Level 3 NVQ in Engineering Maintenance (1688)

National Occupational Standards and Assessment Requirements

Qualification Handbook
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Foreword

This document provides details of the requirements specific to this N/SVQ qualification which includes:
• the requirements for occupational competence for all those involved in assessing performance
• specific assessment requirements and
• the National Occupational Standards.

It is designed to be used in conjunction with the following documents: the N/SVQ Candidate Guide and Logbook and the N/SVQ Centre Guide.

The guide does not contain details of centre and scheme approval – these may be found in the document: ‘Providing City and Guilds qualifications’ (stock code EN-00-1111) available free of charge from the Sales Department or your regional/national City & Guilds office (see Further information section of this document).

Details of general regulations, registration and certification procedures, including fees, also on City & Guilds web site http://www.city-and-guilds.co.uk

The following documents also include information on policy and guidance on quality assurance within NVQs and assessors and verifiers should be aware of the contents.
• City & Guilds policy document ‘Ensuring Quality’ – aimed at those involved in the assessment and verification of City & Guilds awards. Issued 3-4 times a year (available from Sales Department) NB Edition 12 – December 2001 summarises policy from all previous editions
• Joint Awarding Body Guidance on Internal Verification of NVQs, issued November 2001, published by the DfES, also available on City & Guilds web site.
General NVQ information

Centres should refer to the City & Guilds Centre Guide for NVQs, for information on NVQs, the people involved, the assessment process and model recording forms.
Scheme information

Scope of the award
NVQs for the engineering sector are work-based qualifications designed to reflect the roles and responsibilities of personnel within the sector.

This level 3 award is based on a mandatory and optional unit structure. The mandatory units cover those areas which have a common approach such as safety, engineering communications and team working. The optional units are combined into ‘pathways’ which offer a choice to meet the needs of the main occupational patterns within typical maintenance organisations.

National Occupational Standards and Key Skills
The full National Occupational Standards and Key Skills mapping are enclosed within this document. Centres may access whichever units are appropriate to their requirements.

Restrictions on entry
There are no restrictions on entry to this award, however candidates should not register for this award if they hold or are registered with City & Guilds or another awarding body for a similar award at the same level.
The award

The Level 3 NVQ in Engineering Maintenance consists of 59 units. All candidates must take the FOUR core units plus a specified number of optional units from one of the ten occupational pathways to achieve the award. Additional units may be taken, for which the candidate will receive a Certificate of Unit Credit.

The certificates referred to in this guide are as follows:

- Level 3 NVQ in Engineering Maintenance (Mechanical)
- Level 3 NVQ in Engineering Maintenance (Electrical)
- Level 3 NVQ in Engineering Maintenance (Electronic)
- Level 3 NVQ in Engineering Maintenance (Fluid power)
- Level 3 NVQ in Engineering Maintenance (Engineered systems)
- Level 3 NVQ in Engineering Maintenance (Services maintenance)
- Level 3 NVQ in Engineering Maintenance (Lift servicing)
- Level 3 NVQ in Engineering Maintenance (Lift repair)
- Level 3 NVQ in Engineering Maintenance (Escalator repair and service)
- Level 3 NVQ in Engineering Maintenance (Communication electronics)
- Level 3 NVQ in Engineering Maintenance (Servicing medical equipment)

The Units have been contextualised by SEMTA from the National Engineering Competency Standards (ECS).
Qualification structure
Level 3 Engineering Maintenance

Mandatory units for all pathways
Unit 1: Complying with Statutory Regulations and Organisational Safety Requirements
Unit 2: Using Engineering Drawings and Documents in Maintenance Activities
Unit 3: Working Efficiently and Effectively in Engineering
Unit 4: Handing Over and Confirming Completion of Maintenance Activities

Pathways

1 Mechanical
Must cover the following units:
Unit 5: Carrying Out Fault Diagnosis on Mechanical Equipment
Unit 6: Maintaining Mechanical Equipment

