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## Overview

This standard identifies the competences you need to lead maintenance activities by carrying out corrective maintenance activities on process controller equipment within an engineered system, in accordance with approved procedures. As part of a team you will be required to maintain a range of process controller equipment, that typically includes process controllers or sequential controllers (such as programmable logic controllers (PLCs), Distributed Control System (DCS) or SCADA system) which are working in an integrated system involving two or more of the following interactive technologies: mechanical, electrical or fluid power.

You will also be required to identify and implement a systematic approach to improving the equipment maintenance activities undertaken and ensure that the maintenance team have to appropriate skills, knowledge and understanding to maintain the equipment efficiently, effectively and safely.

This will involve dismantling, removing and replacing faulty peripheral components, process controller units and components, down to board level on unitary, rack or modular type process controller systems. You will also need to be able to up-load and download process controller programs, check them for errors, make alterations to programs and create and maintain back-up copies of completed programs.

Your responsibilities will require you to comply with organisational policy and procedures for the maintenance activities undertaken and to report any problems with the maintenance activities, process control system, tools or 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 actions and for the quality and accuracy of the work that you carry out.

Your underpinning knowledge will provide an in depth understanding of your work and will provide an informed approach to applying maintenance procedures on process controller systems within an integrated system. You will understand the maintenance methods and procedures used and their application and will know about the various process controller units and peripheral components, their functions and associated defects, in adequate depth to provide a sound basis for carrying out the maintenance activities, correcting faults and ensuring that the equipment operates to the required specification and remains compliant with all standards and regulations. You will also

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know about the interaction of the other associated integrated technologies and have sufficient knowledge to carry out the dismantling and reassembly of the process controller system safely and effectively.

You will understand the safety precautions required when carrying out the maintenance activities, especially those for isolating the equipment and for taking the necessary safeguards to protect yourself and others in the workplace. You will be required to demonstrate safe working practices throughout.

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## 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. produce and update relevant maintenance schedules and plans
3. lead 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 relevant maintenance documentation accurately
7. dispose of waste materials and components in accordance with safe working practices and approved procedures
8. identify and lead on making improvements to maintenance processes and procedures
9. update management information and systems to support the activities of the maintenance department

## Knowledge and understanding

### *You need to know and understand:*

1. the health, safety and environmental requirements of the area in which the maintenance activity is to take place and the responsibility these requirements place on you
2. how to prioritise your own and the team's workload to ensure that targets are met
3. how to communicate effectively, listen, question, support and coach others to work towards the departmental targets
4. the importance of ensuring that teams have the required skills, knowledge and understanding in order to maintain equipment to the required standards
5. how to complete a skills audit of team members
6. how maintenance teams can access the appropriate training and development programmes once a need training need has been identified
7. the isolation and lock-off procedure or permit-to-work procedure that applies to the system being worked on
8. the isolation procedure which is specific to the process controller system being worked on
9. the specific health and safety precautions that need to be applied during the maintenance activities and their effects on others
10. how to recognise and deal with victims of electric shock (to include isolating the power source and methods of first aid resuscitation)
11. the importance of wearing protective clothing (PPE) and other appropriate safety equipment during the maintenance activities and where this can be obtained
12. the procedures and precautions to be adopted to eliminate electrostatic discharge hazards
13. hazards associated with carrying out maintenance activities on a process controlled integrated system (such as handling fluids, stored pressure/force, electrical supplies, process controller interface, using damaged or badly maintained tools and equipment, not following laid-down maintenance procedures) and how to minimise these and reduce any risks
14. how to obtain and interpret drawings, charts, specifications, manufacturers' manuals, history/maintenance reports, symbols used on process controller documents and other documents needed for the maintenance activities
15. the basic principles of how the system functions, its operation sequence, the working purpose of individual units/components and how they interact

