



# ESCOM

ELECTRICAL SAFETY  
COMMITTEE

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## GUIDELINES AND BEST PRACTICES FOR PORTABLE APPLIANCE TESTING

DOCUMENT No: ESCOM/2024/02, REVISION 1.0

## What is ESCOM?

The Safety, Health and Environment National Authority (SHENA) and Autoriti Elektrik Negara Brunei Darussalam (AENBD) under the Department of Energy established the Electrical Safety Committee or “ESCOM” in January 2023; with the objectives of promoting regulatory compliance and raising electrical safety standards within Brunei Darussalam.

## Who are the ESCOM members?

Members of the ESCOM comprised of industry experts from both government institutions and private organisations with decades of collective experience and a shared passion to drive improvements and promote electrical safety in Brunei Darussalam. The committee is co-chaired by both SHENA and AENBD.

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## 1 INTRODUCTION

- 1.1 Portable Appliance Testing (PAT) is a critical process designed to guarantee the safety of electrical appliances used in various environments.
- 1.2 These guidelines, which set the British Standards or Health and Safety Executive (HSE) recommendations in the UK as references, aim to offer detailed and comprehensive instructions for conducting PAT effectively.
- 1.3 Scope
  - 1.3.1 The PAT guidelines cover the testing and inspection of electrical appliances that are connected to the electrical supply via a plug and socket arrangement.
  - 1.3.2 These appliances may include computers, printers, kettles, power tools, extension leads, and other equipment used in workplaces, educational institutions, public venues, and domestic environments.
  - 1.3.3 The guidelines do not apply to fixed electrical installations or appliances hard-wired into the electrical system.
- 1.4 Competency
  - 1.4.1 PAT requires competent personnel who are adequately trained and qualified in electrical safety practices.
  - 1.4.2 The PAT testers should possess a thorough understanding of electrical systems, relevant safety standards, and the IET Code of Practice for In-service Inspection and Testing of Electrical Equipment (4th Edition).
  - 1.4.3 Regular training and ongoing professional development are essential to remain updated with best practices in the field.
- 1.5 Becoming a competent PAT tester requires specialised training to ensure that the individual possesses the necessary knowledge and skills to conduct the testing safely and effectively.
- 1.6 The specific training for becoming a competent PAT tester typically includes, but is not limited to the following:

### 1.6.1 Electrical Safety Training:

- 1.6.1.1 A fundamental component of PAT testing training involves understanding electrical safety principles and the risks associated with working with electrical appliances.
- 1.6.1.2 This includes learning about electrical hazards, safe working practices, and how to prevent electric shock or other accidents during testing.

### 1.6.2 Understanding PAT Regulations and Standards:

- 1.6.2.1 PAT Operators should be familiar with relevant regulations and standards, such as the IET Code of Practice for In-service Inspection and Testing of Electrical Equipment (4<sup>th</sup> Edition) in the UK.
- 1.6.2.2 Understanding these guidelines ensures that testing procedures align with industry best practices and legal requirements.

### 1.6.3 PAT Testing Procedures:

- 1.6.3.1 Trainees should receive practical instruction on how to conduct PAT tests, including step-by-step procedures for each test (earth continuity, insulation resistance, earth leakage, polarity, etc.).
- 1.6.3.2 Hands-on training with actual testing equipment is essential for gaining confidence and proficiency in performing PAT tests efficiently.

### 1.6.4 Identification of Appliance Types and Classifications:

- 1.6.4.1 PAT testers should be able to identify different appliance types and their respective classifications (Class I, Class II, etc.).
- 1.6.4.2 This knowledge is critical for determining appropriate testing intervals and the required tests for each type of appliance.
- 1.6.4.3 Understanding the classification of appliances helps PAT testers apply the correct testing procedures and intervals to ensure safety and compliance.

1.6.5 Visual Inspection Skills:

1.6.5.1 A significant portion of PAT testing involves a visual inspection of appliances before conducting electrical tests.

1.6.5.2 Trainees should learn how to identify visible defects, damage, and signs of wear that may affect the safety of an appliance.

1.6.5.3 This visual inspection is crucial for ensuring that appliances are safe to use and for identifying potential hazards before performing electrical tests.

1.6.6 Hands-On Practical Training:

1.6.6.1 Trainees should have ample opportunities for hands-on practice with various types of electrical appliances and testing equipment.

1.6.6.2 Practical training enables them to gain confidence in operating the testing instruments and interpreting test results accurately.

1.6.6.3 Hands-on experience allows trainees to become familiar with different appliances and testing procedures, enhancing their ability to perform PAT testing effectively and efficiently in real-world settings.

1.6.7 Test Equipment Calibration:

1.6.7.1 Understanding the importance of regular calibration of PAT testing equipment is crucial to ensure accurate and reliable results.

1.6.7.2 Trainees should learn how to handle, maintain, and calibrate testing instruments properly.

1.6.7.3 Proper calibration ensures that the testing equipment is functioning correctly and provides accurate measurements during PAT testing procedures.

1.6.7.4 Additionally, trainees should be educated on the importance of adhering to calibration schedules and procedures outlined by regulatory standards to maintain the integrity of the testing process.

1.6.8 Record Keeping and Documentation:

1.6.8.1 Comprehensive training should include guidance on proper record-keeping practices, including how to document test results, label appliances correctly, and organise records for easy retrieval and audit purposes.

1.6.8.2 Effective record-keeping ensures that all PAT testing activities are documented accurately, facilitating compliance with regulatory requirements, and providing a historical record of testing outcomes for future reference and analysis.

