Overview

This unit identifies the competences you need to carry out efficient and effective fault diagnosis on instrumentation and control equipment and circuits, in accordance with approved procedures. You will be required to diagnose faults on a range of instrumentation and control equipment, such as pressure, flow, level and temperature instruments; fiscal monitoring equipment; smoke, heat, gas, water, chemical and metal detection and alarm systems; industrial weighing systems; linear and rotational speed measurement; vibration monitoring equipment; photo-optic instruments; nucleonic and radiation measurement; analysers, recorders and indicators; telemetry systems; emergency shutdown systems and other specific instrumentation, both at assembly and component level. 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 evidence gained, you will be expected to identify the fault and its probable cause, and to determine 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 personal 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 on instrumentation and control equipment and circuits. You will understand the various fault diagnostic 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 diagnostic 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.
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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 product or asset
P3 investigate and establish the most likely causes of the fault or 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 or faults 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 or faults
P8 record details on the extent and location of the faults in an appropriate format
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**Knowledge and understanding**

You need to know and understand:

**K1** the health and safety requirements of the area in which the fault diagnostic 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 diagnostic activities

**K5** hazards associated with carrying out fault diagnosis on instrumentation and control equipment (such as contact with live electrical connections; stored energy such as pneumatic, hydraulic, capacitive/inductive/electrostatic; misuse of tools), and how to minimise them to 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** 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, and equipment self-diagnostics), and how they are applied

**K11** how to evaluate sensory conditions (by sight, sound, smell, touch)

**K12** how to analyse evidence and evaluate possible characteristics and causes of specific faults/problems

**K13** how to relate previous reports/records of similar fault conditions

**K14** the care, handling and application of instrumentation test instruments (such as multimeters, logic probes, oscilloscopes, signal tracers, signal generators)

**K15** how to check that test instruments are within current calibration dates, and that they are free from damage and defects

**K16** the precautions to be taken to prevent electrostatic discharge (esd) damage to electronic circuits and components

**K17** how to obtain instrumentation drawings, circuit and physical layouts, charts, specifications, manufacturers' manuals, history/maintenance reports, and other documents needed in the fault diagnostic activities
K18  the basic principles of how the instrumentation and control circuit functions, its operating sequence, the working purpose of individual units/components and how they interact
K19  the reasons for making sure that control systems are isolated or put into manual control, and appropriate trip locks, keys or program overrides are inserted, before isolating any sensors or instruments from the system
K20  how to evaluate the likely risk to yourself and others, and the effects the fault could have on the overall system or process
K21  how to prepare a report, or take follow-up action, on conclusion of the fault diagnosis, in accordance with company policy
K22  the extent of your own authority and to whom you should report if you have problems that you cannot resolve
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Additional Information

You must be able to:

Scope/range related to performance criteria

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 (PPE) and other relevant safety regulations
   1.4 where appropriate, ensure the insertion, or program override, of any relevant system trip defeats (such as fire extinguishant, emergency shutdown)
   1.5 provide and maintain safe access and working arrangements for the fault finding/maintenance area
   1.6 where appropriate, use electrostatic discharge (ESD) precautions
   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 instrumentation and control equipment:
   2.1 pressure (such as absolute, gauge, vacuum)
   2.2 flow (such as orifice plate, venturi tube, electromagnetic, ultrasonic, differential pressure cell, positive displacement)
   2.3 level (such as floats, displacer, differential pressure cells, load cells, ultrasonic, conductivity)
   2.4 temperature (such as bi-metallic, thermocouples, resistance, infra-red, thermal imaging)
   2.5 weight (such as mechanical systems, load cells/strain gauges, transducers)
   2.6 fiscal metering (such as gas, electricity, water, fuel)
   2.7 detection and alarm (such as smoke, heat, gas, chemical, water, metal)
   2.8 speed measurement (such as mechanical, electrical, stroboscopic)
   2.9 emergency shutdown
   2.10 speed control (such as mechanical governors, electrical governors, DC speed controller, AC motor control systems,
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2.11 vibration monitoring (such as vibration switches, proximity probes, seismic velocity transducer, linear variable differential transformers, portable data collectors)
2.12 nucleonic and radiation (such as Geiger-Muller tube, neutron counter, photomultiplier tube, proportional counter)
2.13 analysers (such as gas detection, spectroscopy, oxygen analyser, water analysis, moisture measurement, density)
2.14 recorders and indicators
2.15 telemetry systems (such as master station, outstation, stand-alone systems)
2.16 valves and valve mechanisms (such as control valves, valve actuators and positioners)
2.17 other specific instrumentation or control equipment

3. collect fault diagnostic 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 plant/equipment records
3.6 circuit outputs/computer display (such as pressure, flow, temperature)
3.7 equipment outputs
3.8 sensory input (sight, sound, smell, touch)

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
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6. use **all** of the following fault diagnostic procedures:
   
   6.1 inspection (such as breakages, wear/deterioration, signs of overheating, loose connections/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 multimeter
   7.2 pressure sources
   7.3 oscilloscope
   7.4 digital pressure indicators
   7.5 signal sources/generator
   7.6 standard test gauges
   7.7 current injection devices
   7.8 special purpose test equipment
   7.9 logic probe
   7.10 other specific test equipment
   7.11 signal tracer

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 company-specific reporting procedure
   9.2 step-by-step analytical report
   9.3 preventative maintenance log/report
   9.4 corrective action report
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