Unit 111: Diagnosing and Rectifying Equipment Faults

Level: 4

Unit type: Optional (Equipment Management and Clinical Engineering)

Credit value: 4

Guided learning hours: 32

Unit summary

In this unit, you will acquire the knowledge and skills to diagnose faults within medical equipment and systems and you will be able to apply appropriate engineering workshop skills. You will be able to work safely when diagnosing and rectifying equipment faults across a defined range of equipment, selecting and using appropriate methods and processes. You will be expected to build your professional practice and use critical reflection to review and improve your performance in the workplace and develop the skills to promote continuous professional development.

Unit assessment requirements

There are no specific assessment requirements for this unit. Please refer to the assessment strategy in *Annexe B*.

Additional information

All procedures must be undertaken in accordance with the quality management system Standard Operating Procedures (SOPs), organisational polices and prevailing legislation.

Learning outcome 1: to include power supply-related, specification or range errors, rectification of physical damage.

Learners should select **three** medical devices, each from a different 'type of medical equipment' category, from the table below, as appropriate to the needs of their department.

Types of medical equipment	Medical devices
Beds and electromechanical equipment	• Wheelchairs (including, scooters) • Patient trolleys • Stair lifts; hoists; seating systems • Walking aids; commodes; bathing equipment; patient trollies • Adjustable beds; pressure redistribution and relief devices • Other specific AT equipment
Cardiovascular equipment	• Blood pressure devices (excluding mercury sphygmomanometer) • Pulse oximeters; electrocardiography (ECG) machines; external temporary pacemaker box
Physiological monitoring	• Foetal heart monitoring devices • Apnoea devices • Physiological monitoring equipment • Ophthalmoscopes • Thermometers
Infusion equipment	• Infusion pumps • Syringe drivers • Patient controlled analgesia • Feeding pumps (including breast pump)
Therapeutic equipment	• Phototherapy devices • Radiant heater warmers • Oxygen delivery and monitoring devices
Resuscitation equipment	• Defibrillators • Suction equipment for airway clearance • Oxygen equipment – pipeline and cylinders • Capnography • Miscellaneous equipment, e.g., laryngoscopes, intraosseous drills
Operating theatre and surgical equipment	• Tourniquet devices • Gas monitoring devices; flow and pressure gauges • Surgical lighting equipment/examination lamps • Pneumatic drilling/sawing devices • Blood warmers; patient warmers; operating tables; patient beds

Types of medical equipment	Medical devices
Therapeutic equipment	• Nerve stimulating devices • Nebulisers; continuous positive airway pressure devices • Interferential therapy devices; therapeutic ultrasound devices • Traction devices; heater lamps; exercise equipment
Laboratory equipment	• Centrifuges; coulter counters; particle counters • Blood and gas analysers; ion selective analysers • Flame photometers; chloride meters; pH meters • Spectrophotometers; roller beds; colorimeters
Dental equipment	• Suction units; drilling units; dental air compressors • Descalers; dental hand pieces; polymerisation units • Floor utility service units; dental lighting • Amalgamators; amalgam separators
Renal equipment	• Haemodialysis machines; haemofiltration machines • Reverse osmosis units; water treatment plants • Water quality equipment; patency monitoring
Non-ionising radiation	• MRI scanners • Lasers • Optical light sources
Ionising radiation equipment **Imaging and therapeutic equipment**	Imaging equipment: • diagnostic x-ray • nuclear medicine • CT scanners Radiotherapy equipment: • linear accelerators • radiation monitoring equipment • mould room

AC1.1 includes:

- Control of Substances Hazardous to Health (COSHH) Regulations 2002
- personal protective equipment (PPE)
- Health and Safety at Work etc Act 1974
- Standard Operating Procedures.

AC1.2 includes:

- obtaining and using correct documentation
- company and/or manufacturer's drawings

- maintenance documentation
- ensuring equipment has been decontaminated before and after the fault-diagnostic activities
- ensuring the safe isolation of equipment, including:
    - mechanical
    - electrical
    - gas
    - air
    - fluids
- providing and maintaining safe access and working arrangements for the maintenance area.

