

## Overview

This standard covers a broad range of basic electrical maintenance competences that will prepare you for entry into the engineering or manufacturing sectors, creating a progression between education and employment, or that will provide a basis for the development of additional skills and occupational competences in the working environment.

You will be expected to prepare for the electrical maintenance activities by obtaining all necessary information, documentation, tools and equipment required, and to plan how you intend to carry out the required maintenance activities and the sequence of operations you intend to use.

You will be required to select the appropriate equipment to use, based on the maintenance operations to be carried out and the type of electrical equipment/systems being maintained. This will include electrical equipment that uses single, three-phase or direct current power supplies, and includes equipment such as control systems, motors and starters, switchgear and distribution panels, electrical plant, pumps, fans, alternators, generators, transformers, wiring enclosures and luminaires, portable appliances and other specific electrical equipment. You will be expected to use a variety of maintenance diagnostic techniques and procedures, such as gathering information from fault reports, using recognised fault finding techniques and diagnostic aids, measuring, inspecting and operating the equipment.

You will be expected to cover a range of maintenance activities, such as isolating and locking off, disconnecting, removing and reconnecting electrical components, wires and cables, attaching cable identification markers, replacing damaged or defective components, cables and wires, setting and adjusting components, and making 'off-load' checks before testing the equipment, using appropriate techniques and procedures.

Your responsibilities will require you to comply with health and safety requirements and organisational policy and procedures for the electrical maintenance activities undertaken. You will need to take account of any potential difficulties or problems that may arise with the maintenance activities, and to seek appropriate help and advice in determining and implementing a suitable solution. You will work under a high level of supervision, whilst taking responsibility for your own actions and for the quality and accuracy of the work that you carry out.

Your underpinning knowledge will provide an understanding of your work, and will enable you to apply appropriate electrical maintenance techniques and

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procedures safely. You will understand the electrical maintenance process, and its application, and will know about the electrical equipment and systems being maintained, the components, tools and consumables used, to the required depth to provide a sound basis for carrying out the activities to the required specification.

You will understand the safety precautions required when carrying out the maintenance activities (especially those for ensuring that the equipment is correctly isolated), and when using maintenance tools and equipment. You will be required to demonstrate safe working practices throughout, and will understand your responsibility for taking the necessary safeguards to protect yourself and others in the workplace.

#### **Specific Standard Requirements**

In order to prove your ability to combine different electrical maintenance operations, at least one of the electrical maintenance activities carried out must be of a significant nature, and must cover a minimum of **eight** of the activities listed in scope 5.

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### Performance criteria

- You must be able to:*
- P1 work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines
  - P2 plan the maintenance activities before you start them
  - P3 obtain all the information you need for the safe removal and replacement of the equipment/system components
  - P4 obtain and prepare the appropriate tools and equipment
  - P5 apply appropriate maintenance diagnostic techniques and procedures
  - P6 use the appropriate methods and techniques to remove and replace the required components
  - P7 carry out tests on the maintained equipment, in accordance with the test schedule/defined test procedures
  - P8 deal promptly and effectively with problems within your control, and seek help and guidance from the relevant people if you have problems that you cannot resolve
  - P9 leave the work area in a safe and tidy condition on completion of the maintenance activities

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### Knowledge and understanding

*You need to know and understand:*

- K1 the health and safety requirements, and safe working practices and procedures required for the electrical maintenance activities undertaken
- K2 the isolation and lock-off procedure or permit-to-work procedure that applies to electrical maintenance activities (to include electrical isolation, locking off switchgear, removal of fuses, placing of maintenance warning notices, proving that isolation has been achieved and secured)
- K3 hazards associated with carrying out electrical maintenance activities (such as dangers of electric shock, capacitor discharge, misuse of tools, using damaged or badly maintained tools and equipment, not following laid-down maintenance procedures), and how to minimise them
- K4 what constitutes a hazardous voltage and how to recognise and deal with victims of electric shock (to include methods of safely removing the victim from the power source, isolating the power source, and how to obtain first aid assistance)
- K5 the importance of wearing appropriate protective clothing and equipment (PPE), and keeping the work area safe and tidy
- K6 the procedure for obtaining drawings, job instructions, related specifications, replacement parts, materials and other consumables necessary for the maintenance activities
- K7 how to obtain and interpret information from job instructions and other documentation used in the maintenance activities (such as drawings, specifications, manufacturers' manuals, BS and ISO wiring regulations, symbols and terminology)
- K8 the basic principles of how the equipment functions, and the working purpose of individual units/components
- K9 the various maintenance diagnostic techniques and aids that can be used (such as fault reports, visual checks, measuring, movement and alignment checks, testing)
- K10 the various fault location techniques that can be used, and how they are applied (such as half-split, input-to-output, function testing, unit substitution, and equipment self-diagnostics)
- K11 how to use a range of fault diagnostic equipment to investigate the problem
- K12 the care, handling and application of electrical measuring instruments
- K13 the different types of cabling used in the maintenance activities, and their methods of termination
- K14 the techniques used to dismantle/assemble electrical equipment (such as unplugging, de-soldering, removal of screwed, clamped and crimped connections)
- K15 methods of removing and replacing cables and wires in wiring enclosures without causing damage to existing cables