1.6.9 Safety and Risk Assessment:

1.6.9.1 Trainees should be trained in performing safety risk assessments to determine appropriate testing frequencies for different environments and the level of risk associated with each appliance.

1.6.9.2 Understanding safety risk assessments helps PAT testers prioritize testing schedules and allocate resources efficiently based on the level of risk posed by various appliances and environments.

1.6.9.3 This proactive approach enhances safety measures and ensures that PAT testing activities are conducted in accordance with regulatory standards and best practices.

1.6.10 Continuing Professional Development (CPD) under SHENA:

1.6.10.1 It is essential for PAT testers to engage in continuous learning and CPD to stay up to date with changes in regulations, best practices, and technological advancements related to PAT testing.

1.6.10.2 Continuous learning ensures that PAT testers remain knowledgeable about the latest developments in the field and are equipped to perform their duties effectively and in accordance with current standards and guidelines.

1.6.10.3 CPD activities may include attending training workshops, seminars, webinars, and conferences, as well as staying informed through relevant publications and industry updates.

- 1.7 Qualified training providers or organisations that specialise in electrical safety often offer PAT testing courses.
- 1.8 These courses may range from basic introductory training to more advanced courses for experienced testers.
- 1.9 Upon successful completion of the training, individuals should receive a certificate or qualification to demonstrate their competency as a PAT tester.
- 1.10 Additionally, on-the-job training and mentoring under the supervision of experienced PAT testers can further enhance practical skills and knowledge.

## **2 PORTABLE APPLIANCE TESTING (PAT) STANDARDS**

- 2.1 PAT is governed by various standards and guidelines that provide best practices for conducting electrical safety inspections on portable electrical appliances. The main standards related to PAT include:
  - 2.1.1 IEC 60364-6:
    - 2.1.1.1 The International Electrotechnical Commission (IEC) 60364-6 standard provides guidelines for the verification of electrical installations.
    - 2.1.1.2 Part 6 specifically focuses on electrical installations and equipment in low-voltage systems. It outlines requirements for periodic inspection and testing of electrical installations, including portable appliances.
  - 2.1.2 IET Code of Practice for In-service Inspection and Testing of Electrical Equipment (4th Edition):
    - 2.1.2.1 Published by the Institution of Engineering and Technology (IET) in the UK, this Code of Practice is widely recognized as the definitive guide for PAT testing.
    - 2.1.2.2 It offers detailed guidance on the inspection and testing of electrical equipment, including portable appliances, in various environments.

- 2.1.3 BS 7671:
  - 2.1.3.1 The British Standard BS 7671, also known as the IET Wiring Regulations, sets the requirements for electrical installations in the UK.
  - 2.1.3.2 It includes provisions related to the inspection and testing of electrical equipment, covering aspects such as safety, earthing, and bonding.
- 2.1.4 ISO 9001:
  - 2.1.4.1 Though not specific to PAT, the ISO 9001 standard focuses on quality management systems.
  - 2.1.4.2 Many organizations implementing PAT include it as part of their overall quality management system to ensure consistency and adherence to best practices.
- 2.1.5 ISO 14001:
- 2.1.6 ISO 14001 is an environmental management standard that encourages organizations to establish and implement procedures to minimize their environmental impact.
- 2.1.7 PAT may be included as part of an organization's efforts to maintain safe and environmentally friendly workplace practices.
- 2.1.8 HSE Guidance:
  - 2.1.8.1 In the UK, the Health and Safety Executive (HSE) provides guidance on electrical safety, including PAT.
  - 2.1.8.2 The HSE guidance assists duty holders in understanding their responsibilities related to PAT and electrical safety management.
- 2.2 It is essential to consider the specific requirements and regulations applicable in Brunei Darussalam.
- 2.3 Each country may have its own set of standards and guidelines related to electrical safety and PAT.

- 2.4 For example, in the United States, PAT is commonly referred to as Electrical Safety Testing (EST), and guidelines are provided by organizations like the Occupational Safety and Health Administration (OSHA).
- 2.5 Therefore, it's crucial to familiarize oneself with the relevant standards and guidelines applicable to your jurisdiction to ensure compliance and promote electrical safety practices.
  - 2.5.1 When conducting PAT, it is crucial to refer to the relevant national and international standards to ensure that the testing procedures align with best practices and comply with legal requirements.
    - 2.5.1.1 Additionally, staying up to date with the latest revisions of these standards is essential to maintain effective electrical safety practices.
    - 2.5.1.2 By adhering to established standards and keeping abreast of any updates or revisions, PAT testers can ensure that their testing processes remain robust, reliable, and in line with industry best practices, ultimately contributing to a safer working environment.
- 2.6 The testing procedures involved in PAT aim to assess the safety and integrity of the appliances. The following tests should be conducted:
  - 2.6.1 Earth Continuity Test:
    - 2.6.1.1 This test is applicable to Class I appliances, which rely on an earth connection for protection against electric shock.
    - 2.6.1.2 The tester measures the resistance between the appliance's earth pin and exposed conductive parts.
    - 2.6.1.3 The result should be within acceptable limits, ensuring the integrity of the protective earth conductor.