Plus two more units from the following:
Unit 7: Restoring Mechanical Components to Usable Condition by Repair
Unit 8: Producing Replacement Components for Maintenance Activities
Unit 9: Carrying Out Planned Maintenance on Mechanical Equipment
Unit 10: Carrying Out Condition Monitoring on Plant and Equipment

2 Electrical
Must cover the following units:
Unit 11: Carrying Out Fault Diagnosis on Electrical Equipment and Circuits
Unit 12: Maintaining Electrical Equipment
Unit 13: Modifying or Rewiring Electrical Circuits

Plus two more units from the following:
Unit 14: Testing Electrical Equipment and Circuits
Unit 15: Carrying Out Planned Maintenance on Electrical Equipment
Unit 10: Carrying Out Condition Monitoring on Plant and Equipment

3 Electronic
Must cover all of the following units:
Unit 16: Carrying Out Fault Diagnosis on Electronic Equipment and Circuits
Unit 17: Testing Electronic Equipment and Circuits
Unit 18: Repairing Electronic Equipment

4 Fluid power
Must cover the following units:
Unit 19: Carrying Out Fault Diagnosis on Fluid Power Equipment and Circuits
Unit 20: Maintaining Fluid Power Equipment

Plus two more units from the following:
Unit 21: Carrying Out Planned Maintenance Activities on Fluid Power Equipment
Unit 10: Carrying Out Condition Monitoring on Plant and Equipment
Unit 22: Testing Fluid Power Equipment and Systems
5 Engineered Systems
Must cover the following unit:
Unit 23: Carrying Out Fault Diagnosis on Engineered Systems

Plus two more units from the following:
Unit 24: Maintaining Mechanical Equipment within an Engineered System
Unit 25: Maintaining Electrical Equipment within an Engineered System
Unit 26: Maintaining Fluid Power Equipment within an Engineered System
Unit 27: Maintaining Process Controller Equipment within an Engineered System

Plus one more unit from the following:
Unit 28: Carrying Out Planned Maintenance on Engineered Systems
Unit 10: Carrying Out Condition Monitoring on Plant and Equipment

6 Services Maintenance
Must complete the following units:
Unit 29: Reading and Extracting Information from Service Drawings and Specifications
Unit 30: Carrying Out Fault Diagnosis on Services and Systems

Plus two more units from the following:
Unit 31: Maintaining Fresh Water Distribution Systems and Equipment
Unit 32: Maintaining Waste/Foul Water Distribution Systems and Equipment
Unit 33: Maintaining Workplace Environmental Control Systems
Unit 34: Maintaining Emergency Power Generation Equipment
Unit 35: Maintaining Heating and Ventilation Systems
Unit 36: Maintaining Air Conditioning and Ventilation Systems
Unit 37: Maintaining Gas Distribution Systems and Equipment
Unit 38: Maintaining Compressed Air Systems and Equipment
Unit 39: Maintaining Process Control Systems
Unit 40: Maintaining Instrumentation and Control Systems
Unit 41: Maintaining Industrial Refrigeration Equipment
Unit 42: Maintaining Environmental Control Equipment

Plus one more unit from the following:
Unit 43: Carrying Out Planned Maintenance on Services Systems and Equipment
Unit 10: Carrying Out Condition Monitoring on Plant and Equipment

7 Lift Servicing
Must complete all of the following units:
Unit 44: Carrying Out Fault Diagnosis on Lifts
Unit 45: Inspecting and Servicing Lift Equipment
Unit 46: Checking Lift Function
Unit 47: Rectifying Faults in Lifts

8 Lift Repair
Must complete all of the following units:
Unit 44: Carrying Out Fault Diagnosis on Lifts
Unit 46: Checking Lift Function
Unit 47: Rectifying Faults in Lifts
Unit 48: Repairing/Replacing Lift Doors, Chains and Ropes

