

## Repairing communication-electronic systems

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### Overview

This standard identifies the competences you need to carry out repairs on communication - electronic systems, in accordance with approved procedures. You will be required to carry out repairs on a range of communication - electronic systems, sub-systems or assemblies. This will involve dismantling, removing and replacing faulty line replaceable units (LRUs) on a variety of different types of communication - electronic systems, sub-systems and assemblies. You will be expected to apply a number of dismantling and re-assembly methods and techniques, such as soldering, de-soldering, crimping, harnessing and securing cables and components. You will be expected to take care that you do not cause further damage to the system 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 organisational policy and procedures for carrying out the repair activities, and to report any problems with these activities or 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 minimal 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 communication - electronic repair procedures. You will understand the various repair procedures and their application, and will know about the tools and techniques used, in adequate depth to provide a sound basis for carrying out the activities, recognising and correcting faults and ensuring that the repaired system is to the required specification and remains compliant with all standards and regulations.

You will understand the safety precautions required when carrying out the repair activities, especially those for isolating the equipment and taking the necessary safeguards to protect yourself 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.

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### 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. follow the relevant maintenance schedules to carry out the required work
3. carry out the maintenance activities within the limits of your personal authority
4. carry out the maintenance activities in the specified sequence and in an agreed timescale
5. report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
6. complete and store all relevant repair documentation in accordance with organisational requirements
7. dispose of waste materials in accordance with safe working practices and approved procedures and leave the work area in a safe condition

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## Knowledge and understanding

## You need to know and understand:

1. the health and safety requirements of the area in which the repair 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 to the maintenance activities (such as electrical isolation, locking off switch gear, removal of fuses, placing maintenance warning notices, proving that isolation has been achieved and secured)
3. your responsibilities under regulations relevant to the communication-electronic repair activities being undertaken
4. isolation procedure and safety precautions unique to the communication-electronic systems, subsystem or assembly being worked on
5. the importance of wearing protective clothing and other appropriate safety equipment (PPE) during the repair activities
6. the hazards associated with repairing communication-electronic systems, subsystems or assemblies, or with equipment that is used, and how to minimise them and reduce any risks
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, isolating transformers)
9. the importance of keeping the work area clean and tidy and free from waste and surplus materials
10. how the activities may affect the work of others, and the procedure for informing them of the work to be carried out
11. the procedures and precautions to be adopted to eliminate electrostatic discharge (ESD)
12. how to obtain and interpret drawings, Boolean algebra, truth tables, logic symbols, circuit diagram specifications, manufacturers' manuals, test procedures and other documents needed to carry out repairs
13. the principles of how communication-electronic or associated systems function and interact
14. how subsystems and assemblies function within a system
15. organisational policy on the repair or replacement of faulty LRUs during the maintenance process
16. how to check that the replacement LRUs meet the required specification/operating conditions (such as values, tolerance, current-carrying capacity, operating temperatures)
17. methods of removing and replacing the faulty LRUs from the equipment (such as unplugging, de-soldering, removal of screwed, clamped, edge connected, zero insertion force, fitted and crimped

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- connection)
18. the importance of removing faulting LRUs without causing damage to other components or the surrounding structure
  19. methods of attaching identification marks/labels to removed LRUs or connections, to assist with re-assembly
  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)
  21. how to check that tools and equipment are free from damage or defect, are in a safe and usable condition, and are configured correctly for their intended purpose
  22. how to reconnect 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)
  23. the importance of making 'off-load' checks before proving the equipment with the electrical supply on
  24. how to make adjustments to LRUs to ensure that they function correctly
  25. the maintenance documentation and/or reports to be completed following the maintenance activity, and the importance of ensuring that these reports are completed accurately, legibly and using appropriate technical language
  26. the organisational procedures to be adopted for the safe disposal of waste of all types of material
  27. the extent of your own authority and to whom you should report if you have a problem that you cannot resolve

### Scope/range

1. Carry out all of the following during the repair activities:
  1. plan and communicate the repairing activities to cause minimal disruption to normal working
  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 and other relevant safety regulations and procedures to realise a safe system of work
  4. ensure the safe isolation of equipment
  5. provide and maintain safe access and working arrangements for the maintenance area
  6. carry out the inspection and testing activities, using appropriate techniques and procedures
  7. take electrostatic precautions when handling components and circuit boards
  8. re-connect and return the system to service on completion of the repair activities
  9. record the results of the maintenance activity and report any defects found
  10. 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 repair activities on four communication - electronic systems, subsystems or assemblies to LRU level, at least two of which must be selected from Group A:

Note Any of the items below can be identified as a system, sub-system or assembly in its own right.

