Overview

This standard identifies the competences you need to carry out repairs or overhauling activities on instrumentation and control equipment, in accordance with approved procedures. The instrumentation to be repaired or overhauled will have been removed from service, and the overhauling activities may take place in a workshop or the equipment may have been returned to the manufacturer for overhaul. This standard covers instrumentation 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 and control; vibration monitoring equipment; photo-optic instruments; nucleonic and radiation measurement; analysers recorders and indicators; telemetry systems; emergency shutdown systems and other specific instrumentation.

The repair or overhauling activities will include carrying out all necessary safety and decontamination activities, dismantling the equipment to unit or component level, inspecting and checking all components for damage and wear, replacing all ‘lifed’ items and worn/faulty components or units, reassembling the equipment and carrying out all necessary quality checks.

Your responsibilities will require you to comply with organisational policy and procedures for the repair or overhauling 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 must ensure that all tools, equipment and materials used in the repair/overhaul activities are returned to their designated locations on completion of the activities, and that all necessary servicing, testing and calibration documentation is completed accurately and legibly. 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 repair/overhauling procedures to instrumentation and control equipment. You will understand the dismantling, inspection reassembly and testing methods and procedures used, and their application. You will know how the equipment functions, the common faults encountered,
the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the repair/overhaul and for ensuring that the repaired/overhauled equipment meets the required specification and remains compliant with all standards and regulations.

You will understand the safety precautions required when carrying out the repair/overhauling activities, especially those for ensuring the correct decontamination of the instruments. 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. follow the relevant repair/overhauling schedules to carry out the required work
3. establish and, where appropriate, mark/label components to aid re-assembly
4. carry out the repair/overhaul to the agreed level, using the correct tools and techniques
5. ensure that all removed components are correctly identified and stored in the correct location
6. report any instances where the repair/overhauling activities cannot be fully met, or where there are identified defects outside the planned repair/overhauling schedule
7. complete the relevant documentation, in accordance with organisational requirements
8. dispose of unwanted components, waste materials and substances, in accordance with safe working practices approved procedures
9. deal promptly and effectively with problems within your control and report those that cannot be solved
SEMEM377

Repairing/overhauling instrumentation and control equipment

Knowledge and understanding

You need to know and understand:

1. the safe working practices and procedures and the specific safety precautions to be taken when repairing/overhauling instrumentation and control equipment (to include wearing protective clothing and equipment; decontamination procedures for the instruments being repaired/overhauled; lifting and handling techniques; safe working practices, procedures and guidelines which satisfy current regulations such as HASAWA, COSHH and other work related legislation and guidelines)

2. the hazards associated with repairing/overhauling instrumentation and control equipment, and with the tools and equipment used, and how to minimise them and reduce any risks

3. the protective equipment that you need to use for both personal protection (PPE) and protection of the instrumentation and control equipment being repaired

4. what constitutes a hazardous voltage and how to recognise victims of electric shock

5. how to reduce the risks of a phase to earth shock (such as insulated tools, rubber mating and isolating transformers)

6. how to extract and use information from equipment manuals, history/maintenance reports, charts, circuit and physical layouts, specifications, symbols used in instrumentation and control circuits, and other documents needed in the repair/overhaul process

7. terminology used with instrumentation and control equipment, and the use of system diagrams and associated symbols

8. the basic principles of operation of the instrumentation and control equipment being repaired/overhauled, and the performance characteristics and function of the components within the equipment

9. the techniques used to remove components from the instrumentation and control equipment without damage to the components or surrounding structure (such as de-soldering components, applying electrostatic discharge (ESD) protection procedures)