9 Escalator Repair and Service
Must complete all of the following units:
Unit 49: Carrying Out Fault Diagnosis on Escalators
Unit 50: Rectifying Faults in Escalators
Unit 51: Inspecting and Servicing Escalators
Unit 52: Testing and Reinstating Escalator Installations
10 Communication Electronics
Must cover one of the following units:
Unit 16: Carrying Out Fault Diagnosis on Electronic Equipment and Circuits
Unit 53: Carrying Out Fault Diagnosis on Communication Electronic Systems

Plus two more units from the following:
Unit 17: Testing Electronic Equipment and Circuits
OR (but not both)
Unit 54: Testing Communication-Electronic Systems
Unit 18: Repairing Electronic Equipment
OR (but not both)
Unit 55: Repairing Communication-Electronic Systems
Unit 56: Carrying Out Planned Maintenance on Communication-Electronic Systems
Unit 57: Modifying Communication-Electronic Systems
Unit 58: Configuring Communication-Electronic Systems
Unit 59: Installing Communication-Electronic Systems

11 Servicing Medical Equipment
Must complete the following units:
Unit 060: Carrying out fault diagnosis on medical equipment
Unit 061: Testing medical equipment
Unit 062: Carrying out scheduled servicing on medical equipment

Plus three more from the following units:
Unit 063: Servicing cardiovascular equipment
Unit 064: Servicing physiological monitoring and infusion equipment
Unit 065: Servicing anaesthetic and ventilation equipment
Unit 066: Servicing operating theatre and surgical equipment
Unit 067: Servicing medical imaging equipment
Unit 068: Servicing laboratory equipment
Unit 069: Servicing dental equipment
Unit 070: Servicing medical therapeutic equipment
Unit 071: Servicing mechanical and electromechanical assistive technology equipment
Unit 072: Maintaining medical device & surgical instrument decontamination equipment
Unit 073: Maintaining medical gas pipeline systems and equipment
Assessment requirements for awards within the Engineering Sector

Introduction
The purpose of the assessment strategy is to
• assist assessors, internal verifiers and external verifiers
• encourage and promote consistent assessment of the qualification
• promote cost effective assessment strategies
• promote the use of external quality control of assessment methods
• The assessment strategy also specifies
• the qualifications and experience required for assessors and verifiers
• the assessment environment and standard of equipment that should be used
• access to the qualification
• the evidence required to support competent performance against the standards
• carrying out assessments
• assessing knowledge and understanding

Section A General Requirements
The assessment strategy for City and Guilds awards based on SEMTA units is detailed below. It applies throughout the standards and must be used as the basis for all individual assessments.

In the implementation of all SEMTA standards, reference should be made back to this strategy when specifying the assessment requirements for each unit or element of competence. The internal and external verifier will seek evidence that the requirements have been fulfilled by candidates and assessors at all times.

Scope of the award
Evidence of competence must be assessed against the requirements of the relevant National Occupational Standards. For this award, the relevant standards are contextualised versions of the Engineering Competence Standards (ECS).

Qualification structure
The qualification structure for this award requires candidates to complete common mandatory units, followed by a choice of pathways. Candidates may then be required to complete further mandatory units within their chosen pathway, followed by a number of optional units from a provided selection. The range of optional units allows for any variations in the occupation in different organisations and across the sector.

Assessor requirements
Assessment must be carried out by competent assessors who hold, or are working towards, the nationally recognised Assessor units (A1/A2) (formerly D32/D33).
Assessors must be able to demonstrate that they have sufficient technical competence to evaluate and judge evidence for this award. This will be demonstrated either by holding a relevant technical qualification or by proven suitable experience of the technical areas to be assessed. The assessor’s competence must, at the very least, be at the same level as that required of the candidate(s) in the units being assessed.

Specific technical requirements for assessors of this qualification are outlined on page 16.
Assessors must also know:

- the content and meaning of the National Occupational Standards against which assessments are to be carried out
- the appropriate Regulatory Body's system of vocational qualifications
- the relevant Awarding Body's documentation and system of vocational qualifications within which the assessment is taking place.