16. the various fault finding techniques that can be used and how they are applied (such as half-split, input/output, emergent problem sequence, six point technique, functional testing, unit substitution, injection and sampling techniques and equipment self-diagnostics)
17. how to evaluate the various types of information available for fault diagnosis (such as operator reports, monitoring equipment, sensory inputs, machinery history records and condition of the end product)
18. how to evaluate sensory information from sight, sound, smell, touch
19. the procedures to be followed to investigate faults and how to deal with intermittent conditions
20. how to use the various aids and reports available for fault diagnosis
21. the types of equipment that can be used to aid fault diagnosis (such as mechanical measuring instruments, electrical measuring instruments, test rigs and pressure and flow devices) and how to check the equipment is calibrated or configured correctly for the intended use and that it is free from damage and defects
22. the application of specific fault finding methods and techniques that are best suited to the problem
23. how to analyse and evaluate possible characteristics and causes of specific faults/problems
24. how to make use of previous reports/records of similar fault conditions
25. how to evaluate the likely risk of running the equipment with the displayed fault and the effects the fault could have on the overall process
26. the devices and systems for storing programmes
27. procedures to be applied to storage, location and method of backing up programmes
28. the different types of interface cards and their application
29. the application of computer-based authoring software for design and development
30. the numbering system and codes used for identification of inputs and outputs
31. how to search a programme within the process controller for specific elements
32. programming techniques and codes used (such as interlocking, timers, counters, sub-routines)
33. the techniques involved in editing, entering and removing contacts from lines of logic and, where applicable, the procedure to be followed for 'on' and 'off-line' programming
34. the procedure for obtaining replacement parts, materials and other

consumables necessary for the maintenance process

35. company policy on repair/replacement of components during the maintenance activities

36. the techniques used to dismantle/assemble integrated equipment (such as release of pressures/force, proofmarking to aid re-assembly, plugging exposed pipe/component openings, dealing with soldered joints, screwed, clamped and crimped connections)

37. methods of attaching identification marks/labels to removed components or cables to assist with re-assembly

38. methods of checking that components are fit for purpose and the need to replace items such as batteries, boards and other failed items

39. how to check that tools and equipment are free from damage or defects, are in a safe and usable condition and are configured correctly for the intended purpose

40. the importance of making 'off-load' checks before proving the equipment with the electrical supply on

41. the generation of maintenance documentation and/or reports on completion of the maintenance activity

42. the equipment operating and control procedures to be applied during the maintenance activity

43. how to use lifting and handling equipment in the maintenance activity

44. the problems that can occur during the maintenance of the process controller system and how they can be overcome

45. the organisational procedure to be adopted for the safe disposal of waste of all types of materials

46. the extent of your own authority and to whom you should report if you have a problem you cannot resolve

## Scope/range related to performance criteria

1.

Lead a maintenance team by carrying out all the following:

- 1.1 communicate the maintenance activities to the team
- 1.2 involve the team in planning how the maintenance activities will be undertaken
- 1.3 allocate specific maintenance activities to each team member
- 1.4 involve the team in identifying improvements that could be made to the maintenance process and/or procedures
- 1.5 encourage the team and/or individuals to take the lead where appropriate

2.

Review and update maintenance procedures and plans to include three the following:

- 2.1 preventive maintenance (routine inspections and adjustments)
- 2.2 corrective maintenance (activities identified from preventative maintenance activities)
- 2.3 predictive maintenance (analysis of the equipment's condition)
- 2.4 reactive maintenance (unexpected equipment/component failure)
- 2.5 maintenance prevention (equipment/component design and development)

plus supporting documentation associated with two \*\*of the following

6. equipment performance
7. equipment downtime/failure
8. overall equipment effectiveness (OEE)
9. maintenance costs
10. health and safety
11. staff development and training
12. maintenance procedures/instructions
13. operator manuals/working instructions
14. regulatory compliance

1.

Carry out fault diagnosis on two of the following types of interactive technologies, to sub-assembly or component level:

- 1.1 mechanical
- 1.2 electrical
- 1.3 fluid power
- 1.4 process controller

2.

Collect information about the fault from four of the following sources:

- 2.1 the person or operator who reported the fault
- 2.2 sensory (such as sight, sound, smell, touch)
- 2.3 monitoring equipment or gauges
- 2.4 plant or machinery records/history
- 2.5 recording devices
- 2.6 condition of the end product

3.

Use a range of fault diagnostic techniques, to include two of the following:

- 3.1 half-split technique
- 3.2 emergent problem sequence
- 3.3 functional/performance testing
- 3.4 input/output
- 3.5 six point technique
- 3.6 injection and sampling
- 3.7 unit substitution
- 3.8 equipment self diagnostics

4.

Use a variety of diagnostic aids, to include two of the following:

- 4.1 manufacturer's manual
- 4.2 logic diagrams
- 4.3 algorithms
- 4.4 flow charts
- 4.5 probability charts/reports
- 4.6 fault analysis charts (such as fault trees)
- 4.7 equipment self diagnostics
- 4.8 troubleshooting guides
- 4.9 circuit diagrams/specifications

5.