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- K16 the use of BS 7671/IET wiring, and other regulations, when selecting wires and cables and when carrying out tests on systems
- K17 methods of attaching identification markers/labels to removed components or cables, to assist with re-assembly
- K18 the tools and equipment used in the maintenance activities (such as the use of cable stripping tools, crimping tools, soldering irons and torches, gland connecting tools)
- K19 methods of checking that components are fit for purpose, and the need to replace 'lived' items (such as seals and gaskets overload protection devices)
- K20 how to check that tools and equipment are free from damage or defects, and are in a safe and usable condition
- K21 the importance of completing documentation and/or reports following the maintenance activity
- K22 the importance of making 'off-load' checks before proving the equipment with the electrical supply on
- K23 how to use appropriate lifting and handling equipment in the maintenance activity
- K24 the problems that can occur during the electrical maintenance activity, and how they can be overcome
- K25 when to act on your own initiative and when to seek help and advice from others
- K26 the importance of leaving the work area in a safe and clean condition on completion of the maintenance activities (such as returning hand tools and test equipment to its designated location, cleaning the work area, and removing and disposing of waste)

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### Additional Information

#### Scope/range related to performance criteria

*You must be able to:*

1. Carry out **all** of the following during the electrical maintenance activities:
  - 1.1 adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations
  - 1.2 ensure the safe isolation of equipment (such as electrical, mechanical, gas, air or fluids), where appropriate
  - 1.3 follow job instructions, maintenance drawings and procedures
  - 1.4 check that the tools and test instruments are within calibration date and are in a safe, PAT tested and usable condition
  - 1.5 ensure that the system is kept free from foreign objects, dirt or other contamination
  - 1.6 return all tools and equipment to the correct location on completion of the maintenance activities
  
2. Carry out maintenance/repair activities on **two** of the following types of electrical equipment:
  - 2.1 electrical plant
  - 2.2 motors and starters
  - 2.3 transformers
  - 2.4 wiring enclosures
  - 2.5 heaters
  - 2.6 pumps
  - 2.7 portable appliances
  - 2.8 luminaires
  - 2.9 fans/blowers
  - 2.10 generators
  - 2.11 switchgear
  - 2.12 distribution panels
  - 2.13 alternators
  - 2.14 other specific electrical equipment
  
3. Carry out maintenance/repair activities on **three** of the following electrical systems:
  - 3.1 single phase lighting circuits
  - 3.2 air conditioning control circuits
  - 3.3 single phase power circuits
  - 3.4 refrigeration control circuits

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- 3.5 three-phase power supplies
  - 3.6 heating/boiler control circuits
  - 3.7 direct current power supplies
  - 3.8 aircraft lighting circuits
  - 3.9 motor start and control
  - 3.10 power generation and control circuits
  - 3.11 vehicle heating or ventilating
  - 3.12 avionic circuits and systems
  - 3.13 vehicle lighting
  - 3.14 emergency lighting systems
  - 3.15 vehicle starting and ignition
  - 3.16 communication systems
  - 3.17 instrumentation and control circuits
  - 3.18 computer systems
  - 3.19 alarm systems (such as fire, intruder, process control)
  - 3.20 electro-pneumatic or electro-hydraulic control circuits
  - 3.21 other control systems
  - 3.22 other specific electrical systems
4. Use **four** of the following maintenance diagnostic techniques, tools and aids:
- 4.1 fault finding techniques (such as six point, half-split, input/output, unit substitution)
  - 4.2 diagnostic aids (such as manuals, flow charts, troubleshooting guides, maintenance records)
  - 4.3 information gathered from fault reports
  - 4.4 visual checks (such as signs of damage, overheating, missing parts, wear/deterioration)
  - 4.5 movement checks (such as loose fittings and connections)
  - 4.6 monitoring equipment or gauges
  - 4.7 test instrumentation measurement (such as voltage, resistance, current)
5. Carry out **all** of the following maintenance activities:
- 5.1 removing excessive dirt and grime
  - 5.2 making mechanical/screwed/clamped connections
  - 5.3 dismantling/disconnecting equipment to the required level
  - 5.4 soldering and de-soldering
  - 5.5 crimping (such as tags and pins)
  - 5.6 disconnecting and reconnecting wires and cables
  - 5.7 replacing damaged/defective components
  - 5.8 stripping cable insulation/protection
  - 5.9 removing and replacing damaged wires and cables
  - 5.10 attaching suitable cable identification markers
  - 5.11 setting and adjusting replaced components
  - 5.12 removing electrical units/components

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- 5.13 making de-energised checks before reconnecting power supply
  - 5.14 removing/replacing cable end fittings
  - 5.15 checking components for serviceability
6. Replace/refit a range of electrical components, to include **six** of the following:
- 6.1 cables and connectors
  - 6.2 capacitors
  - 6.3 batteries
  - 6.4 locking and retaining devices
  - 6.5 circuit boards
  - 6.6 transformers
  - 6.7 overload protection devices
  - 6.8 luminaires
  - 6.9 solenoids
  - 6.10 inverter and servo controllers
  - 6.11 switches or sensors
  - 6.12 thermistors or thermocouples
  - 6.13 relay components
  - 6.14 contactors
  - 6.15 encoders or resolvers
  - 6.16 rectifiers
  - 6.17 other specific components
7. Carry out checks and tests on the maintained equipment, to include:
- 7.1 making visual checks for completeness and freedom from damage
- Plus **three** more from the following:
- 7.2 protective conductor resistance values
  - 7.3 load current
  - 7.4 power rating
  - 7.5 insulation resistance values
  - 7.6 polarity
  - 7.7 frequency values
  - 7.8 continuity
  - 7.9 resistance
  - 7.10 inductance
  - 7.11 voltage levels
  - 7.12 capacitance
  - 7.13 RCD disconnection time
  - 7.14 specialised tests (such as speed, sound, light, temperature)
8. Maintain electrical equipment, in accordance with **one** or more of the following quality and accuracy standards:
- 8.1 BS 7671/IET wiring regulations
  - 8.2 other BS and/or ISO standards

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- 8.3 company standards and procedures
- 8.4 equipment manufacturer's requirement

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