Verifier requirements

Internal Verifiers must hold, or be working towards, the nationally recognised Internal Verifier unit (V1) (formerly D34), and would be expected to be familiar with, and preferably hold, the nationally recognised Assessor units.

External Verifiers must hold, or be working towards, the nationally recognised External Verifier unit (V2) (formerly D35), and would be expected to be familiar with, and preferably hold, the nationally recognised Assessor units, and possibly even the nationally recognised Internal Verifier unit.

Verifiers, both internal and external, will also be expected to be fully conversant with the standards against which the assessments and verification are to be carried out, the appropriate Regulatory Body's system of vocational qualifications, and the relevant Awarding Body's documentation and system of vocational qualifications within which the assessment and verification is taking place.

Additionally verifiers, both internal and external, should be technically familiar with the skill area being verified.

Specific technical requirements for verifiers of this qualification are outlined on page 16.

Witness testimony

Where observation of process is used to obtain the performance evidence, this observation must be carried out against the standards. Best practice would require that such observation is carried out by a qualified assessor. If this is not practicable then alternative sources of evidence may be used. For example, the observation may be carried out against the standards by someone else in close contact with the candidate. This could be a supervisor, colleague, mentor or manager, who may be regarded as a suitable witness to the candidate's competency. However, the witness must be technically competent in the process or skills that they are providing testimony for to at least the same level of expertise as that required of the candidate. It will be the responsibility of the assessor to make sure that any witness testimonies accepted as evidence of a candidate's competency are reliable and technically valid.

Assessment environment

Evidence for this award should be obtained from the working environment where the work activities or work outcomes to be assessed are clearly attributable to the candidate. However, in certain circumstances, replication of work activities may be acceptable.

Where replication is considered necessary, assessors must be confident that the environment replicates the workplace to such an extent that competencies gained will be fully transferable to the workplace. In this case assessors must clearly identify those aspects of the workplace that are critical to performance, and make sure that they have been replicated satisfactorily. Where replication is involved, assessors must obtain agreement with internal and external verifiers before assessing any candidates.

Examples of critical aspects could be:

- environmental conditions such as, noise levels, lighting conditions and the presence of hazards
- the use of industrial equipment and procedures
- pressure of work such as time constraints and repetitive activities
- carrying out work on actual work pieces and the consequences of making mistakes
- customer/supplier/departmental relationships
**Access to assessment**
There are no entry qualifications or age limits required for these qualifications unless this is a legal requirement of the process or the environment. Assessment is open to any candidate who has the potential to reach the standards laid down for this qualification. However centres should refer to the statement on access to assessment in the City & Guilds Centre Guide for NVQs on not entering for similar awards at the same level.

Aids or appliances which are designed to alleviate disability may be used during assessment providing they do not compromise the standard required.

**Carrying out assessments**
SEMTA strongly recommends that the majority of assessment evidence for the mandatory units is gathered during the performance of the optional units. Evidence should be obtained as a whole, where practically possible, since competent performance in the optional units is often dependent on competence in the mandatory units. Although it is possible to achieve this qualification with the minimum number of optional units, organisations may wish their candidates to be assessed for more than this.

Where key skills are required, these may be included as additional units and assessed in conjunction with the mandatory and optional units, where this is appropriate.

The standards were developed to cover a range of activities. The evidence produced for this award will, therefore, depend on the candidate's choice of 'scope' items in the standard, which are intended to help the candidate to seek the appropriate information and to acquire the necessary skills, techniques and knowledge before being able to demonstrate competent performance.

Where the scope section gives a choice (for example 'any three from five'), assessors should note that candidates do not need to cover the other (in this example, two) items, particularly where these additional items may relate to other activities or methods which are not part of the candidate's normal workplace activity or area of expertise.

