

Maintaining electronic equipment/systems

Overview

This standard covers a broad range of basic electronic maintenance competences that will prepare you for entry into the engineering or manufacturing sectors, creating a progression between education and employment, or that will provide a basis for the development of additional skills and occupational competences in the working environment.

You will be expected to prepare for the electronic maintenance activities by obtaining all the necessary information, documentation, tools and equipment required, and to plan how you intend to carry out the required maintenance activities and the sequence of operations you intend to use.

You will be required to select the appropriate equipment to use, based on the maintenance operations to be carried out and the type of electronic equipment or systems being maintained. This will include power supplies, motor control systems, alarm and protection circuits, sensors and actuator circuits, digital circuits and systems, analogue circuits and systems, and hybrid circuits and systems. You will be expected to use a variety of maintenance diagnostic techniques and procedures, such as gathering information from fault reports, using recognised fault finding techniques and diagnostic aids, measuring, inspecting and operating the equipment.

You will be expected to apply a range of dismantling and reassembly methods and techniques at circuit board and component level, such as soldering, de-soldering, crimping, harnessing, securing cables and components, replacing damaged or defective components, cables and wires, setting and adjusting components, and making de-energised checks before testing the equipment, using appropriate techniques and procedures. You will be expected to take care that you do not cause further damage to the equipment/circuit during the repair activities and, therefore, the application of electrostatic discharge (ESD) procedures will be a critical part of your role.

Your responsibilities will require you to comply with health and safety requirements and organisational policy and procedures for the electronic maintenance activities undertaken. You will need to take account of any potential difficulties or problems that may arise with the maintenance activities, and to seek appropriate help and advice in determining and implementing a suitable solution. You will work under a high level of supervision, whilst taking responsibility for your own actions and for the quality and accuracy of the work that you carry out.

Your underpinning knowledge will provide an understanding of your work, and will enable you to apply appropriate electronic maintenance techniques and procedures safely. You will understand the electronic maintenance process, and its application, and will know about the electronic equipment and systems being maintained, the equipment components, tools and consumables used, to the required depth to provide a sound basis for carrying out the activities to the required specification.

Maintaining electronic equipment/systems

You will understand the safety precautions required when carrying out the repair activities, especially those for isolating the equipment, and for taking the necessary safeguards to protect yourself, and others, against direct and indirect electric shock. You will be required to demonstrate safe working practices throughout, and will understand the responsibility you owe to yourself and others in the workplace.

Specific Standard Requirements

In order to prove your ability to combine different electronic maintenance operations, at least one of the electronic maintenance activities carried out must be of a significant nature, and must cover a minimum of **seven** of the activities listed in scope 4 **plus** the removal and replacement of **three** of the components identified in scope 5.

Maintaining electronic equipment/systems

Performance criteria

You must be able to:

1. work safely at all times, complying with health and safety legislation, regulations, directives and other relevant guidelines
2. plan the maintenance activities before you start them
3. obtain all the information you need for the safe removal and replacement of the equipment/system components
4. obtain and prepare the appropriate tools and equipment
5. maintain the electronic equipment or system
6. apply appropriate maintenance diagnostic techniques and procedures
7. use the appropriate methods and techniques to remove and replace the required components
8. carry out tests on the maintained equipment, in accordance with the test schedule/defined test procedures
9. deal promptly and effectively with problems within your control, and seek help and guidance from the relevant people if you have problems that you cannot resolve
10. leave the work area in a safe and tidy condition on completion of the maintenance activities

Maintaining electronic equipment/systems

Knowledge and understanding

You need to know and understand:

1. the health and safety requirements, and safe working practices and procedures required for the electronic maintenance activities undertaken
2. the isolation and lock-off procedure or permit-to-work procedure that applies to the electronic repair activities and the electronic equipment or circuits being worked on (such as electrical isolation, locking off switchgear, removal of fuses, placing maintenance warning notices, proving that isolation has been achieved and secured)
3. the hazards associated with maintaining electronic equipment, and with the tools and equipment that are used (such as live electrical components, capacitor discharge, misuse of tools, using damaged or badly maintained tools and equipment, not following laid-down maintenance procedures), and how these can be minimised
4. what constitutes a hazardous voltage and how to recognise and deal with victims of electric shock
5. the importance of wearing appropriate protective clothing/equipment (PPE), and of keeping the work area safe and tidy
6. the procedure for obtaining drawings, job instructions, related specifications, replacement parts, materials and other consumables necessary for the maintenance activities
7. how to extract information from job instructions, drawings and data (such as circuit diagrams, specifications, manufacturers' manuals, test procedures and other documents needed to carry out repairs)
8. the procedures and precautions to be adopted to eliminate electrostatic discharge (ESD) hazards
9. the basic principles of how the electronic circuit functions, and the working purpose of individual units/components
10. the various maintenance diagnostic techniques and aids that can be used (such as fault reports, visual checks, measuring, movement and alignment checks, testing; fault location using techniques such as half-split, input-to-output, function testing, unit substitution, and equipment self-diagnostics)
11. the care, handling and application of electronic measuring instruments/fault diagnostic equipment to investigate the problem (such as multimeter, oscilloscope, signal generators, logic probes/analyzers, measuring bridges)
12. checking that test equipment is safe to use (such as condition of power cables, using suitably fused test probes, clips and leads); how to check that equipment is within current calibration approval dates and tested
13. checking that the test equipment is suitable for the tests you are to carry out and can cover the range and values you are to measure
14. connecting to an approved power supply and, where appropriate,

Maintaining electronic equipment/systems

- signal source; identifying correct test points in the circuit; how to position test instruments into circuits without damaging circuit components (such as using test probes, ensuring correct polarity, taking antistatic precautions); setting instrument zero readings; obtaining instrument readings and comparing them with expected results
15. the application of Ohm's Law and relevant calculations (including units of electronic measurement and their multiples and sub-multiples)
 16. the use of calculations and regulations, when selecting wires and cables and when carrying out tests on electronic circuits
 17. making adjustments to circuit components; making decisions on circuit performance and faulty components; removal and replacement of faulty components
 18. how to check that the replacement components meet the required specification/operating conditions (such as values, tolerance, current-carrying capacity, ambient temperatures, connection orientation)
 19. methods of removing and replacing the faulty components from the equipment (such as unplugging, de-soldering, removal of screwed, clamped, edge connected, zero insertion force, and crimped connections) without causing damage to other components, wiring, circuit boards or the surrounding structure
 20. the tools and equipment used in the repair activities (including the use of wire-stripping tools, crimping tools, soldering irons, insertion devices and connecting tools); how to check that they are in a safe and usable condition
 21. the sequence for reconnecting the equipment, and the checks to be made prior to restoring power (such as checking components for correct polarity, ensuring that there are no exposed conductors, cable insulation is not damaged, all connections are mechanically and electrically secure, casings are free from loose screws, there are no wire ends or solder blobs/spikes that could cause short circuits, and all fuses/protection devices are installed)
 22. the importance of making de-energised checks before proving the equipment with the electrical supply on
 23. how to make adjustments to components/assemblies to ensure that they function correctly
 24. the documentation and/or reports to be completed following the maintenance activity, and the importance of ensuring that these reports are completed accurately and legibly
 25. problems that can occur with the electronic equipment maintenance activity, and how they can be overcome
 26. when to act on your own initiative and when to seek help and advice from others
 27. the importance of leaving the work area in a safe and clean condition on completion of the maintenance activities (such as returning hand tools and test equipment to its designated location,

Maintaining electronic equipment/systems

cleaning the work area, removing and disposing of waste)

Maintaining electronic equipment/systems

Scope/range related to performance criteria

1. Carry out **all** of the following during the maintenance activities:
 1. adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations
 2. ensure the safe isolation of equipment (where appropriate)
 3. follow job instructions, maintenance drawings and procedures
 4. take electrostatic discharge (ESD) precautions when handling sensitive components and circuit boards
 5. check that the tools and test instruments are within calibration date and are in a safe, tested and usable condition
 6. ensure that the system is kept free from foreign objects, dirt or other contamination
 7. return all tools and equipment to the correct location on completion of the maintenance activities
 8. leave the work area in a safe and tidy condition
2. Carry out maintenance/repair activities on **three** of the following types of electronic equipment:
 1. power supplies (such as switched mode, series regulation, shunt regulation)
 2. motor control systems (such as closed loop servo/proportional control, inverter control)
 3. sensor/actuator circuit (such as linear, rotational, temperature, photo-optic, flow, level, pressure)
 4. digital circuit (such as process control, microprocessor, logic devices, display devices)
 5. signal processing circuit (such as frequency modulating/demodulating, amplifiers, filters)
 6. alarms and protection circuits
 7. ADC and DAC hybrid circuits
3. Use **four** of the following maintenance diagnostic techniques, tools and aids:
 1. fault finding techniques (such as six point, input/output, half-split, unit substitution)
 2. diagnostic aids (such as manuals, flow charts, troubleshooting guides, maintenance records)
 3. information gathered from the person who reported the fault
 4. visual checks (such as signs of damage, overheating, missing parts, wear/deterioration)
 5. movement checks (such as loose fittings and connections)

