

## Overview

This standard covers a broad range of basic maintenance competences required for the maintenance of engineering equipment and systems. This will prepare you for entry into the engineering or manufacturing sectors, creating a progression between education and employment, or 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 maintenance activities by obtaining all necessary information, documentation, tools and equipment, 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 equipment being maintained.

The maintenance activities will involve the application of fault finding techniques to identify and locate faults on mechanical, electrical/electronic, fluid power and process controller equipment. You will be expected to use a variety of fault location methods and procedures, such as gathering information from the person who reported the fault, using recognised fault finding techniques and diagnostic aids, measuring, inspecting and operating the equipment.

You will then be expected to dismantle, remove and replace or repair the faulty units or components, on a variety of engineering systems or equipment. You will be expected to cover a range of maintenance activities, such as draining and removing fluids, isolating equipment, releasing stored energy, labelling/proof marking to aid reassembly, dismantling components to the required level, checking components for serviceability, replacing faulty components and 'lived' items, setting and adjusting components, tightening fasteners to the required torque, and making 'off-load' checks of the maintained equipment.

Your responsibilities will require you to comply with health and safety requirements and organisational policy and procedures for the 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

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will enable you to apply appropriate maintenance techniques and procedures safely. You will understand the maintenance process, and its application, and will know about the equipment being maintained, the equipment components, tools and consumables used, to the appropriate 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, and when using maintenance tools and equipment. You will be required to demonstrate safe working practices throughout, and will understand the responsibility you owe to yourself and others in the workplace.

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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 components
  - P4 obtain and prepare the appropriate tools and equipment
  - P5 apply appropriate fault finding techniques, tools and aids to locate the faults
  - 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 maintenance activities undertaken
- K2 the importance of wearing appropriate protective clothing and equipment (PPE), and keeping the work area safe and tidy
- K3 hazards associated with carrying out maintenance activities on engineering equipment and systems (such as handling oils, greases, stored energy/force, live electrical components, process controller interface, misuse of tools, using damaged or badly maintained tools and equipment, not following laid-down maintenance procedures), and how to minimise them
- K4 the system isolation procedures or permit-to-work procedure that applies
- K5 how to obtain and interpret drawings, specifications, manufacturers' manuals and other documents needed in the maintenance process
- K6 the procedure for obtaining drawings, job instructions, related specifications, replacement parts, materials and other consumables necessary for the maintenance activities
- K7 how to use and extract information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS or ISO standards), in relation to work undertaken
- K8 the basic principles of how the equipment functions, operation sequence, the working purpose of individual units/components and how they interact
- K9 how to use the various diagnostic aids to help identify the location of the fault
- 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 evaluate sensory information (sight, sound, smell, touch)
- K12 how to use a range of fault diagnostic equipment to investigate the problem
- K13 the methods and techniques used to dismantle and reassemble mechanical equipment (such as release of pressures/force; proof marking to aid reassembly; removing/replacing mechanical fasteners - nuts, bolts, clips and pins); removing components by extraction or pressing)
- K14 methods and techniques used to dismantle and reassemble electrical/electronic equipment (such as unplugging, soldering and de-soldering, removal and replacement of screwed, clamped and crimped connections)
- K15 methods and techniques used to dismantle and reassemble fluid power and process control instrumentation equipment (such as isolation of

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- equipment; release of pressures/force; disconnecting and reconnecting pipes and hoses)
- K16 the methods and procedures used to check programmable controllers (such as checking the program for errors against the required performance with regard to the sequence of operations and programmed instructions; using monitoring devices and test measurements to check inputs and outputs; using techniques such as 'force on - force off' to simulate process conditions; checking that fail safe devices and system emergency stops are operating correctly)
  - K17 methods of checking that components are fit for purpose; how to identify defects and wear characteristics; and the need to replace 'lived' items
  - K18 the use of BS 7671/IET wiring and other regulations when selecting wires and cables, and when carrying out tests on systems
  - K19 how to check that tools and equipment are free from damage or defect, are in a safe and usable condition; are within calibration and test dates, and are configured correctly for the intended purpose
  - K20 the importance of making 'off-load' checks before running the equipment under power
  - K21 the importance of completing maintenance documentation and/or reports following the maintenance activity
  - K22 the problems that can occur during the maintenance activity, and how they can be overcome
  - K23 when to act on your own initiative and when to seek help and advice from others
  - K24 the importance of leaving the work area and equipment in a safe and clean condition on completion of the maintenance activities (such as returning hand tools and test equipment to the 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 maintenance activity:
    - 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 mechanical, electrical, 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/test date, and are in a safe 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. Use appropriate dismantling and re-assembly techniques to deal with **three** of the following technologies:

**Mechanical equipment:** Carry out all of the following:

    - 2.1 draining and replenishing fluids
    - 2.2 removing and refitting major mechanical components (such as shafts, gear mechanisms, bearings, clutches)
    - 2.3 removing and refitting/replacing locking and retaining devices
    - 2.4 proof marking components to aid reassembly
    - 2.5 replacing lified items (such as filters, oils/lubricants)
    - 2.6 removing and refitting minor mechanical units/sub-assemblies(such as guards, cover plates, pulleys and belts)
    - 2.7 setting, aligning and adjusting replaced units

**Electrical equipment:** Carry out **all** of the following:

    - 2.8 isolating the power supply
    - 2.9 removing and replacing major electrical components (such as motors, switch/control gear)
    - 2.10 disconnecting and reconnecting wires/cables
    - 2.11 removing and replacing minor electrical components (such as relays, sensing devices, limit switches)
    - 2.12 attaching cable end fittings (such as crimped and soldered)
    - 2.13 making de-energised checks before powering up

**Fluid power equipment:** Carry out **all** of the following:

    - 2.14 chocking/supporting cylinders/rams/components

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- 2.15 removing and replacing major components (such as pumps, cylinders, valves, actuators)
  - 2.16 releasing stored pressure
  - 2.17 removing and replacing hoses/pipes
  - 2.18 setting and adjusting replaced components
  - 2.19 removing and replacing minor or lifted components (such as filters, gaskets, dust seals)
  - 2.20 making de-energised checks before re-pressurising the system
- Programmable controller based equipment:** Carry out **all** of the following:
- 2.21 de-activating and resetting program controller
  - 2.22 checking and reviewing program format and content
  - 2.23 disconnecting and reconnecting wires/cables
  - 2.24 editing programs using the correct procedure (where appropriate)
  - 2.25 removing and replacing input/output interfacing
  - 2.26 removing and replacing program logic peripherals
- Process Instrumentation:** Carry out **all** of the following:
- 2.27 isolating instruments/sensing devices
  - 2.28 re-connecting instrumentation pipework and power supply
  - 2.29 disconnecting supply/signal connections
  - 2.30 removing and replacing instruments in the system
  - 2.31 checking that signal transmission is satisfactory
  - 2.32 replacing all 'lified' items (such as seals, gaskets, dust covers)
- Electronic Equipment:** Carry out **all** of the following:
- 2.33 isolating equipment from the power supply
  - 2.34 removing and replacing electronic components
  - 2.35 dismantling/disconnecting equipment to the required level
  - 2.36 soldering and de-soldering
  - 2.37 disconnecting and reconnecting wires and cables
  - 2.38 removing and replacing electronic units/circuit boards
  - 2.39 making de-energised checks before powering up
3. Carry out checks and tests to help diagnose problems, and confirm that the maintained equipment performs to specification, to include **two** of the following:
- 3.1 making visual checks (such as signs of leakage, damage, missing parts, overheating, wear/deterioration)
  - 3.2 the use of fault finding techniques (such as six point, half-split, input/output, unit substitution)
  - 3.3 the use of diagnostic aids (such as manuals, flow charts, troubleshooting guides, maintenance records)
- Plus **two** more from the following:
- 3.4 mechanical checks (such as correct operation of moving parts, correct working clearance of parts, belt/chain tension, bearing loading, torque loading of fasteners)
  - 3.5 electrical checks (such as continuity, polarity, protective conductor

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- 3.6 resistance values, voltage levels, load current, inductance)  
electronic checks (such as resistance, capacitance, waveform, frequency values, amplification, signal noise/interference levels, logic states)
  - 3.7 process control checks (such as pressure, flow, level, temperature, weight, sequence/timing)
  - 3.8 controller checks (such as forcing contacts on and off, logic states, checking that fail safe devices and system emergency stops are operating correctly)
4. Maintain engineering equipment and systems, in compliance with **one** or more of the following:
- 4.1 organisational guidelines and codes of practice
  - 4.2 equipment manufacturer's operation range
  - 4.3 BS and/or ISO standards



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