SEMME3021
Diagnosing faults on marine electrical and electronic equipment and circuits

Overview

This standard identifies the competences you need to carry out efficient and effective fault diagnosis on marine electrical and electronic equipment and circuits, in accordance with approved procedures. You will be required to diagnose faults on a range of marine electrical and electronic equipment, such as single, three-phase and direct current power supplies and control systems, motors and starters, switchgear and distribution panels, control systems, communication systems, weapon systems, navigation systems, sensor systems, computer control systems, lighting and alarm systems, electrical plant, luminaires and domestic electrically powered equipment. 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 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 are outside your permitted authority, to the relevant people. You will be expected to work with a minimum of supervision, taking full 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 diagnosis procedures to marine electrical and electronic equipment and circuits. You will understand the various fault diagnosis methods and techniques used and their application. You will also know how to apply and interpret information obtained from the 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 be required to demonstrate safe working practices throughout and will understand your responsibility for 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 and other relevant regulations, directives and guidelines
2. review and use all relevant information on the symptoms and problems associated with the products or assets
3. investigate and establish the most likely causes of the 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 for other work and for safety considerations
7. use the evidence gained to draw valid conclusions about the nature and probable cause of the fault
8. record details on the extent and location of the faults in an appropriate format
Knowledge and understanding

You need to know and understand:

1. the health and safety requirements of the area in which the fault diagnosis activity is to take place and the responsibility they place on you
2. the isolation and lock-off procedure or permit-to-work procedure that applies
3. the importance of wearing protective clothing and other appropriate safety equipment (PPE) during the fault diagnostic process
4. hazards associated with carrying out fault diagnosis on marine electrical equipment (such as live electrical components, stored energy, misuse of tools) and how they can be minimised
5. how to recognise and deal with emergencies and the procedures to be followed (such as methods of safely evacuating and closing down of compartments in the case of fire or other major incident, first aid, fire fighting and resuscitation of personnel)
6. the precautions to be taken to prevent electrostatic discharge (ESD) damage to circuits and sensitive components (such as use of earthed wrist straps)
7. what constitutes a hazardous voltage and how to recognise victims of electric shock
8. how to reduce the risks of a phase to earth shock (such as insulated tools, rubber matting and isolating transformers)
9. the procedure to be adopted to establish the background of the fault
10. how to evaluate the various types of information available for fault diagnosis
11. how to use the various aids and reports available for fault diagnosis
12. how to use various types of fault diagnostic equipment to investigate the problem
13. 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)
14. how to evaluate sensory conditions by sight, sound, smell, touch
15. how to analyse evidence and evaluate the characteristics and
possible causes of specific faults/problems
16. how to relate previous reports/records of similar fault conditions
17. the care, handling and application of watt meters, multimeters and other electrical test instruments
18. how to calibrate electrical test instruments and check that they are free from damage and defects
19. how to obtain and interpret drawings, circuit and physical layouts, charts, specifications, manufacturers’ manuals, history/maintenance reports, graphical electrical symbols, IET wiring regulations and other documents needed in the maintenance process
20. how to carry out currency/issue checks of the specifications you are working with
21. the basic principles of how the circuit functions, its operating sequence, the working purpose of individual units/components and how they interact
22. the different types of cabling (such as multicore cables, single core cables, steel wire armoured (SWA) cables, mineral insulated (MI) cables, screened cables), fittings and their application
23. the different types of motors and starters and their operation
24. the different types of control systems and components and their operation
25. the different types of electrical and electronic components and the items that will require checking
26. how to evaluate the likely risks to yourself and others and the effects that the fault could have on the overall process
27. how to prepare and produce a risk analysis report, if required
28. how to prepare a report or take follow-up action which satisfies the company policy on concluding fault diagnosis
29. the extent of your own responsibility and whom you should report to if you have problems that you cannot resolve
1. Carry out all of the following during the fault diagnostic activity:
   1. plan the fault diagnosis, to ensure that all drawings and equipment are available
   2. use the correct issue of vessel/system drawings and maintenance documentation
   3. adhere to risk assessment, COSHH and other relevant safety standards
   4. obtain clearance to work on the system and observe the appropriate power isolation and safety procedures
   5. provide safe access and working arrangements for the fault finding/maintenance area
   6. carry out the fault diagnostic activities, using safe and approved procedures
   7. collect equipment fault diagnosis evidence from 'live' and isolated circuits
   8. disconnect or isolate components or parts of circuits, when appropriate, to confirm the diagnosis
   9. identify the fault and determine the appropriate corrective action
   10. ensure that the equipment/system is left in a recognised configuration after the fault diagnostic activities
   11. leave the work area in a safe condition and to the prescribed category of cleanliness

2. Carry out fault diagnosis on **one** the following types of marine electrical/electronic equipment:
   1. communication equipment and systems
   2. navigational equipment and systems
   3. sensor equipment and systems
   4. computer equipment and systems
   5. weapons equipment and systems
   6. rotating electrical machines and domestic equipment
   7. lighting, alarm, detection and monitoring systems
   8. power generation and distribution equipment and systems

3. Carry out fault diagnosis on **eight** of the following:
1. wiring and cables
2. switches/contactors
3. connectors
4. overload protection devices
5. back-up battery system
6. units/components
7. power supplies
8. motors and starters
9. distribution panels
10. luminaires
11. alarms
12. detection devices
13. monitoring devices
14. sensors and actuators
15. mechanical devices
16. board level component/modules
17. software
18. control systems
19. other specific component

4. Collect fault diagnosis evidence from **three** of the following sources:
   1. the person or operator who reported the fault
   2. circuit meters (such as voltmeter, power factor, ammeter)
   3. equipment self-diagnostics
   4. recording devices
   5. test measurements
   6. sensory (such as sight, sound, smell, touch)
   7. plant/equipment records
   8. other specific source

5. Use a range fault diagnostic techniques, to include **two** of the following methods:
   1. half-split
   2. input/output technique
   3. injection and sampling
   4. emergent sequence
5. six point
6. unit substitution
7. function testing

6. Use a variety of diagnostic aids and equipment, to include two of the following:
   1. circuit diagrams
   2. logic diagrams
   3. flow charts or algorithms
   4. manufacturers' technical or service manuals
   5. equipment self-diagnosis
   6. fault analysis charts (such as fault trees)
   7. trouble shooting guides
   8. electronic aids
   9. other to be specified (such as company specific processes, procedures and documentation)

7. Use all of the following fault diagnosis procedures:
   1. inspection (such as breakages, wear/deterioration, signs of overheating, missing parts, loose fittings)
   2. operation (such as manually switching off and on, RCD test buttons, automatic switching/timing/sequencing, desired outputs)
   3. measurement (such as voltage, current, continuity, power, temperature, luminescence)

8. Use three of the following types of test equipment to aid fault diagnosis:
   1. multimeter
   2. watt meter
   3. voltmeter
   4. ammeter
   5. earth-loop impedance tester
   6. insulation resistance tester
   7. portable appliance tester
8. light meter  
9. communications analyser  
10. oscilloscope  
11. signal generator  
12. other specific test equipment  

9. 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  

10. Provide a record of the outcomes of the fault diagnosis, using one of the following:  
    1. step-by-step analytical report  
    2. preventative maintenance log/report  
    3. corrective action report  
    4. company specific reporting procedure  
    5. job card  
    6. other specific company recording system
Behaviours

**Behaviours:**

You will be able to apply the appropriate behaviours required in the workplace to meet the job profile and overall company objectives, such as:

- strong work ethic
- positive attitude
- team player
- dependability
- responsibility
- honesty
- integrity
- motivation
- commitment
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