Maintaining electronic equipment/systems

6. monitoring equipment or gauges
7. test instrumentation measurement (such as voltage, resistance, current, waveform)
4. Carry out **all** of the following maintenance techniques and procedures during the repair activities:
 1. removing excessive dirt and grime
 2. dismantling/disconnecting equipment to the required level
 3. disconnecting and reconnecting wires and cables
 4. checking the condition/deterioration of components
 5. soldering and de-soldering
 6. repairing circuit board tracks
 7. removing and replacing electronic units/circuit boards
 8. removing and replacing electronic components
 9. making adjustments to components and/or connections
 10. re-assembling of units or sub-assemblies
5. Replace/refit a range of electronic components, to include **twelve** of the following:
 1. cables and connectors
 2. rectifiers
 3. surface mount packages
 4. printed circuit boards
 5. encoders or resolvers
 6. integrated circuits
 7. fixed resistors
 8. variable resistors
 9. potentiometers
 10. thyristors
 11. transistors
 12. regulators
 13. decoders
 14. light dependant resistor (LDR)
 15. thermistors
 16. diodes
 17. Zener diodes
 18. opto-electronics/optical fibre components
 19. light emitting diodes (LEDs)
 20. analogue or digital integrated circuits
 21. fixed capacitors
 22. electrolytic capacitors
 23. variable capacitors
 24. sensors
 25. switches
 26. edge connectors
 27. heat sinks
 28. wiring pins/tags/wire links

Maintaining electronic equipment/systems

29. mini transformers
 30. protection devices
 31. inverters or servo controllers
 32. relays
 33. inductors
6. Use the correct joining/connecting techniques to deal with **three** of the following types of connection:
1. push-fit connectors
 2. crimped connections
 3. soldering or de-soldering
 4. zero insertion force (zif) connectors
 5. clip assemblies
 6. adhesive joints/assemblies
 7. threaded connections
 8. edge connectors
 9. other specific connectors
7. Use **five** of the following types of test equipment:
1. multimeter
 2. signal generator
 3. oscilloscope
 4. signal tracer
 5. logic probe/clip
 6. stabilised power supplies
 7. logic analyser
 8. measuring bridges
 9. pulse sequencing analyser
 10. software diagnostic programs
 11. counter-timers
 12. data communications test set
 13. signature analysers
 14. bus exerciser/analyser
 15. protocol analyser
8. Carry out checks and tests on the maintained equipment, to include **both** of the following:
1. visual checks (such as for solder bridges, dry joints, incorrect value components, signs of damage, missing components)
 2. movement checks (such as loose wires and connections, incorrectly seated devices/packages)

Plus **three** more from the following:

3. logic states
4. pulse width/rise time
5. inductance

Maintaining electronic equipment/systems

6. dc voltage/current levels
7. open/short circuit
8. frequency modulation/demodulation
9. ac voltage/current levels
10. resistance
11. amplification
12. clock/timer switching
13. capacitance
14. signal noise/interference levels
15. oscillations
16. wave form analysis
17. attenuation

9. Carry out maintenance activities on electronic equipment, in accordance with **one** of the following:

1. organisational guidelines and codes of practice
2. equipment manufacturer's operation range
3. BS and ISO standards

Behaviours

Additional Information

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

Maintaining electronic equipment/systems

Developed by	Enginuity
Version Number	3
Date Approved	30 Mar 2017
Indicative Review Date	31 Mar 2020
Validity	Current
Status	Original
Originating Organisation	Semta
Original URN	SEMPEO2-38
Relevant Occupations	Engineering, Engineering and Manufacturing Technologies
Suite	Performing Engineering Operations Suite 2
Keywords	engineering; engineering operations; maintaining electronic equipment; maintaining electronic systems; electronic maintenance; manufacturing; tools; equipment; power supplies; motor control systems