
Overview

This standard 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 information 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.

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 product or asset
3. investigate and establish the most likely causes of the fault or 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 or faults 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 or faults
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 requirements of the area in which the fault diagnostic activity is to take place, and the responsibility these requirements place on you
2. the isolation and lock-off procedure or permit-to-work procedure that applies
3. what constitutes a hazardous voltage and how to recognise victims of electric shock
4. how to reduce the risks of a phase to earth shock (such as insulated tools, rubber matting, isolating transformers)
5. the importance of wearing protective clothing and other appropriate safety equipment (PPE) during the fault diagnostic activities
6. 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
7. the procedure to be adopted to establish the background of the fault
8. how to evaluate the various types of information available for fault diagnosis
9. how to use the various aids and reports available for fault diagnosis
10. how to use various types of fault diagnostic equipment needed to investigate the problem
11. 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
12. how to evaluate sensory conditions (by sight, sound, smell, touch)
13. how to analyse information and evaluate possible characteristics and causes of specific faults/problems
14. how to relate previous reports/records of similar fault conditions
15. the care, handling and application of instrumentation test instruments (such as multimeters, logic probes, oscilloscopes, signal tracers, signal generators)
16. how to check that test instruments are within current calibration dates, and that they are free from damage and defects
17. the precautions to be taken to prevent electrostatic discharge (ESD) damage to electronic circuits and components
18. 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
19. the basic principles of how the instrumentation and control circuit

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- functions, its operating sequence, the working purpose of individual units/components and how they interact
20. 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
 21. how to evaluate the likely risk to yourself and others, and the effects the fault could have on the overall system or process
 22. how to prepare a report, or take follow-up action, on conclusion of the fault diagnosis, in accordance with organisational policy
 23. 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. plan the fault diagnosis using available information about the fault
 2. obtain and use the correct issue of organisational and/or manufacturers' drawings and maintenance documentation
 3. adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations
 4. where appropriate, ensure the insertion, or program override, of any relevant system trip defeats (such as fire extinguishant, emergency shutdown)
 5. provide and maintain safe access and working arrangements for the fault finding/maintenance area
 6. where appropriate, use electrostatic discharge (ESD) precautions
 7. carry out the fault diagnostic activities, using appropriate procedures
 8. collect equipment fault diagnostic information from 'live' and isolated circuits
 9. disconnect or isolate components, or parts of circuits when appropriate, to confirm the diagnosis
 10. identify the fault and determine the appropriate corrective action
 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 four of the following types of instrumentation and control equipment:
 1. pressure (such as absolute, gauge, vacuum)
 2. flow (such as orifice plate, venturi tube, electromagnetic, ultrasonic, differential pressure cell, positive displacement)
 3. level (such as floats, displacer, differential pressure cells, load cells, ultrasonic, conductivity)
 4. temperature (such as bi-metallic, thermocouples, resistance, infra-red, thermal imaging)
 5. weight (such as mechanical systems, load cells/strain gauges, transducers)
 6. fiscal metering (such as gas, electricity, water, fuel)
 7. detection and alarm (such as smoke, heat, gas, chemical, water, metal)
 8. speed measurement (such as mechanical, electrical,

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- stroboscopic)
 - 9. emergency shutdown
 - 10. speed control (such as mechanical governors, electrical governors, DC speed controller, AC motor control systems, stepper motors, invertors)
 - 11. vibration monitoring (such as vibration switches, proximity probes, seismic velocity transducer, linear variable differential transformers, portable data collectors)
 - 12. nucleonic and radiation (such as Geiger-Muller tube, neutron counter, photomultiplier tube, proportional counter)
 - 13. analysers (such as gas detection, spectroscopy, oxygen analyser, water analysis, moisture measurement, density)
 - 14. recorders and indicators
 - 15. telemetry systems (such as master station, outstation, stand-alone systems)
 - 16. valves and valve mechanisms (such as control valves, valve actuators and positioners)
 - 17. other specific instrumentation or control equipment
3. Collect fault diagnostic information from four of the following sources:
- 1. the person or operator who reported the fault
 - 2. equipment self-diagnosis
 - 3. test instrument measurements (such as multimeter, oscilloscope, logic probe, signal tracer, signal generator)
 - 4. recording devices
 - 5. plant/equipment records
 - 6. circuit outputs/computer display (such as pressure, flow, temperature)
 - 7. equipment outputs
 - 8. sensory input (sight, sound, smell, touch)
4. Use a range of fault diagnostic techniques, to include two of the following:
- 1. half-split technique
 - 2. input/output technique
 - 3. injection and sampling
 - 4. six point technique
 - 5. emergent sequence
 - 6. unit substitution
 - 7. function/performance testing
 - 8. equipment self-diagnostics
5. Use a variety of diagnostic aids, to include two of the following:
- 1. logic diagrams
 - 2. fault analysis charts (such as fault trees)

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3. flow charts or algorithms
 4. manufacturers' manuals
 5. probability charts/reports
 6. troubleshooting guides
 7. computer-aided test equipment
 8. electronic aids
6. Use all of the following fault diagnostic procedures:
1. inspection (such as breakages, wear/deterioration, signs of overheating, loose connections/fittings)
 2. operation (such as manual switching off and on, automatic switching/timing/sequencing, outputs)
 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:
1. multimeter
 2. pressure sources
 3. oscilloscope
 4. digital pressure indicators
 5. signal sources/generator
 6. standard test gauges
 7. current injection devices
 8. special purpose test equipment
 9. logic probe
 10. signal tracer
 11. other specific test equipment
8. Find faults that have resulted in two of the following breakdown categories:
1. intermittent action or circuit failure
 2. partial failure or reduced performance
 3. complete breakdown
9. Complete and store all relevant documentation of the fault diagnosis in accordance with organisational requirements, using one of the following:
1. organisational-specific reporting procedure
 2. step-by-step analytical report
 3. preventative maintenance log/report
 4. corrective action report
 5. electronic reporting system

SEMEM374

Carrying out fault diagnosis on instrumentation and control equipment and circuits



Developed by	Enginuity
Version Number	3
Date Approved	30 Mar 2021
Indicative Review Date	01 Mar 2024
Validity	Current
Status	Original
Originating Organisation	Enginuity
Original URN	SEMEM374
Relevant Occupations	Maintenance Engineer
Suite	Engineering Maintenance Suite 3
Keywords	Fault diagnosis; instrumentation; control equipment; control circuits; engineering; maintenance; manufacturing; diagnostic techniques; faults; maintenance documentation.