Table 2-1: Limiting Values of measured earth loop impedances

Limiting values of measured earth fault loop impedances for common overcurrent protective devices, for fault protection, operating at 230 V based on 80 % (approx) of the values given in BS 7671															
Rated current (A)	Fuses										Circuit-breakers to BS 3871 or BS EN 60898				
	BS 88 (gG) Parts 2 and 6		BS 1361 or BS 1362		BS 3036		BS 88-2 Fuse systems E (bolted) and G (clip in)		BS 88-3 Fuse system C		Type 1	Type 2	Type B	Types 3 and C	Type D
	0.4 s	5 s	0.4 s	5 s	0.4 s	5 s	0.4 s	5 s	0.4 s	5 s	0.4 s and 5 s				
3	N/A	N/A	13.12	18.56	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	12.26	N/A	N/A
5	N/A	N/A	8.36	13.12	7.66	14.16	N/A	N/A	8.36	12.26	9.20	5.26	N/A	3.68	1.84
6	6.82	10.80	N/A	N/A	N/A	N/A	6.57	10.24	N/A	N/A	7.66	4.37	6.13	3.06	1.54
10	4.08	5.94	N/A	N/A	N/A	N/A	3.91	5.75	N/A	N/A	4.60	2.63	3.68	1.84	0.92
13	N/A	N/A	1.94	3.06	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
15	N/A	N/A	2.62	4.00	2.04	4.28	N/A	N/A	N/A	N/A	3.06	1.75	N/A	1.23	0.61
16	2.16	3.34	N/A	N/A	N/A	N/A	2.05	3.34	1.94	3.29	2.87	1.64	2.30	1.15	0.58
20	1.42	2.33	1.36	2.24	1.41	3.06	1.42	2.36	1.63	2.70	2.30	1.31	1.84	0.92	0.46
25	1.15	1.84	N/A	N/A	N/A	N/A	1.08	1.84	N/A	N/A	1.84	1.04	1.47	0.74	0.37
30	N/A	N/A	0.92	1.47	0.87	2.11	N/A	N/A	N/A	N/A	1.53	0.87	N/A	0.61	0.31
32	0.83	1.47	N/A	N/A	N/A	N/A	0.83	1.47	0.77	1.31	1.44	0.82	1.15	0.58	0.29
40	0.65	1.08	N/A	N/A	N/A	N/A	N/A	1.08	N/A	N/A	1.15	0.65	0.92	0.46	0.23
45	N/A	N/A	0.46	0.77	0.47	1.27	N/A	N/A	N/A	0.83	1.02	0.58	0.82	0.41	0.20
50	0.48	0.83	N/A	N/A	N/A	N/A	N/A	0.83	N/A	N/A	0.92	0.52	0.73	0.37	0.18
60	N/A	N/A	N/A	0.56	N/A	0.90	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
63	0.36	0.66	N/A	N/A	N/A	N/A	N/A	0.66	N/A	0.58	0.72	0.41	0.58	0.29	0.14
80	0.24	0.46	N/A	0.40	N/A	N/A	N/A	0.46	N/A	0.42	0.57	0.32	0.46	0.23	0.11
100	0.18	0.34	N/A	0.29	N/A	0.42	N/A	0.37	N/A	0.32	0.46	0.26	0.37	0.18	0.09
125	0.14	0.26	N/A	N/A	N/A	N/A	N/A	0.27	N/A	N/A	N/A	N/A	0.30	0.14	0.07
160	0.11	0.20	N/A	N/A	N/A	N/A	N/A	0.22	N/A	N/A	N/A	N/A	N/A	N/A	N/A
200	0.8	0.15	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

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2.6.2 Insulation Resistance Test: This test is relevant for both Class I and Class II appliances. It assesses the electrical insulation of the appliance by applying a high voltage (typically 500V or 1000V) between the live conductors and the protective earth. The tester measures the insulation resistance, and the value should exceed the specified threshold.

Table 2-2: Insulation Resistance Test Values

Rated measurement voltage (V)	Effective full-scale value (MΩ)	Effective measurement range (MΩ)	Example uses	
			Standard electrical devices	Electrical equipment/electrical circuits
25	20	0.02 - 10	Measurement of insulation at a safe voltage level	-
50	20	0.1 - 50	Measurement of the insulation in devices used with telephone lines	-
125	20	0.1 - 50	Measurement of the insulation in control devices	Maintenance and management of low-voltage electrical circuits and devices operating at voltages of 100 V or less
250	50	0.1 - 50	Measurement of the insulation in control devices	Maintenance and management of low-voltage electrical circuits and devices operating at voltages of 200 V or less
500	100	0.1 - 50	Measurement of the insulation in circuits and devices operating at voltages of 300 V or less	Maintenance and management of low-voltage electrical circuits and devices operating at voltages of 400 V or less
500	1000	1 - 500	Measurement of the insulation in circuits and devices operating at voltages of 300 V or less	Measurement of insulation at the time of completion of installation of 100 V, 200 V, and 400 V class devices
1000	2000	2 - 1000	Measurement of the insulation in circuits and devices operated at voltages of greater than 300 V	Measurement of the insulation in high-voltage cables, high-voltage electrical devices, and communications equipment that uses high voltages

2.6.3 **Earth Leakage Test:** This test is specific to Class I appliances and aims to detect any excessive leakage current to earth, which could pose a risk of electric shock. The tester measures the current flowing from the live conductors to earth and ensures it remains within safe limits.

Table 2-3: Leakage Currents

CURRENT	Figure #	TYPE B		TYPE BF		TYPE CF	
		N	SF	N	SF	N	SF
Earth leakage current <sup>a</sup>	4	0.5	1	0.5	1	0.5	1
Earth leakage current <sup>b</sup>		2.5	5	2.5	5	2.5	5
Earth leakage current <sup>c</sup>		5	10	5	10	5	10
Enclosure leakage current	5	0.1	0.5	0.1	0.5	0.1	0.5
Patient leakage current (dc)	6a-c	0.01	0.03	0.01	0.05	0.01	0.05
Patient leakage current (ac)	6a-c	0.1	0.5	0.1	0.5	0.01	0.05
Patient leakage current (mains on applied part)	7	—	—	—	5	—	0.05
Patient leakage current (mains on signal input/ signal output part)	8	—	5	—	—	—	—
Patient auxiliary current (dc)	9	0.01	0.05	0.01	0.05	0.01	0.05
Patient auxiliary current (ac)	9	0.1	0.5	0.1	0.5	0.01	0.05

<sup>a</sup> General equipment.