Use two of the following types of test equipment to help in the fault diagnosis:

- 5.1 mechanical measuring equipment (such as measuring instruments, dial test indicators, torque instruments)
- 5.2 electrical/electronic measuring instruments (such as multimeters, logic probes)
- 5.3 fluid power test equipment (such as test rigs, flow meters, pressure gauges)

6.

Find faults that have resulted in two of the following breakdown categories:

- 6.1 intermittent problem
- 6.2 partial failure or reduced performance/out of specification product
- 6.3 complete breakdown

7.

Carry out all of the following during the maintenance activities:

- 7.1 plan and communicate the maintenance activities to cause minimal disruption to normal working
- 7.2 obtain and use the correct issue of company and/or manufacturers'

drawings and maintenance documentation

7.3 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

7.4 ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)

7.5 provide and maintain safe access and working arrangements for the maintenance area

7.6 carry out the maintenance activities using appropriate techniques and procedures

7.7 reconnect and return the system to service on completion of the maintenance activities

7.8 dispose of waste items in safe and environmentally acceptable manner and leave the work area in a safe condition

8.

Use appropriate dismantling and re-assembly techniques to deal with two of the following:

#### **mechanical components:**

1. draining and replenishing of fluids
2. removing and refitting locking and retaining devices
3. removing minor mechanical units/sub-assemblies (such as guards, structures)
4. removing major mechanical units (such as gearboxes, pumps, mechanical handling, workholding/transfer equipment)
5. proofmarking components to aid reassembly
6. setting, aligning and adjusting replaced units

#### **electrical components**

7. isolating the power supply using correct lock-off communication procedure

8. disconnecting and re-connecting wires/cables

9. removing and replacing major electrical components (such as motors, switch/control gear)

10. removing and replacing minor electrical components (such as relays, sensing devices, limit switches)

11. removing and replacing wiring enclosures (such as conduit, trunking, cable traywork)

#### **fluid power components**

12. releasing stored pressure

13. chocking/supporting cylinders/rams/components

14. disconnecting/removing hoses/pipes

15. removing and replacing units/components (such as pumps, valves, actuators,

cylinders)

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1.

Carry out maintenance activities on one of the following types of process controller equipment:

- 1.1 unitary
- 1.2 modular
- 1.3 rack mount

2.

Carry out seven of the following program maintenance activities on the process controller system:

- 2.1 select and use appropriate programming devices (such as terminals, handheld programmers and personal computers)
- 2.2 use ladder logic, statement lists, or system flowcharts
- 2.3 force contacts on and off
- 2.4 edit, enter and remove contacts from lines of logic
- 2.5 alter counter and timer settings
- 2.6 use 'on' and 'off-line' programming use
- 2.7 single-step mode of operation
- 2.8 carry out on-line monitoring of programs
- 2.9 programme by computer based authoring (to include sub-routines)
- 2.10 load, read and save programs
- 2.11 produce back-ups of completed programs

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1.

Carry out all of the following during the maintenance activities:

- 1.1 take electrostatic discharge (ESD) precautions when working on or close to sensitive components and circuit boards
- 1.2 proofmark or label removed wires and components
- 1.3 inspect and/or test components for serviceability
- 1.4 use program full-run modes of operation
- 1.5 change or add circuit boards/modules
- 1.6 replace power supplies
- 1.7 replace peripherals (such as sensors, actuators, relays, switches)
- 1.8 replace process controller units
- 1.9 replace back-up batteries (as appropriate)
- 1.10 functionally test the system

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1.

Identify and implement improvements in the services provided by the maintenance

team to include two \*\*of the following:

- 1.1 equipment downtime during maintenance
- 1.2 equipment performance monitoring systems
- 1.3 overall equipment effectiveness (OEE)
- 1.4 maintenance procedures
- 1.5 operator instructions
- 1.6 visual management systems/documentation
- 1.7 resource planning
- 1.8 costs
- 1.9 staff development and training
- 1.10 health and safety
- 1.11 procurement
- 1.12 other specific improvement

2.

Ensure maintenance activities comply with three of the following:

- 2.1 organisational guidelines and procedures
- 2.2 equipment manufacturer's operating specification/range
- 2.3 British, European or International standards or directives
- 2.4 recognised compliance agency/body standards or directives
- 2.5 health, safety and environmental requirements
- 2.6 customer standards and requirements

3.

Complete the relevant paperwork from one of the following and pass it to the appropriate people:

- 3.1 job cards
- 3.2 maintenance log or report
- 3.3 permits to work/formal risk assessment and/or sign on/off procedures
- 3.4 company-specific documentation

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## 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

SEMEM448

Carrying out maintenance activities on process controller equipment within an engineered system



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