SEMEM441

Carrying out maintenance activities on mechanical equipment

## Overview

This standard identifies the competences you need to lead maintenance activities by carrying out corrective maintenance activities on mechanical equipment, in accordance with approved procedures. As part of the team you will be required to maintain a range of mechanical equipment. This will involve dismantling, removing and replacing faulty equipment at component or unit level on a variety of different types of mechanical assemblies and sub-assemblies. 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.

You will be expected to apply a range of dismantling and assembling methods and techniques, such as proof marking to aid reassembly, dismantling components requiring pressure or expansion/contraction techniques, setting, aligning and adjusting components, torque loading components and making 'off-load' checks before starting up the maintained equipment.

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 or 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 maintenance activities are removed from the work area on completion of the activities, and that all necessary job/task documentation is completed accurately and legibly. 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 an in depth understanding of your work, and will provide an informed approach to applying mechanical maintenance procedures. You will understand the dismantling and reassembly methods and procedures, and their application. You will know how the equipment functions and the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the maintenance activities, correcting faults and ensuring the repaired equipment functions to the required specification and remains compliant with all standards and regulations. In addition, you will have sufficient in-depth knowledge of these components to ensure that they are fit for purpose and meet the

specifications, thus providing a sound basis for carrying out reassembly.

You will understand the safety precautions required when carrying out the maintenance activities, especially those for isolating the equipment.  You will also understand your responsibilities for safety and the importance of 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. 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 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 and safety 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 your 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 procedures or permit-to-work procedure that applies
8. the specific health and safety precautions to be applied during the maintenance procedure and their effects on others
9. hazards associated with carrying out mechanical maintenance activities (such as handling oils, greases, stored pressure/force, misuse of tools, using damaged or badly maintained tools and equipment, not following laid-down maintenance procedures) and how to minimise these and reduce any risks
10. the importance of wearing protective clothing and other appropriate safety equipment during maintenance process
11. how to obtain and interpret drawings, specifications, manufacturers' manuals and other documents needed in the maintenance process
12. the procedure to be adopted to establish the background of the fault
13. how to evaluate various types of information available for fault diagnosis (such as operator reports, monitoring equipment, sensory information, machinery history records and condition of end product)
14. 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, function testing, unit substitution, injection and sampling techniques, and equipment self diagnostics)
15. how to use a range of fault diagnostic equipment to investigate the problem (such as measuring devices, torque and run-out devices)
16. how to use various items of test equipment, and how to calibrate it and check

that it is free from damage and defects
17. how to evaluate sensory information (sight, sound, smell, touch)
18. the procedure(s) to be followed for investigating the faults, and how to deal with intermittent faults
19. how to analyse and evaluate possible characteristics and causes of specific faults/problems
20. how to relate previous reports/records of similar fault conditions
21. how to evaluate the likely risk of running the equipment with the displayed fault, and the effects the fault could have on health and safety, and on the overall process or system
22. the procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance activities
23. company policy on repair/replacement of components during the maintenance process
24. the sequence to be adopted for the dismantling/re-assembly of various types of assemblies
25. the methods and techniques used to dismantle/assemble mechanical equipment (such as release of pressures/force, proof marking, extraction, pressing, alignment)
26. methods of checking components are fit for purpose, and how to identify defects and wear characteristics
27. the basic principles of how the equipment functions, operation sequence, the working purpose of individual units/components and how they interact
28. the identification, application, fitting and removal of different types of bearings (such as roller, ring, thrust)
29. methods and techniques of fitting keys and splined components
30. identification, application, fitting and removal of different types of gears
31. how to correctly tension belts and chains
32. the identification and application of different types of locking devices
33. methods of checking that removed components are fit for purpose, and the need to replace `lifed' items (such as seals, gaskets, belts)
34. the uses of measuring equipment (such as micrometers, verniers, run-out devices, other measuring devices)
35. how to make adjustments to components/assemblies to ensure they function correctly (such as setting working clearance, setting travel, setting backlash in gears, preloading bearings)
36. the importance of making `off-load' checks before running the equipment under

power

37. how to check tools and equipment are free from damage or defects, are in a safe and usable condition, and are configured correctly for the intended purpose
38. the importance of maintenance documentation and/or reports following the maintenance activity, and how to generate them
39. the equipment operating and control procedures to be applied during the maintenance activity
40. how to use lifting and handling equipment in the maintenance activity
41. the problems associated with the maintenance activity, and how they can be overcome
42. the organisational procedure(s) to be adopted for the safe disposal of waste of all types of materials
43. how to conduct a systematic plan, do, check, act (PDCA) approach to problem-solving and business improvement
44. how to evaluate improvement ideas in order to select those that are to be pursued
45. how improvements to the process are achieved by engaging the knowledge and experience of the people working on the process
46. how to create or update Standard Operating Procedures (SOP's) maintenance schedules and plans
47. the techniques required to communicate information using visual control systems (such as, card systems, colour coding, floor footprints, graphs and charts, team boards, tool/equipment shadow boards)
48. the extent of your own authority and to whom you should report if you have a problem that 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.

