

Overview

This standard identifies the competences you need to carry out efficient and effective fault diagnosis on medical equipment, in accordance with approved procedures. You will be required to diagnose faults on a range of medical equipment. This will include equipment such as cardiovascular equipment, physiological, monitoring and infusion equipment, anaesthetic and ventilation equipment, operating theatre and surgical equipment, medical imaging equipment, laboratory equipment, dental equipment, therapeutic equipment and mechanical or electromechanical Assisted Technology (AT) equipment.

You will be expected to use a variety of fault diagnostic methods and techniques, and to utilise a number of diagnostic aids and equipment. From the information gained, you will be expected to identify the fault and its probable cause, and to suggest appropriate action to remedy the problem.

Your responsibilities will require you to comply with organisational policy and procedures for the fault diagnostic activities undertaken, and to report any problems with these activities or with the tools and equipment used, that you cannot personally resolve or that are outside your permitted authority, to the relevant people. You will be expected to work with a minimum of supervision, taking full responsibility for your own actions and for the quality and accuracy of the work that you carry out.

Your underpinning knowledge will provide a good understanding of your work, and will provide an informed approach to applying fault diagnostic procedures to medical equipment. You will understand the various fault diagnostic methods and techniques used, and their application. You will also know how to apply and interpret information obtained from diagnostic aids and equipment, in adequate depth to provide a sound basis for carrying out the activities and for identifying faults or conditions that are outside the required specification.

You will understand the safety precautions required when carrying out the servicing activities, especially those for isolating the equipment. You will also understand your responsibilities for safety, and the importance of taking the necessary safeguards to protect yourself and others in the workplace.

Performance criteria

You must be able to:

1. work safely at all times, complying with health and safety legislation and other relevant regulations, directives and guidelines
2. review and use all relevant information on the symptoms and problems associated with the products or assets
3. investigate and establish the most likely causes of the faults
4. select, use and apply diagnostic techniques, tools and aids to locate faults
5. complete the fault diagnosis within the agreed time and inform the appropriate people when this cannot be achieved
6. determine the implications of the fault for other work and for safety considerations
7. use the information gained to draw valid conclusions about the nature and probable cause of the fault
8. complete and store all relevant documentation of the fault diagnosis in accordance with organisational requirements
9. dispose of waste materials in accordance with safe working practices and approved procedures and leave the work area in a safe condition

Knowledge and understanding

You need to know and understand:

1. the health and safety, infection control and de-contamination requirements of the area in which the fault diagnostic activity is to take place, and the responsibility these requirements place on you
2. the statutory and advisory documentation relating to medical devices (such as warnings and guidance from regulatory authority, British and European standards)
3. the importance of reporting any equipment adverse incidents to the regulatory authority
4. the isolation procedure or permit-to-work procedure that applies
5. 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 methods of first aid resuscitation)
6. how to reduce the risks of a phase to earth shock (such as insulated tools, rubber matting, isolating transformers)
7. the importance of wearing protective clothing and other appropriate safety equipment (PPE) during the fault diagnostic activities
8. hazards associated with carrying out fault diagnosis on electronic equipment (such as mains electricity, stored capacitive/inductive/electrostatic energy, misuse of tools), and how to minimise them and reduce any risks
9. the basic principles of how the medical equipment functions, its operating sequence, the function/purpose of individual units/components, and how they interact
10. how to obtain and interpret documents needed in the fault diagnostic activities (such as drawings, circuit and physical layouts, charts, specifications, manufacturers' manuals, history/maintenance reports, graphical electronic/electrical symbols, BS7671/IEE wiring regulations)
11. the procedure to be adopted to establish the background of the fault
12. how to evaluate the various types of information available for fault diagnosis
13. how to use the various aids and reports available for fault diagnosis
14. how to use various types of fault diagnostic equipment to investigate the problem
15. digital circuits and their operation (including logic truth tables and Boolean algebra for AND, OR, NAND, NOR, NOT, EXCLUSIVE-OR gates)

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16. the various fault-finding techniques that can be used (such as half-split, input-to-output, emergent problem sequence, six point technique, function testing, unit substitution, injection and sampling techniques, equipment self-diagnostics), and how they are applied
17. how to evaluate sensory conditions (sight, sound, smell, touch)
18. how to analyse information and evaluate possible characteristics and causes of specific faults/problems
19. how to relate previous reports/records of similar fault conditions
20. the care, handling and application of electronic test instruments (such as multimeter, logic probes, oscilloscopes, signal tracers, signal generators)
21. how to calibrate test instruments and check that they are free from damage and defects
22. the precautions (such as use of wrist straps, special packaging and handling areas) to be taken to prevent electrostatic discharge (ESD) damage to electronic circuits and components
23. how to evaluate the likely risk to yourself and others, and the effects that the fault could have on the overall system or process
24. how to prepare and produce a risk analysis report, where appropriate
25. how to prepare a report, or take follow-up action, on conclusion of the fault diagnosis, in accordance with organisational policy
26. the extent of your own authority and to whom you should report if you have problems that you cannot resolve

Scope/range

1.