<sup>b</sup> No accessible protective earth parts, no means of protective earthing of another device, mobile x-ray equipment, mobile equipment with mineral insulation (refer to notes 2 & 4, Table IV, IEC 60601-1).

<sup>c</sup> Permanently installed protective earth conductor (refer to note 3, Table IV, IEC 60601-1) (click to enlarge).

**2.6.4 Polarity Test (for extension leads):** This test is specific to extension leads and ensures that the connections are correctly wired. It confirms that the live and neutral conductors are not swapped.

**2.6.4.1 Note:** PAT testing can be done manually using a variety of conventional test instruments, such as a low-resistance ohmmeter for ground continuity and a high-voltage insulation tester. However, it is typically carried out using an automatic tester that runs a series of tests one at a time.

**2.7 Record Keeping:** Maintaining detailed and accurate records is a fundamental aspect of PAT. Comprehensive records of all testing activities must be kept to track compliance, monitor trends, and facilitate audits.

**2.7.1** The records should include the following information:

**2.7.1.1** Appliance identification, such as serial number, asset number, or location.

**2.7.1.2** Date of testing and the next due date for testing.

**2.7.1.3** Results of each specific test conducted (earth continuity, insulation resistance, earth leakage, polarity).

**2.7.1.4** Any defects or issues identified during testing and their resolution.

- 2.7.2 Records should be organized in a manner that allows easy retrieval and audit, and they should be retained for a suitable period, typically five years or as required by local regulations.
- 2.8 Failure and Retesting: If an appliance fails any part of the testing process, it should be immediately removed from use, labelled as "Do Not Use," and reported to the responsible person (e.g., facility manager). Repairs should be carried out by a competent person, such as a qualified electrician. After repair, the appliance should be retested to ensure it meets safety standards before being returned to service.
- 2.9 Labelling: All appliances that have successfully undergone PAT should be labelled with a 'Passed' or 'Tested for Electrical Safety' label. The label should also include the date of testing and the next due date for testing. Labels should be durable, tamper-resistant, and prominently displayed on the appliance.

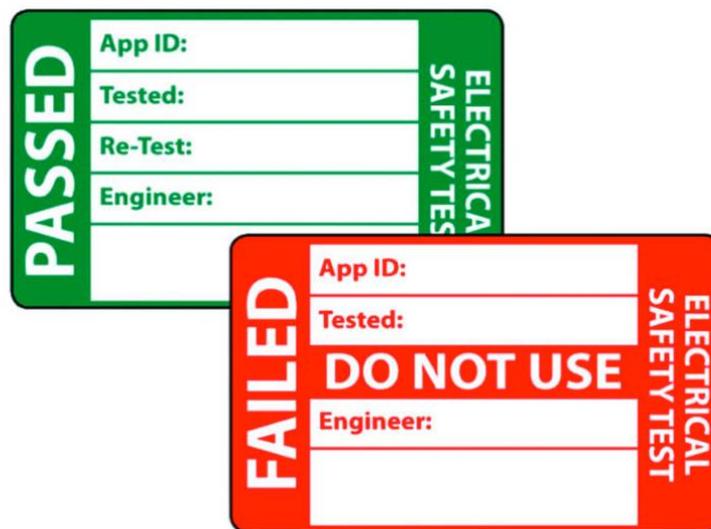


Figure 2-1 Label samples for appliances tested for PAT.

- 2.10 Documentation and Reporting: Testing reports and records should be made available to the relevant personnel, such as facility managers, health and safety representatives, and regulatory authorities, upon request. The records should be used to monitor the testing schedule, identify trends, and inform decision-making for electrical safety management.
- 2.11 Review and Update: These guidelines should be regularly reviewed and updated to align with the latest British Standards, HSE recommendations, or any changes in the organization's electrical safety policies and any applicable domestic

regulations. It is essential to stay abreast of developments in electrical safety standards and best practices to ensure compliance and continued safety.

2.12 The checklist table for Portable Appliance Testing can be found in Appendix 1.

### **3 AUTHORIZATION TO CONDUCT PAT**

3.1 The authorization to conduct Portable Appliance Testing (PAT) should be given to individuals who have received appropriate training and possess the necessary knowledge and skills to perform the testing accurately and safely. The specific authorization process may vary depending on the organization's policies and industry regulations. Here are the key steps to authorize a person to conduct PAT:

3.1.1 **Training and Competency Assessment:** Ensure that the individual undergoes formal training in PAT, covering topics such as electrical safety, testing procedures, relevant regulations, and the proper use of testing equipment. After training, conduct a competency assessment to verify that the individual can carry out PAT effectively.

3.1.2 **Qualifications and Certifications:** Check if the individual has any relevant qualifications or certifications in electrical safety, PAT, or related fields. Certifications from reputable organizations or accredited training providers can demonstrate the individual's competency.

3.1.3 **Experience and Knowledge:** Consider the individual's experience in conducting PAT or working with electrical equipment. Practical experience enhances the individual's understanding of potential hazards and improves their ability to identify faults accurately.

3.1.4 **Understanding of Regulations and Standards:** Ensure that the individual is familiar with the relevant regulations and standards related to PAT in your country or region. This knowledge is crucial for conducting testing in compliance with legal requirements.