**Performance evidence requirements**
Performance evidence must be the main form of evidence gathered.

In order to demonstrate consistent, competent performance for a unit, a minimum of three different evidence examples of performance evidence will be required, to show that the tasks reflected by the unit title have been carried out to the stated standards. The number of items required in each of the scope statements specified for a unit (eg. four from a choice of six) must all be covered. It is possible that some of the scope items may be covered more than once. If, however, the three examples of performance evidence are not sufficient to cover all the specified scope items, then further examples of performance evidence will be required to ensure this coverage is achieved.

Assessors must make sure that the evidence provided reflects the candidate's competence and not just the achievement of the training programme.

Items of performance evidence often contain features that apply to more than one unit, and can be used as evidence in any unit where appropriate.

Performance evidence may be either:
- products of the candidate's work, such as items that have been produced or worked on, documents produced as part of a work activity, records or photographs of the product
- or
- evidence of the way the candidates carried out the activities such as witness testimonies, assessor observations or authenticated candidate reports of the activity undertaken

Competent performance is more than just carrying out a series of individual set tasks. Many of the units contain statements that require the candidate to provide evidence that proves they are capable of combining the various features and techniques. Where this is the case, separate fragments of evidence would not provide this combination of features and techniques and will not, therefore, be acceptable as demonstrating competent performance.
If there is any doubt as to what constitutes suitable evidence, the external verifier should be consulted.

Assessing knowledge and understanding
Knowledge and understanding are key components of competent performance, but it is unlikely that performance evidence alone will provide enough evidence in this area. Where the candidate's knowledge and understanding (and the handling of contingency situations) is not apparent from performance evidence, it must be assessed by other means and be supported by suitable evidence.

Knowledge and understanding can be demonstrated in a number of different ways, but it is suggested that the most appropriate methods for this qualification are oral questioning and practical demonstrations. Assessors should ask enough questions to be able to determine that the candidate has an appropriate level of knowledge and understanding as required by the unit.

Where oral questioning is used the assessor must retain a record of the questions asked, together with the candidate's answers.

Section B Qualification-Specific Requirements for the Level 3 N/SVQ in Engineering maintenance

Scope of the award
This qualification is for people who are occupied in an engineering mechanical manufacturing activity and who have a high level of technical skill and knowledge in that activity. They will be expected to demonstrate safe working practices and procedures at all times and work with minimum supervision, taking personal responsibility for the quality and accuracy of the work they carry out.

Candidates for this qualification will have gained a high level of skill ability and acquired sound knowledge and understanding of the relevant techniques, materials, tools and equipment used, in order to enable them to carry out the activities, solve related problems, correct any faults and ensure the work output meets the required specification standard.

Specific technical requirements for assessors
Assessors of this qualification should have a minimum of three years’ relevant skills experience, and should have a thorough working knowledge of the processes, techniques and procedures that are used within the mechanical engineering industry.

Competence in the specific areas covered by the unit being assessed is essential.

Specific technical requirements for verifiers
Verifiers should have some relevant skills experience, and should have held a position of engineering responsibility, preferably within the mechanical sector. They should have sufficient technical knowledge to enable them to verify that assessments have been carried out to the technical and safety standards required, and to be able to ask relevant questions of assessors or candidates, if deemed necessary.

Specific evidence requirements
Candidates must carry out at least three separate assessment tasks. The unit guidance and scope for each unit indicate in detail what evidence is required. There is a specific Unit Checklist provided for each unit in this guide.

Completing the unit checklists The candidate must carry out at least three separate assessment tasks. The location of all items of evidence, that must cover all of the criteria given in the standards, should be entered on the checklist provided after each unit under the ‘Performance Evidence’ columns. These locations must be identified in a way that allows the verifiers (internal and external) to easily trace and audit the evidence eg Page 6 – could refer to the position in the portfolio of the inspection sheet covering a task. Drawing 1 could provide the specification for the same task. Also Job 1234 could refer to an actual product.
Note that it may not be possible to cover all of the required criteria by completing three tasks. In such cases supplementary work may be needed to cover this shortfall, this will be referenced in the fourth column.