AC1.5 includes:

- inspection of equipment (such as breakages, wear/deterioration, signs of overheating, missing parts, loose fittings)
- operation (such as manual switching off and on, automatic switching/timing/sequencing, outputs)
- measurement (such as voltage, current, continuity, logic state, noise, frequency, signal shape and level)
- disconnecting or isolating components, or parts of circuits when appropriate, to confirm the diagnosis
- applying electrostatic discharge (ESD) protection procedures when handling sensitive components and circuit boards where appropriate
- identifying the fault and determine the appropriate corrective action
- completing the fault diagnosis within the agreed time and informing the appropriate people when this cannot be achieved.

AC1.8 includes:

- sight
- sound
- smell
- touch.

AC2.1 to include **two** of the following:

- six-point technique
- emergent sequence
- input/output technique
- half-split technique
- equipment self-diagnostics
- unit substitution
- function/performance testing

- injection and sampling.

AC2.2 to include **four** of the following:

- logic diagrams
- flow charts or algorithms
- probability charts/reports
- computer-aided test equipment
- fault analysis charts (such as fault trees)
- manufacturer's manuals
- troubleshooting guides
- electronic aids.

AC2.3 to include **eight** of the following:

- oscilloscope
- multimeter
- medical equipment simulators
- ammeter
- logic analyser
- logic probe
- voltmeter
- signal tracer
- signal generator
- electrical safety analyser
- special purpose testing equipment
- built-in test equipment (BITE)
- insulation resistance tester
- residual current (RCD) tester
- portable appliance tester (PAT)
- temperature measuring devices
- flow measuring devices
- pressure measuring devices.

AC2.6 includes:

- intermittent problem
- partial failure/out-of-specification output
- complete breakdown
- sources of interference and other reasons leading to degradation of equipment performance
- physical damage/missing components.

AC3.1 includes:

- step-by-step analytical report
- preventative maintenance log/report
- corrective action report
- company-specific reporting procedure
- record the outcome of the fault diagnosis
- feed back to the equipment user.

AC4.1 includes:

- prioritisation of jobs
- knowing when it is not cost effective to repair.

Learning outcomes and assessment criteria

To pass this unit, learners need to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria outline the requirements that the learner is expected to meet **in own area of work and in accordance with Standard Operating Procedures (SOPs)** to achieve the learning outcomes and the unit.

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
1	Be able to diagnose different equipment faults in accordance with Standard Operating Procedures and legislation	1.1	Follow health and safety procedures and systems in place for risk assessment			
		1.2	Plan the fault diagnosis, using all available information			
		1.3	Explain the procedure to establish the background of the fault			
		1.4	Discuss the implications of the fault on the patient and healthcare services			
		1.5	Perform the fault-diagnostic activities, using approved procedures			
		1.6	Explain the importance of reporting any equipment adverse incidents to the regulatory authority			
		1.7	Explain how to analyse evidence and evaluate possible characteristics and causes of specific faults/problems			
		1.8	Explain how to evaluate sensory conditions			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
		1.9	Explain how to evaluate the various types of information available for fault diagnosis			
		1.10	Explain how to prepare a report, or take follow-up action on completion of the fault diagnosis			
		1.11	Explain how to relate previous reports and records of similar fault conditions			
		1.12	Explain how to use the various aids and reports available for fault diagnosis			
		1.13	Explain the limitations of conducting physical repairs to equipment casings			
		1.14	Report on conclusion of the fault diagnosis			

Learning outcomes		Assessment criteria		Evidence type	Portfolio reference	Date
2	Be able to investigate and establish the most likely causes of the faults	2.1	Collect clear information of the fault from the equipment user			
		2.2	Explain the essential information needed as part of the fault reporting process			
		2.3	Use diagnostic techniques, tools and aids to locate faults			
		2.4	Use appropriate test equipment to aid fault diagnosis			
		2.5	Establish faults in relation to breakdown categories in own area of work			
		2.6	Make valid conclusions about the nature and probable cause of the fault			
		2.7	Perform post-repair quality control procedures			
3	Be able to maintain accurate records of the outcome of the fault diagnosis	3.1	Record the outcome of the fault diagnosis following local procedures			
		3.2	Follow data protection policy and local procedures to maintain data records and confidentiality			
4	Be able to determine appropriate action and repair equipment	4.1	Set out the appropriate action to rectify the fault			
		4.2	Repair the equipment or escalate fault in accordance with local procedures			
		4.3	Record the actions taken in accordance with local procedures			

Learner name: _____ Date: _____

Learner signature: _____ Date: _____

Assessor signature: _____ Date: _____

Internal verifier signature: _____ Date: _____
(*if sampled*)