3.1.5 **Supervision and Mentoring:** If the individual is relatively new to PAT testing, consider providing initial supervision or mentoring by an experienced PAT tester. This allows them to gain practical experience and learn from an experienced professional.

- 3.1.6 **Equipment Handling and Calibration:** Verify that the individual knows how to handle testing equipment properly, including calibration procedures. Proper handling and regular calibration of testing equipment are essential for accurate and reliable testing results.
  - 3.1.7 **Health and Safety Training:** Ensure that the individual has received training in general health and safety practices, including the use of Personal Protective Equipment (PPE) and safe working procedures.
  - 3.1.8 **Documentation and Record Keeping:** Ensure that the individual understands the importance of maintaining comprehensive and accurate records of all PAT testing activities. Clear documentation helps track compliance and facilitates audits.
  - 3.1.9 **Authorisation Certificate:** Once the individual meets all the necessary criteria, issue them an authorization certificate to conduct PAT. This certificate should specify the scope of their authorization and any limitations, such as the types of appliances they are authorized to test.
  - 3.1.10 **Continuing Professional Development (CPD):** Encourage the authorized PAT tester to engage in regular CPD activities to stay updated with changes in regulations, best practices, and technological advancements.
- 3.2 Regularly review and reassess the competency of authorized PAT testers to ensure that they maintain the required skills and knowledge. By authorizing competent individuals to conduct PAT, organizations can ensure the effective implementation of electrical safety practices and reduce the risk of accidents related to electrical appliances.

## **4 PRIOR TO CONDUCTING PAT AT THE WORKPLACE**

- 4.1 Before conducting PAT at the workplace, it is essential to perform a comprehensive risk assessment as required under the Workplace Safety and Health (Risk Management) Regulations, 2014 to identify potential hazards and implement necessary safety measures. The risk assessment process should consider the following steps:
  - 4.1.1 **Identify Hazards:** Conduct a thorough inspection of the workplace and the areas where PAT testing will take place. Identify potential hazards, such as electrical risks, tripping hazards, obstructions, and other safety concerns related to the testing environment.

- 4.1.2 **Assess Risks:** Evaluate the likelihood and severity of the identified hazards. Consider factors such as the frequency of appliance use, the type of equipment being tested, the working environment, and the presence of vulnerable individuals (e.g., employees with disabilities or children in educational institutions).
- 4.1.3 **Prioritise Risks:** Prioritize the identified risks based on their potential impact on safety. Focus on high-risk areas and equipment that pose significant risks to personnel or property.
- 4.1.4 **Determine Control Measures:** Develop control measures to mitigate identified risks. These measures may include engineering controls, administrative controls, and the use of personal protective equipment (PPE).
- 4.1.5 **Engineering Controls:** Implement engineering controls to eliminate or reduce risks at the source. For example, ensure that the testing equipment is properly calibrated and in good working condition, and that all electrical connections are secure and appropriately insulated.
- 4.1.6 **Administrative Controls:** Implement administrative controls to minimize risks through policies, procedures, and training. Provide clear instructions and guidelines for PAT testers to follow during the testing process. Ensure that testers are competent and adequately trained.
- 4.1.7 **Personal Protective Equipment (PPE):** Determine the appropriate PPE required for the testing environment. Ensure that PAT testers are equipped with the necessary safety gear, such as insulated gloves, safety glasses, and protective footwear.
- 4.1.8 **Training and Competency:** Ensure that all individuals involved in PAT testing are appropriately trained and competent to perform the testing safely and accurately.
- 4.1.9 **Workplace Organization:** Maintain a clean and organized workspace to reduce tripping hazards and facilitate safe movement during testing.
- 4.1.10 **Emergency Procedures:** Establish clear emergency procedures in case of accidents or incidents during testing. Ensure that personnel are aware of emergency exits and evacuation routes.

- 4.1.11 **Communication and Awareness:** Communicate the results of the risk assessment and the implemented control measures to all relevant personnel. Make employees and other stakeholders aware of the ongoing PAT testing activities and any potential disruptions to their work areas.
  - 4.1.12 **Review and Update:** Periodically review and update the risk assessment as needed. Factors such as changes in the workplace layout, new equipment, or modifications to testing procedures may require adjustments to the risk assessment and control measures.
- 4.2 By conducting a thorough risk assessment and implementing appropriate control measures, the workplace can ensure that PAT testing is carried out safely, minimizing the potential for accidents and ensuring the well-being of employees, visitors, and the organization as a whole.
- 4.2.1 Before proceeding with electrical testing, a comprehensive visual inspection of each appliance should be performed. The visual inspection serves to identify any damages, apparent defects or hazards that may compromise the appliance's safety. The visual inspection should include the following:
    - 4.2.1.1 Check for any signs of damage, such as frayed or damaged cables, cracked casings, or loose parts.
    - 4.2.1.2 Examine the plug and socket for damage, proper wiring, and appropriate fuses.
    - 4.2.1.3 Inspect the appliance for signs of overheating, such as discolouration or burn marks.
    - 4.2.1.4 Verify the presence of safety labels, including the CE mark or relevant safety standard mark.
    - 4.2.1.5 Check that any cable connections are secure and properly terminated.
  - 4.2.2 If any defects or safety issues are observed during the visual inspection, the appliance must not be tested until the issues are resolved by a competent person.