10. the various types of electrical connector that are used, their methods of unlocking, orientation indicators and locating and locking-in of the connections
11. the various mechanical fasteners that are used, and their methods of removal and replacement (such as threaded fasteners, special securing devices)
12. the importance of using the specified components for the particular instrument, and why you must not substitute others
13. the need to label and store components correctly, and to check that replaced components have the correct part/identification markings
14. the procedure for obtaining replacement parts, materials and other consumables necessary for the repair/overhaul
15. the techniques used to position, align, adjust and secure the replaced components to the equipment without damage to the components or surrounding structure
16. the quality control procedures to be followed during the repair/overhauling operations
17. procedures for ensuring that you have the correct tools, equipment, components and fasteners for the activities
18. how to conduct checks of the instruments to ensure the integrity, accuracy and quality of the repair/overhaul
19. the problems that can occur with the repair/overhauling operations, and how these can be overcome
20. how to recognise defects (such as poor seals, misalignment, incorrectly seated plugs and sockets, ineffective fasteners, foreign object damage or contamination)
21. the recording documentation to be completed for the activities undertaken
22. the procedure for the safe disposal of waste materials and scrap components
23. the extent of your own responsibility, and to whom you should report if you have problems that you cannot resolve
1. Carry out all of the following during the repair/overhauling activity:
   1. obtain and use the correct equipment repair/overhauling documentation (such as manuals, drawings, maintenance records)
   2. adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations
   3. provide and maintain safe access and working arrangements for the repair/overhauling area
   4. where applicable, ensure that appropriate decontamination procedures are used for instruments that have been used with hazardous (such as toxic, corrosive, inflammable, explosive, radioactive) substances
   5. where appropriate, apply electrostatic discharge (ESD) protection procedures
   6. carry out the repair/overhauling activities, using appropriate techniques and procedures
   7. ensure that the equipment is maintained free from damage and foreign objects
   8. record the results of the maintenance activity and report any defects found
   9. dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition
   10. return all tools and equipment to the correct location on completion of the activities
   11. leave the work area in a clean and safe condition on completion of the activities

2. Carry out the repair/overhauling activities 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, 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. Carry out all of the following activities, as applicable to the instrumentation/control equipment being repaired or overhauled:
   1. cleaning parts prior to dismantling
   2. checking components for serviceability
   3. carrying out pre-disassembly checks and tests
   4. replacing all `lifed' items (such as seals, gaskets, batteries)
   5. disconnecting and/or de-soldering electrical connections
   6. replacing all damaged or defective components
   7. removing cable securing devices
   8. reassembling equipment
   9. removing bolt securing devices and mechanical fasteners
   10. making mechanical connections (such as pipes)
   11. making electrical connections (such as crimping, soldering, heat shrinking)
   12. dismantling equipment to unit/sub-assembly level
   13. dismantling units to component level
   14. setting and adjusting/calibrating replaced components
15. marking/labelling of components to aid reassembly
16. securing components by using mechanical fasteners and threaded devices
17. applying locking and retaining devices (such as circlips, pins, wire locking, cable securing devices)

4. Replace a range of instrumentation components, to include **eight** of the following:
   1. printed circuit boards/electronic cards
   2. switches (such as limit, proximity)
   3. electronic modules
   4. gaskets/seals
   5. relays
   6. bellows
   7. electronic components (such as resistors, capacitors, diodes)
   8. diaphragms or discs
   9. bourdon tubes
  10. transmitters
  11. actuators or actuator components (such as pistons, springs, glands linkages)
  12. transducers
  13. load cells
  14. valves or valve components (such as glands, spindles, seats)
  15. thermocouples
  16. wires/cables
  17. pipework/pipework components
  18. plugs/sockets/terminations
  19. other specific components

5. Carry out checks on the serviced/overhauled instruments, to include **four** of the following:
   1. visual inspection of the instrument for completeness and freedom from damage or foreign objects
   2. checking security of all mechanical connections
   3. checking integrity of all electrical connectors
   4. standard serviceability test
   5. operational/function checks
6. Repair/overhaul instrumentation and control equipment in compliance with one of the following:
   1. company standards and procedures
   2. BS, ISO and/or BSEN standards
   3. customer standards and requirements
   4. instrument manufacturer’s requirements

7. Complete the relevant paperwork from one of the following, and pass it to the appropriate people:
   1. maintenance log or report
   2. company-specific documentation
   3. job cards
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