox"/>

Monitor all the arrangements and make sure that follow-up action is carried out, including a review of the frequency of formal visual inspection.	<input type="checkbox"/>
Do not use items that fail maintenance checks until they have been repaired by a competent person.	<input type="checkbox"/>