## **5 APPROPRIATE PERSONAL PROTECTIVE EQUIPMENT (PPE) WHEN CONDUCTING PAT**

5.1 PAT involves working with electrical equipment, which poses certain risks. Therefore, using appropriate PPE is essential to ensure the safety of the PAT tester from hazards such as trips, burns, electrocution and falls. The suitable PPE for PAT testing includes:

- 5.1.1 **Safety Gloves:** Wearing insulated gloves with appropriate voltage ratings is crucial to protect against electric shock while handling live equipment. Insulated gloves should comply with relevant safety standards and be regularly inspected for any signs of damage or wear.
- 5.1.2 **Safety Footwear:** Electrical hazard-rated safety shoes or boots are essential to protect the feet from potential electrical shocks or hazards that may be present in the testing environment.
- 5.1.3 **Safety Glasses or Face Shield:** Safety glasses or a face shield should be worn to protect the eyes from any debris or splashes that may occur during the testing process.
- 5.1.4 **Lab Coat or Protective Clothing:** A lab coat or other protective clothing can provide an additional layer of protection against accidental spills, splashes, or minor abrasions during testing.
- 5.1.5 **Insulating Mat or Flooring:** In certain testing scenarios, especially when working with higher voltages, an insulating mat or rubber flooring can provide an extra layer of protection against electrical shock and should be placed on the floor where the testing is being conducted.
- 5.1.6 **Test Probe Covers:** If available, use test probe covers to minimize the risk of accidental contact between the tester's probes and live conductors while performing tests.
- 5.1.7 **Voltage Detector Pen:** A voltage detector pen or non-contact voltage tester can be used to check for the presence of voltage before handling an appliance. This tool helps identify live conductors without making direct contact.

- 5.1.8 Hearing Protection: In certain industrial environments where noise levels may be high, hearing protection should be worn to safeguard against potential hearing damage.
- 5.2 It is important to note that the specific PPE requirements may vary based on the testing environment and the equipment being tested. Additionally, the PAT tester should be trained in the proper use and care of the PPE to ensure its effectiveness.
- 5.3 Besides PPE, PAT testers should also follow proper safety procedures, such as working on de-energized equipment whenever possible, using insulated tools, and following lockout/tagout procedures as needed. Conducting PAT testing in a safe and responsible manner helps minimise the risk of accidents and ensures the well-being of the tester and others in the testing environment. A first aid kit should be available on-site and this activity does not require supervision.

## 6 CONDUCTING PORTABLE APPLIANCE TESTING (PAT)

- 6.1 Conducting PAT requires specific tools and equipment to perform the necessary electrical tests accurately and safely. Below are some of the essential tools typically used by PAT testers:
  - 6.1.1 PAT Testing Machine/Tester: A PAT testing machine or tester is the primary tool used to conduct the electrical tests. It performs various tests, such as earth continuity, insulation resistance, and earth leakage. PAT testers come in different types, including manual testers and automatic testers with more advanced features. Some testers also provide downloadable test result storage and reporting capabilities.



Figure 6-1 Samples of PAT Tester

- 6.1.2 Visual Inspection Equipment: Visual inspection involves examining the external condition of the appliances for any visible defects or damage. The following equipment may be used during visual inspection:
- 6.1.2.1 Torch/Flashlight: To inspect dark or hard-to-reach areas.
  - 6.1.2.2 Magnifying Glass: To examine small components or labels.
  - 6.1.2.3 Labels and Tags: For labelling appliances after testing.
- 6.1.3 Calibration Checker: To ensure the accuracy of the PAT testing machine, a calibration checker or test box is used to verify that the tester is working correctly and producing accurate test results. Calibration should be performed regularly to maintain the reliability of the tester.
- 6.1.4 Test Leads and Probes: Test leads and probes are essential for connecting the PAT tester to the appliance being tested. They come in various lengths and designs to accommodate different types of appliances and ensure safe connections during testing.
- 6.1.5 Adapters and Test Accessories: Adapters and test accessories may be required for specific appliances or situations. For example:
- 6.1.5.1 IEC Adapters: For testing IEC leads and computer equipment.
  - 6.1.5.2 Extension Lead Adapters: To test extension leads safely.
  - 6.1.5.3 Test Buttons: To simulate pressing buttons during testing.
- 6.1.6 Insulation Resistance Megger Tester: In some cases, a separate insulation resistance tester (commonly known as a Megger Test) may be used to perform specific insulation resistance tests. These testers apply a higher voltage (e.g., 500V or 1000V) to measure insulation resistance accurately.



Figure 6-2 Megger Insulation Resistance Tester

- 6.1.7 **Socket Tester (for Polarity Check):** A socket tester or socket checker is used to verify the correct wiring of socket outlets. It indicates if the live and neutral connections are wired correctly and can help identify wiring faults.
  - 6.1.8 **Labels and Tags:** After completing PAT testing on an appliance, labels or tags indicating the test results and the next test due date are applied to the appliance. These labels help to visually communicate the safety status of the appliance to users.
  - 6.1.9 **Carrying Case or Bag:** A sturdy carrying case or bag is essential to transport the PAT testing equipment safely between testing locations.
- 6.2 It is crucial to use high-quality, well-maintained tools and equipment for PAT testing to ensure accurate results and reduce the risk of errors. Additionally, regular calibration and periodic maintenance of the testing equipment are necessary to maintain its accuracy and reliability. PAT testers should also be trained in the proper use of the tools and equipment to ensure safe and effective testing practices.

## 7 FREQUENCY OF PORTABLE APPLIANCE TESTING (PAT)

- 7.1 The frequency of PAT depends on several factors, including the type of appliance, its usage, the working environment, and the relevant regulations or guidelines in a particular country. It is essential to perform a risk assessment to determine the appropriate testing intervals. As a general guideline, the following testing frequencies are commonly recommended according to the British Standard BS 7671.