Carry out all of the following during the fault diagnostic activity:

- 1.1 plan the fault diagnosis, using all available information about the fault, prior to starting
- 1.2 obtain and use the correct issue of organisational and/or manufacturer's drawings and maintenance documentation
- 1.3 adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
- 1.4 ensure that the correct equipment decontamination procedure has been adhered to, before and after the fault diagnostic activities
- 1.5 ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
- 1.6 provide and maintain safe access and working arrangements for the maintenance area
- 1.7 carry out the fault diagnostic activities, using approved procedures
- 1.8 disconnect or isolate components, or parts of circuits when appropriate, to confirm the diagnosis
- 1.9 where appropriate, apply electrostatic discharge (ESD) protection procedures when handling sensitive components and circuit boards
- 1.10 identify the fault and determine the appropriate corrective action
- 1.11 dispose of waste materials in accordance with safe working practices and approved procedures and leave the work area in a safe condition

2.

Carry out fault diagnosis on three of the following types of medical equipment:

- 2.1 cardiovascular equipment
- 2.2 medical imaging equipment
- 2.3 physiological monitoring and infusion equipment
- 2.4 laboratory equipment
- 2.5 anaesthetic and ventilation equipment
- 2.6 dental equipment
- 2.7 operating theatre and surgical equipment
- 2.8 therapeutic equipment
- 2.9 mechanical/electromechanical AT equipment

3.

Collect information about the fault from four of the following sources:

- 3.1 the person who reported the fault
- 3.2 circuit meters (such as voltmeter, power factor meter, ammeter)
- 3.3 test instrument measurements
- 3.4 medical equipment simulators
- 3.5 sensory input (such as sight, sound, smell, touch)
- 3.6 equipment self-diagnosis
- 3.7 recording/indicator devices
- 3.8 equipment outputs

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3.9 servicing records

4.

Use a range of fault diagnostic techniques, to include two of the following:

- 4.1 six point technique
- 4.2 emergent sequence
- 4.3 unit substitution
- 4.4 input/output technique
- 4.5 function/performance testing
- 4.6 half-split technique
- 4.7 injection and sampling
- 4.8 equipment self-diagnostics

5.

Use a variety of diagnostic aids and equipment, to include four of the following:

- 5.1 logic diagrams
- 5.2 fault analysis charts (such as fault trees)
- 5.3 flow charts or algorithms
- 5.4 manufacturers' manuals
- 5.5 probability charts/reports
- 5.6 troubleshooting guides
- 5.7 computer-aided test equipment
- 5.8 electronic aids

6.

Use all of the following fault diagnostic procedures:

- 6.1 inspection (such as breakages, wear/deterioration, signs of overheating, missing parts, loose fittings)
- 6.2 operation (such as manual switching off and on, automatic switching/timing/sequencing, outputs)
- 6.3 measurement (such as voltage, current, continuity, logic state, noise, frequency, signal shape and level)

7.

Use eight of the following types of test equipment to aid fault diagnosis:

- 7.1 oscilloscope
- 7.2 electrical safety analyser
- 7.3 multimeter
- 7.4 special purpose testing equipment
- 7.5 medical equipment simulators
- 7.6 built in test equipment (BITE)
- 7.7 insulation resistance tester
- 7.8 logic analyser
- 7.9 residual current (RCD) tester
- 7.10 logic probe
- 7.11 temperature measuring devices
- 7.12 signal tracer
- 7.13 flow measuring devices
- 7.14 signal generator

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- 7.15 pressure measuring devices
- 7.16 ammeter
- 7.17 voltmeter
- 7.18 other specific test equipment

8.

Find faults that have resulted in two of the following breakdown categories:

- 8.1 intermittent problem
- 8.2 partial failure/out-of-specification output
- 8.3 complete breakdown

9.

Complete and store all relevant documentation of the fault diagnosis in accordance with organisational requirements, using one of the following:

- 9.1 step-by-step analytical report
- 9.2 preventative maintenance log/report
- 9.3 corrective action report
- 9.4 organisational-specific reporting procedure
- 9.5 electronic reports

SEMEM360

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Scope/range related to performance criteria

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