#### Group A - communication electronic

1. transmitters (such as HF, VHF, UHF, microwave transmitters)
2. transceivers (such as HF, VHF, UHF, microwave)
3. receivers (such as HF, VHF, UHF, microwave receivers)
4. signal processing (analogue) (such as radar anti-clutter, comms audio and AGC stages)
5. signal processing (digital) (such as digital MTI, multiplexers, AGC)
6. aerial systems (such as phased arrays, long wire and parabolic reflectors)
7. transmission lines (such as optical fibres, coaxial, baluns, twin

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- wire, waveguide)
- 8. display systems (such as CRT, plasma, TFT, TV tab, LED)
- 9. man-machine interface (such as IS/ICT equipment or peripherals: keypads, keyboards, microphones)
- 10. electro-optical systems (such as cameras, thermal imaging, targeting systems)
- 11. hydraulic-electrical systems (such as hydraulic motors, HSUs and actuators)
- 12. cryptographic systems (such as data encryption and de-encryption)
- 13. built-in test equipment
- 14. data network systems (such as LANs, WANs)
- 15. data network Interfaces (such as switch, router, bridging networks)
- 16. any other identifiable communication-electronic system, sub-system or assemblies

### Group B - associated equipment

- 17. environmental control systems (such as temperature, humidity, vibration, shock, alarm and protection)
- 18. electromechanical systems (such as servos, motors, relays, complex switches)
- 19. power generation systems (such as fixed/transportable AC/DC generators, batteries)
- 20. power distribution systems (such as single phase/3-phase distribution panels)
- 21. power supply control systems (such as voltage/current series/shunt regulator/stabiliser)
- 22. hybrid systems (such as ADC, DAC)

### 3. Carry out all of the following repair activities:

- 1. application of electrostatic discharge (ESD) precautions
  - 2. preparation of areas for repairing
  - 3. disconnection/dismantling of required LRUs
  - 4. replacement of faulty LRUs
  - 5. re-assembly of LRUs in line with specification
  - 6. functionally testing completed equipment
  - 7. making any adjustments required
4. Replace five different LRUs from communication - electronic systems, subsystems or assemblies, at least three of which must be selected from Group A:

Note Any of the items below can be identified as a system, sub-system or assembly in its own right.

### Group A - communication electronics

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1. transmitters (such as HF, VHF, UHF, microwave transmitters)
2. transceivers (such as HF, VHF, UHF, microwave)
3. receivers (such as HF, VHF, UHF, microwave receivers)
4. signal processing (analogue) (such as radar anti-clutter, comms audio and AGC stages)
5. signal processing (digital) (such as digital MTI, multiplexers, AGC)
6. aerial systems (such as phased arrays, long wire and parabolic reflectors)
7. transmission lines (such as optical fibres, coaxial, baluns, twin wire, waveguide)
8. display systems (such as CRT, plasma, TFT, TV tab, LED)
9. man-machine interface (such as IS/ICT equipment or peripherals: keypads, keyboards, microphones)
10. electro-optical systems (such as cameras, thermal imaging, targeting systems)
11. hydraulic-electrical systems (such as hydraulic motors, HSUs and actuators)
12. cryptographic systems (such as data encryption and de-encryption)
13. built-in test equipment
14. data network systems (such as LANs, WANs)
15. data network Interfaces (such as switch, router, bridging networks)
16. any other identifiable electronic system, sub-system or assemblies

### Group B - associated equipment

17. environmental control systems (such as temperature, humidity, vibration, shock, alarm and protection)
18. electromechanical systems (such as servos, motors, relays, complex switches)
19. power generation systems (such as fixed/transportable AC/DC generators, batteries)
20. power distribution systems (such as single phase/3-phase distribution panels)
21. power supply control systems (such as voltage/current series/shunt regulator/stabiliser)
22. hybrid systems (such as ADC, DAC)

### 5. Use appropriate joining/connecting techniques to deal with four of the following types of connection:

1. push-fit connectors
2. zero insertion force (ZIF)
3. soldering or de-soldering
4. adhesive joints/assemblies
5. clip assemblies
6. edge connectors
7. threaded connections
8. insulation displacement connections (IDC)
9. crimped connections

### 6. Ensure the repaired systems comply with one of the following:

1. organisational guidelines and codes of practice
2. BS, ISO and/or BSEN standards
3. equipment manufacturers' operation range
4. Ministry of Defence (MoD)

### 7. Complete and store all relevant repair documentation in accordance

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with organisational requirements using one of the following:

1. job cards
2. permits-to-work/formal risk assessment and/or sign-on/off procedures
3. maintenance logs or reports
4. organisational-specific documentation
5. electronic reports

## Repairing communication-electronic systems

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	SEM355
Relevant Occupations	Maintenance Engineer
Suite	Engineering Maintenance Suite 3
Keywords	Engineering; maintenance; electronic; communication; testing; transmitters; receivers; signal processors; display system