Table 7-1: Recommended frequency of PAT

Location	Class I Appliances (Earthed Appliances)	Class II Appliances (Double Insulated Appliances)	Handheld Appliances and Moveable Equipment	Fixed Appliances
Industrial and commercial environment	Every 12 months			Periodic inspections only

Location	Class I Appliances (Earthed Appliances)	Class II Appliances (Double Insulated Appliances)	Handheld Appliances and Moveable Equipment	Fixed Appliances
Educational institutions and hotels	Every 12 months		Every 12 months	
Offices, shops and rental properties	Every 24 months		Every 12 months	
General environment		Every 48 months		
Construction sites			Every 3 months	

7.1.1 Class I Appliances (Earthed Appliances):

- 7.1.1.1 In industrial and commercial environments: Every 12 months.
- 7.1.1.2 In educational institutions and hotels: Every 12 months.
- 7.1.1.3 In offices, shops, and rental properties: Every 24 months.

7.1.2 Class II Appliances (Double Insulated Appliances):

- 7.1.2.1 In general environments: Every 48 months.

7.1.3 Handheld Appliances and Moveable Equipment:

- 7.1.3.1 In construction sites: Every 3 months.
- 7.1.3.2 In schools, hotels, and offices: Every 12 months.

7.1.4 Fixed Appliances:

- 7.1.4.1 Fixed appliances, such as built-in ovens or fixed lighting fixtures, do not require regular PAT testing. However, they should be included in periodic electrical inspections.

7.2 It is essential to remember that these testing intervals are general recommendations, and they can vary based on the specific circumstances of the workplace, the risk assessment, and the regulations in your country. Factors such

as the specific appliance's history, manufacturer recommendations, and modifications made to the appliance may require more frequent testing, especially if they are subject to harsh conditions or heavy use.

- 7.3 Additionally, any appliance that undergoes repair or has experienced damage should be retested before being returned to service, regardless of its regular testing schedule.
- 7.4 To ensure the safety and compliance of electrical appliances, it is advisable to consult with a qualified electrician or an experienced PAT tester to develop a testing schedule tailored to the unique requirements of your workplace. Regular risk assessments and a well-maintained testing program are essential for promoting electrical safety in the workplace.

## **8 EXPECTATIONS FOR PAT AT THE WORKPLACE**

- 8.1 The expectations for PAT at the workplace are centered around ensuring the safety of employees, visitors, and the organization as a whole. A well-executed PAT program demonstrates the commitment to electrical safety and compliance with relevant regulations. Here are the key expectations for PAT at the workplace:
  - 8.1.1 **Electrical Safety:** The primary expectation of PAT is to ensure that all electrical appliances used in the workplace are safe and pose no risk of electric shock or fire hazards. Regular testing helps identify faulty or damaged appliances, allowing for timely repairs or replacements.
  - 8.1.2 **Compliance with Regulations:** PAT is often a legal requirement in many countries and industries. The expectation is that the organization complies with relevant regulations and standards regarding the testing and safety of electrical equipment.
  - 8.1.3 **Prevention of Accidents:** By identifying and rectifying potential electrical hazards, PAT helps prevent accidents and injuries caused by faulty appliances, protecting the well-being of employees and visitors.
  - 8.1.4 **Risk Mitigation:** PAT aims to mitigate the risks associated with electrical equipment and appliances by identifying potential issues before they escalate into serious safety incidents.

- 8.1.5 **Minimizing Property Damage:** By identifying and addressing faulty appliances, PAT helps reduce the risk of electrical fires and other incidents, minimizing property damage and associated costs.
  - 8.1.6 **Improved Equipment Performance:** Regular testing and maintenance of electrical appliances can contribute to their overall performance and longevity.
  - 8.1.7 **Trust and Confidence:** Employees and visitors expect their workplace takes their safety seriously. A well-implemented PAT program instills trust and confidence in the organization's commitment to a safe working environment.
  - 8.1.8 **Insurability:** Some insurance policies require compliance with safety standards, including PAT testing. Meeting these requirements ensures that the organization's insurance coverage remains valid.
  - 8.1.9 **Efficient Testing Process:** Expectations include an efficient PAT testing process that minimizes disruption to daily operations and allows for timely completion of testing across all appliances.
  - 8.1.10 **Comprehensive Records:** Organizations are expected to maintain comprehensive records of PAT testing activities, including test results, due dates for retesting, and any actions taken to address faults or defects.
  - 8.1.11 **Competent Testing Personnel:** PAT testing should be carried out by competent personnel who have received appropriate training and possess the necessary knowledge and skills to conduct testing accurately and safely.
  - 8.1.12 **Continual Improvement:** Organizations are encouraged to continuously improve their PAT program, taking feedback from testing results and staying updated with changes in regulations and best practices.
- 8.2 By meeting these expectations, workplaces can ensure a safe and compliant environment, prevent accidents, protect employees and property, and foster a positive safety culture within the organization. Regular and effective PAT is an essential component of an overall electrical safety management system.

