Overview

This unit identifies the competences you need to carry out efficient and effective fault diagnosis on electronic equipment/circuits, in accordance with approved procedures. You will be required to diagnose faults on a range of electronic equipment, such as power supply systems, motor control systems, sensors and actuators, digital circuits and systems, analogue circuits and systems, and hybrid circuits and systems, both at assembly and component level. You will be expected to use a variety of fault diagnosis methods and techniques, and to utilise a number of diagnostic aids and equipment. From the evidence 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 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 minimal supervision, taking personal responsibility for your own actions and for the quality and accuracy of the work that you produce.

Your underpinning knowledge will provide a good understanding of your work, and will provide an informed approach to applying fault diagnosis procedures on electronic equipment and circuits. You will understand the various fault diagnosis methods and techniques used, and their application. You will also know how to interpret and apply 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 fault diagnosis 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:

P1 work safely at all times, complying with health and safety and other relevant regulations and guidelines
P2 review and use all relevant information on the symptoms and problems associated with the products or assets
P3 investigate and establish the most likely causes of the faults
P4 select, use and apply diagnostic techniques, tools and aids to locate faults
P5 complete the fault diagnosis within the agreed time and inform the appropriate people when this cannot be achieved
P6 determine the implications of the fault for other work and for safety considerations
P7 use the evidence gained to draw valid conclusions about the nature and probable cause of the fault
P8 record details on the extent and location of the faults in an appropriate format
**Knowledge and understanding**

You need to know and understand:

K1 the health and safety requirements of the area in which the fault diagnosis activity is to take place, and the responsibility these requirements place on you

K2 the isolation and lock-off procedure or permit-to-work procedure that applies

K3 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)

K4 the importance of wearing protective clothing and other appropriate safety equipment during the fault diagnosis activities

K5 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 these and reduce any risks

K6 the procedure to be adopted to establish the background of the fault

K7 how to evaluate the various types of information available for fault diagnosis

K8 how to use the various aids and reports available for fault diagnosis

K9 how to use various types of fault diagnostic equipment needed to investigate the problem

K10 digital circuits and their operation (including logic truth tables and Boolean algebra for AND, OR, NAND, NOR, NOT and EXCLUSIVE-OR gates)

K11 the various fault finding techniques that can be used, and how they are applied (such as half-split, input-to-output, emergent problem sequence, six point technique, function testing, unit substitution, injection and sampling techniques, and equipment self-diagnostics)

K12 how to evaluate sensory conditions (by sight, sound, smell, touch)

K13 how to analyse evidence and evaluate possible characteristics and causes of specific faults/problems

K14 how to relate previous reports/records of similar fault conditions

K15 the care, handling and application of electronic test instruments (such as multimeters, logic probes, oscilloscopes, signal tracers, signal generators)

K16 how to calibrate electronic test instruments and check that they are free from damage and defects

K17 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

K18 how to obtain and interpret drawings, circuit and physical layouts, charts, specifications, manufacturers' manuals, history/maintenance reports, graphical electronic/electrical symbols, BS7671/IEE wiring regulations,
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and other documents needed in the fault diagnosis activities
K19 the basic principles of how the circuit functions, its operating sequence, the function/purpose of individual units/components, and how they interact
K20 the different types of cabling (such as multicore, single core, ribbon, screened cables), fittings/connectors (including insulation displacement), and their application
K21 the different types of control systems and components, and their operation
K22 the functions of different types of electronic components (analogue and digital), and their operation
K23 how to evaluate the likely risk to yourself and others, and the effects the fault could have on the overall system or process
K24 how to prepare and produce a risk analysis report, where appropriate
K25 how to prepare a report, or take follow-up action, on conclusion of the fault diagnosis, in accordance with company policy
K26 the extent of your own authority and to whom you should report if you have problems that you cannot resolve
1. carry out all of the following during the fault diagnostic activity:
   1.1 plan the fault diagnosis using available information about the fault
   1.2 obtain and use the correct issue of company and/or manufacturers' 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 the safe isolation of equipment
   1.5 provide and maintain safe access and working arrangements for the fault finding/maintenance area
   1.6 use grounded wrist straps and other electrostatic discharge (ESD) precautions, as appropriate
   1.7 carry out the fault diagnostic activities using appropriate procedures
   1.8 collect equipment fault diagnostic evidence from ‘live’ and isolated circuits
   1.9 disconnect or isolate components, or parts of circuits when appropriate, to confirm the diagnosis
   1.10 identify the fault and determine the appropriate corrective action
   1.11 dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition

2. carry out fault diagnosis on four of the following types of equipment:
   2.1 power supply systems (such as switched mode, series regulation, shunt regulation)
   2.2 motor control systems (such as closed-loop servo/proportional, inverter control)
   2.3 sensors and actuators (such as linear, rotational, temperature, level, photo-optic, pressure, flow)
   2.4 digital circuits and systems (eg, programmable controller, microprocessor, ROM/RAM, logic gates)
   2.5 analogue circuits and systems (eg, frequency modulation/demodulation, amplifiers, filters, oscillators)
   2.6 hybrid circuits and systems (eg, analogue to digital convertors [ADC], d-to-a convertors [DAC])

3. collect fault diagnosis evidence from four of the following sources:
   3.1 the person or operator who reported the fault
   3.2 equipment self-diagnosis
   3.3 test instrument measurements (such as multimeter, oscilloscope, logic probe, signal tracer, signal generator)
   3.4 recording devices
   3.5 sensory input (sight, sound, smell, touch)
   3.6 plant/equipment records
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3.7 circuit meters (such as voltmeter, power factor meter, ammeter)
3.8 equipment outputs

4. use a range of fault diagnostic techniques to include two of the following:
   4.1 half-split technique
   4.2 input/output technique
   4.3 injection and sampling
   4.4 six point technique
   4.5 emergent sequence
   4.6 unit substitution
   4.7 function/performance testing
   4.8 equipment self-diagnostics

5. use a variety of diagnostic aids, to include two 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 four of the following types of test equipment to aid fault diagnosis:
   7.1 oscilloscope
   7.2 multimeter
   7.3 logic probe
   7.4 signal tracer
   7.5 signal generator
   7.6 other specific test equipment

8. find faults that have resulted in two of the following breakdown categories:
   8.1 intermittent action or circuit failure
   8.2 partial failure or reduced performance
   8.3 complete breakdown

9. provide a record of the outcome of the fault diagnosis, 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 company-specific reporting procedure
## Carrying out fault diagnosis on electronic equipment and circuits

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