Collect evidence regarding the fault from three of the following sources:

1.1 person or operator who reported the fault
1.2 sensory input (such as sight, sound, smell, touch)
1.3 monitoring equipment or gauges
1.4 plant/machinery records
1.5 recording devices
1.6 condition of end product

2.

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

2.1 half-split technique
2.2 emergent sequence
2.3 unit substitution
2.4 input/output
2.5 function/performance testing
2.6 six point technique
2.7 injection and sampling
2.8 equipment self diagnostics

3.

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

3.1 manufacturer's manual
3.2 physical layout diagrams
3.3 algorithms
3.4 flow charts
3.5 probability charts/reports
3.6 fault analysis charts (such as fault trees)
3.7 equipment self diagnostics
3.8 trouble shooting guides

4.

Apply two of the following monitoring or testing procedures to help in the fault diagnosis:

4.1 alignment checks
4.2 force/pressure checks (such as spring pressure, hydraulic or pneumatic pressures)
4.3 leakage
4.4 vibration
4.5 thermal checks (such as bearings, friction surfaces)
4.6 movement checks (such as travel, clearance, levers, links)

5.

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

5.1 measuring instruments/devices
5.2 thermal indicators
5.3 dial test indicators
5.4 audio test devices
5.5 torque measuring devices
5.6 self-diagnostic equipment
5.7 other specific test equipment

6.

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

6.1 intermittent problem
6.2 partial failure/out-of-specification output
6.3 complete breakdowns

7.

Carry out all of the following during the maintenance activity:

7.1 obtain and use the correct issue of company and/or manufacturer's drawings and maintenance documentation
7.2 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
7.3 ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
7.4 provide and maintain safe access and working arrangements for the maintenance area
7.5 carry out the maintenance activities using appropriate techniques and procedures
7.6 re-connect and return the system to service on completion of activities
7.7 dispose of waste items in a safe and environmentally acceptable manner and leave the work area in a safe condition

8.

Carry out maintenance activities on three of the following types of equipment:

8.1 gearboxes
8.2 machine tools
8.3 lifting and handling equipment
8.4 processing plant
8.5 production plant
8.6 engines
8.7 pumps
8.8 process control valves
8.9 compressors
8.10 transfer equipment
8.11 mechanical structures
8.12 workholding devices
8.13 company-specific equipment

9.

Carry out six **of the following maintenance techniques, as applicable to the equipment being maintained:

9.1 dismantling equipment to unit/sub-assembly level
9.2 dismantling units to component level
9.3 proof marking/labelling of components
9.4 checking components for serviceability
9.5 replacing all lifed items (such as seals, bearings, gaskets)
9.6 replacing damaged/defective components
9.7 setting, aligning and adjusting replaced components
9.8 tightening fastenings to the required torque
9.9 making 'off-load' checks before starting up
9.10 replenishing oils and greases
9.11 safety system checks
9.12 functionally testing the completed system

10.

Replace/refit a range of mechanical components, to include ten of the following:

- 10.1 shafts
- 10.2 couplings
- 10.3 gears
- 10.4 clutches
- 10.5 valves and seats
- 10.6 pistons
- 10.7 splined components
- 10.8 brakes
- 10.9 bearing and seals
- 10.10 fitting keys
- 10.11 springs
- 10.12 diaphragms
- 10.13 cams and followers
- 10.14 chains & sprockets
- 10.15 pulleys and belts
- 10.16 levers and links
- 10.17 slides
- 10.18 rollers
- 10.19 tooling
- 10.20 fluid storage units
- 10.21 fabricated components
- 10.22 wire ropes/cables
- 10.23 housings
- 10.24 actuating mechanisms
- 10.25 structural/operational components
- 10.26 locking & retaining devices (such as circlips, pins, lock nuts)
- 10.27 covers and casings
- 10.28 integrated modules
- 10.29 other specific components

11.

Identify and implement improvements in the services provided by the maintenance team to include two **of the following:

- 11.1 equipment downtime during maintenance
- 11.2 equipment performance monitoring systems
- 11.3 overall equipment effectiveness (OEE)
- 11.4 maintenance procedures
- 11.5 operator instructions
- 11.6 visual management systems/documentation
- 11.7 resource planning
- 11.8 costs
- 11.9 staff development and training
- 11.10 health and safety
- 11.11 procurement
- 11.12 other specific improvement

12.

Maintain mechanical equipment which complies with three of the following:

12.1 organisational guidelines and procedures
12.2 equipment manufacturer's operating specification/range
12.3 British, European or International standards or directives
12.4 recognised compliance agency/body standards or directives
12.5 health, safety and environmental requirements
12.6 customer standards and requirements

13.

Complete the relevant maintenance documentation to include one from the following:

13.1 job cards
13.2 permit to work/formal risk assessment and/or sign-on/off procedures
13.3 maintenance log or report
13.4 company-specific recording system

## 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

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