## 9 CONSEQUENCES OF NOT CONDUCTING OR NEGLECTING PAT

- 9.1 If PAT is not conducted or neglected, there can be significant consequences for both individuals and organizations. These consequences can include:
- 9.1.1 **Electrical Hazards and Accidents:** Without regular PAT, faulty or damaged electrical appliances may continue to be used, posing a serious risk of electric shock, fires, and other electrical accidents. This can result in injuries or even fatalities to individuals using the appliances.
  - 9.1.2 **Legal and Regulatory Non-Compliance:** Many countries, including the UK, have specific regulations and standards that mandate regular PAT testing for certain types of workplaces and environments. Failure to comply with these regulations can lead to legal consequences, including fines and penalties.
  - 9.1.3 **Voiding Insurance Coverage:** Insurance policies for businesses often include clauses requiring compliance with safety regulations, including PAT testing. If an incident occurs due to an untested appliance, insurance coverage may be invalidated, leaving the organisation responsible for all associated costs.
  - 9.1.4 **Damage to Property and Assets:** Faulty electrical appliances can cause fires, leading to damage to property, equipment, and assets. The cost of repair or replacement of damaged items can be substantial.
  - 9.1.5 **Reputational Damage:** A workplace that neglects PAT testing may be seen as negligent in its approach to health and safety. This can lead to reputational damage, affecting the organization's credibility and potentially leading to a loss of trust from clients, customers, and stakeholders.
  - 9.1.6 **Potential Legal Action:** If an accident occurs due to an untested appliance and results in injuries or damages, affected individuals may pursue legal action against the organization for negligence.
  - 9.1.7 **Disruption to Operations:** If an accident occurs, it can lead to disruptions in business operations, resulting in downtime, decreased productivity, and potential financial losses.

- 9.1.8 Employee Dissatisfaction: Employees may feel unsafe and dissatisfied if they perceive that their workplace does not prioritize their safety and well-being through regular PAT testing.
  - 9.1.9 Increased Maintenance Costs: Without regular testing, faulty appliances may not be identified and repaired promptly, leading to higher maintenance costs in the long run.
  - 9.1.10 Audit and Inspection Failures: During regulatory inspections or audits, the absence of PAT records or evidence of testing compliance may result in failures, leading to further scrutiny and potential fines.
- 9.2 In conclusion, neglecting PAT can lead to severe consequences, ranging from safety hazards and legal liabilities leading to the damaging of an organization's reputation and financial losses. Implementing a regular and thorough PAT testing program is essential to ensure the safety of individuals, protect property, and maintain compliance with relevant regulations.

## 10 CONCLUSION

- 10.1 PAT is an essential aspect of electrical safety management, promoting the well-being of individuals and protecting property from electrical hazards.
- 10.2 Organisations should prioritise the implementation of these guidelines and consider seeking assistance from qualified and competent electrical safety specialists for complex or high-risk environments.
- 10.3 Regular training and continued professional development for PAT testers are crucial to ensure the highest standards of safety.

## 11 REFERENCES

- 11.1 Several standards and regulations provide guidance on PAT practices.
- 11.2 These standards and regulations may vary depending on the country and industry. It is recommended to consult the relevant standards and regulations applicable to your specific circumstances when conducting PAT testing.
- 11.3 Some of the key standards and regulations related to PAT testing include:

- 11.3.1 BS 7671 (IET Wiring Regulations): Provides requirements for the electrical installation of buildings, including guidance on PAT testing frequencies and procedures.
- 11.3.2 IEC 62353: International standard for medical electrical equipment - Recurrent test and test after repair of medical electrical equipment.
- 11.3.3 IEC 60446: Basic and safety principles for man-machine interface, marking, and identification - Identification of equipment terminals, conductor terminations, and conductors.
- 11.3.4 IEC 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use - General requirements.
- 11.3.5 IEC 60950: Information technology equipment - Safety.
- 11.3.6 IEC 60065: Audio, video, and similar electronic apparatus - Safety requirements.
- 11.3.7 IEC 60204-1: Safety of machinery - Electrical equipment of machines - Part 1: General requirements.
- 11.3.8 ISO/IEC 17025: General requirements for the competence of testing and calibration laboratories.
- 11.3.9 Health and Safety at Work Act 1974 (UK): Legislation outlining general duties for employers to ensure the health, safety, and welfare of employees at work.
- 11.3.10 Electricity at Work Regulations 1989 (UK): Regulations that require precautions to be taken against the risk of death or personal injury from electricity in work activities.

**APPENDIX A**

Checklist table for Portable Appliance Testing (PAT) that includes essential elements to be covered during the testing process. Please note that this is a basic template, and the specific requirements and tests may vary based on the organisation's policies, industry, and the type of appliances being tested. The "PASS" and "FAIL" columns indicate the outcome of each test.

Table A-1: Check List for PAT with essential elements

No	Appliance ID	Appliance Description	Visual Inspection	Earth Continuity	Insulation Resistance	Earth Leakage	Polarity	Overall Result
1	2	3	4	5	6	7	8	

NOTE: Explanation of Column Nos. 1 – 8.

1. Appliance ID: Unique identifier for each appliance being tested, such as serial number or asset number.
2. Appliance Description: Briefly describe the type of appliance, model, or name for easy identification.
3. Visual Inspection: Record any visible defects or issues identified during the visual inspection, such as damaged cables, loose parts, or signs of overheating.
4. Earth Continuity: Indicate the result of the earth continuity test, verifying the integrity of the protective earth conductor. If the test passes, mark "PASS"; if it fails, mark "FAIL."
5. Insulation Resistance: Record the result of the insulation resistance test, measuring the electrical insulation of the appliance. If the test passes, mark "PASS"; if it fails, mark "FAIL."
6. Earth Leakage: Indicate the result of the earth leakage test, checking for excessive leakage current to earth for Class I appliances. If the test passes, mark "PASS"; if it fails, mark "FAIL."

7. Polarity: Record the result of the polarity test for extension leads, confirming the correct wiring of live and neutral conductors. If the test passes, mark "PASS"; if it fails, mark "FAIL."
8. Overall Result: Provide an overall result for each appliance based on the test outcomes. If all tests pass, mark "PASS"; if any test fails, mark "FAIL."