Gas Network Craftsperson

Unit EIAU05 – Carrying out Fault Diagnosis on Instrumentation and Control Equipment and Circuits

This assessment specification has been developed as part of the network maintenance craftsperson standard for the electrical and instrumentation apprentice. The specification details the required skills, knowledge and behaviour that a learner should expect to be assessed against during their training programme. This module should be designed to develop an apprentice’s skills and knowledge on how to carry out fault diagnosis on instrumentation and control equipment and circuits.

What does this specification look like?

This is a training unit that could be delivered by the employer or a training organisation. The assessment specification is the minimum core standard of these requirements, but this does not preclude employers from enhancing the skills and knowledge of the learner through additional or company specific training. The knowledge and performance criteria should be used as the basis for training input.

Both practical and written assessment should be included as part of this training.

What do I need to take this module?

Whilst there are no pre-requisites required for attendance at this training, the apprentice should be competent in the methods used for safe electrical isolation and operations.

Candidates to be assessed as competent in this area must successfully meet the criteria listed below or have other unitary evidence demonstrating an equivalent level of competence.

Evidence could be from the workplace or from a realistic simulated environment. This should be supported with a written assessment.
Performance Criteria

To achieve this unit, you will need to be able to:

P1. Work safely at all times, complying with health and safety and other relevant regulations and guidelines

P2. Complete the following tasks during the fault diagnostic activity:
   a) Plan the fault diagnosis using available information about the fault
   b) Obtain and use the correct issue of company and / or manufacturers' drawings and maintenance documentation
   c) Adhere to procedures or systems in place for risk assessment, COSHH, PPE and other relevant safety regulations
   d) Where appropriate, ensure the insertion, or program override, of any relevant system trip defeats (such as fire extinguishant, emergency shutdown)
   e) Provide and maintain safe access and working arrangements for the fault finding / maintenance area
   f) Where appropriate, use electrostatic discharge (ESD) precautions
   g) Carry out the fault diagnostic activities, using appropriate procedures
   h) Collect equipment fault diagnostic evidence from ‘live’ and isolated circuits
   i) Disconnect or isolate components, or parts of circuits when appropriate, to confirm the diagnosis
   j) Identify the fault and determine the appropriate corrective action
   k) Dispose of waste items in a safe and environmentally acceptable manner and leave the work area in a safe condition

P3. Carry out fault diagnosis on four of the following types of instrumentation and control equipment:
   a) Pressure (such as absolute, gauge, vacuum)
   b) Flow (such as orifice plate, venturi tube, electromagnetic, ultrasonic, differential pressure cell, positive displacement)
   c) Level (such as floats, displacer, differential pressure cells, load cells, ultrasonic, conductivity)
   d) Temperature (such as bi-metallic, thermocouples, resistance, infra-red, thermal imaging)
   e) Weight (such as mechanical systems, load cells / strain gauges, transducers)
   f) Fiscal metering (such as gas, electricity, water, fuel)
   g) Detection and alarm (such as smoke, heat, gas, chemical, water, metal)
   h) Speed measurement (such as mechanical, electrical, stroboscopic)
   i) emergency shutdown
   j) Speed control (such as mechanical governors, electrical governors, DC speed controller, AC motor control systems, stepper motors, invertors)
   k) Vibration monitoring (such as vibration switches, proximity probes, seismic velocity transducer, linear variable differential transformers, portable data collectors)
I) Nucleonic and radiation (such as Geiger-Muller tube, neutron counter, photomultiplier tube, proportional counter)

m) Analysers (such as gas detection, spectroscopy, oxygen analyser, water analysis, moisture measurement, density)

n) Recorders and indicators

o) Telemetry systems (such as master station, outstation, stand-alone systems)

p) Valves and valve mechanisms (such as control valves, valve actuators and positioners)

q) Other specific instrumentation or control equipment

P4. Find faults that have resulted in two of the following breakdown categories:
   a) Intermittent action or circuit failure
   b) Partial failure or reduced performance
   c) Complete breakdown

P5. Review and use all relevant information on the symptoms and problems associated with the product or asset

P6. Investigate and establish the most likely causes of the fault or faults

P7. Select, use and apply diagnostic techniques, tools and aids to locate faults

P8. Collect fault diagnostic evidence from four of the following sources:
   a) The person or operator who reported the fault
   b) Test instrument measurements (such as multimeter, oscilloscope, logic probe, signal tracer, signal generator)
   c) Circuit outputs / computer display (such as pressure, flow, temperature)
   d) Sensory input (sight, sound, smell, touch)
   e) Equipment self-diagnosis
   f) Recording devices
   g) Plant / equipment records
   h) Equipment outputs

P9. Use a range of fault diagnostic techniques, to include two of the following:
   a) Half-split technique
   b) Input / output technique
   c) Six point technique
   d) Unit substitution
   e) Equipment self-diagnostics
   f) Injection and sampling
   g) Emergent sequence
   h) Function / performance testing

P10. Use a variety of diagnostic aids, to include two of the following:
   a) Logic diagrams
   b) Flow charts or algorithms
   c) Probability charts / reports
   d) Computer-aided test equipment
e) Fault analysis charts (such as fault trees)
f) Manufacturers’ manuals
g) Troubleshooting guides
h) Electronic aids

P11. Use all of the following fault diagnostic procedures:
a) Inspection (such as breakages, wear / deterioration, signs of overheating, loose connections / fittings)
b) Operation (such as manual switching off and on, automatic switching / timing / sequencing, outputs)
c) Measurement (such as voltage, current, continuity, logic state, noise, frequency, signal shape and level)

P12. Use four of the following types of test equipment to aid fault diagnosis:
a) Multimeter
b) Oscilloscope
c) Signal sources / generator
d) Current injection devices
e) Logic probe
f) Signal tracer
g) Pressure sources
h) Digital pressure indicators
i) Standard test gauges
j) Special purpose test equipment
k) Other specific test equipment

P13. Complete the fault diagnosis within the agreed time and inform the appropriate people when this cannot be achieved

P14. Determine the implications of the fault or faults for other work and for safety considerations

P15. Use the evidence gained to draw valid conclusions about the nature and probable cause of the fault or faults

P16. Record details on the extent and location of the faults in an appropriate format

P17. Provide a record of the outcome of the fault diagnosis, using one of the following:
a) Company-specific reporting procedure
b) Step-by-step analytical report
c) Preventative maintenance log / report
d) Corrective action report

Knowledge and Understanding

To achieve this unit, you will need to be able to understand:
K1. How to carry out fault diagnosis on instrumentation and control equipment and circuits
K2. 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 the learner

K3. The isolation and lock-off procedure or permit-to-work procedure that applies

K4. 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)

K5. The importance of wearing protective clothing and other appropriate safety equipment during the fault diagnostic activities

K6. The 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

K7. The procedure to be adopted to establish the background of the fault

K8. How to evaluate the various types of information available for fault diagnosis

K9. How to use the various aids and reports available for fault diagnosis

K10. How to use various types of fault diagnostic equipment needed to investigate the problem

K11. 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

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 instrumentation test instruments (such as multimeters, logic probes, oscilloscopes, signal tracers, signal generators)

K16. How to check that test instruments are within current calibration dates, and that they are free from damage and defects

K17. The precautions to be taken to prevent ESD damage to electronic circuits and components

K18. 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

K19. 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

K20. 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
K21. How to evaluate the likely risk to themselves and others, and the effects the fault could have on the overall system or process
K22. How to prepare a report, or take follow-up action, on conclusion of the fault diagnosis, in accordance with company policy
K23. The extent of their own authority and to whom they should report if they have problems that they cannot resolve