In addition to the unit checklist, the required evidence must also contain

- Actual product evidence where practical – eg taking into account its weight, size and or if it is an actual production item for customer use. Photographs or videos may be used in lieu provided they show the skill areas in sufficient detail for the verifiers (internal and external) to make a decision regarding the practical standards achieved
- A work sheet (company or centre devised) that clearly lays down the required product specification in terms of materials, tolerances and any time restrictions plus a drawing.
  
  Note
  
  i.  it is not necessary for the candidate to personally reproduce drawings, method descriptors etc. unless these items do not exist.
  
  ii.  in cases of industrial confidentiality or sensitivity then it may be permissible to exclude certain items from the evidence, but a description of the general nature of the work/activity must be provided. In cases of doubt the EV should be consulted about the validity of a proposed assessment before the candidate commences any such work.
- An inspection sheet or report that clearly identifies that the product has been reliably tested against the specification. If there are any discrepancies of a non-critical nature then the assessment may be deemed acceptable provided there is a statement to this effect signed by a duly appointed and responsible person.
- A brief report, prepared by the candidate, that identifies any hazards or difficulties associated with the work and how these were dealt with. It should also highlight any specific requirements or special skill areas that were involved eg non standard tools, tool and work holding methods (use of jigs and fixtures etc.) Note that where relevant some aspects of this could also form part of the required knowledge evidence.

Knowledge evidence
Where the required knowledge and understanding cannot be obviously and positively inferred from an assessor or expert witness observing the practical tasks, then the candidate must be formally questioned using either short written answer or oral types of questions. The questions should only relate to the specific areas defined by the criteria for this unit. eg if only AC equipment is used then the questions should not ask for setting details etc. of DC equipment. (Note that this knowledge may well form part of an all round underpinning knowledge programme but in such cases it would be assessed separately).

Assessors must carefully plan all types of questioning procedures beforehand. The actual questions (oral and written) must be kept under secure conditions and only made available to the candidates during the assessment process. The candidates will retain a copy of their results, including comments made by the assessor during oral questioning. (See the separate information section regarding the use of oral questioning techniques).

Assessors must make the questions available to verifiers so that the latter can compare them against the results sheets held by the candidates.

The knowledge evidence should be referenced in a similar fashion to that used for performance evidence.

Note that it is not necessary to assess the knowledge criteria on three separate occasions
## Level 3 NVQ in Engineering Maintenance
### Knowledge evidence recording sheet

(this should be copied for each unit)

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## Engineering sector progression routes

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**ENTRY LEVEL**
National occupation standards and assessment record sheets – Level 3 Engineering maintenance

Standards supplied by SEMTA
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Unit 1
Complying with statutory regulations and organisational safety requirements

Unit summary
This unit identifies the competencies you need to deal with statutory and organisational safety requirements in accordance with approved regulations, codes of practice and procedures. You will be required to comply with all relevant regulations that apply to your area of work as well as your general responsibilities as defined in the Health and Safety at Work Act. You will also need to be able to identify the relevant qualified first aiders or appointed person and know the location of the first aid facilities. You will have an understanding of the procedures to be adopted in the case of accidents involving injury and in situations where there are dangerous occurrences or hazardous malfunctions of equipment, processes or machinery. You will also need to be fully conversant with the organisation's procedures for fire alerts and the evacuation of premises.

You will also be required to identify the hazards and risks that are associated with your job. Typically these will focus on your working environment, the tools and equipment that you use, materials and substances that you use and working practices that do not follow laid down procedures, and manual lifting and carrying techniques.

Your responsibilities will require you to comply with organisational policy and procedures for the Statutory Regulations and organisational safety activities undertaken and to report any problems with the safety activities that you cannot personally resolve, or are outside your permitted authority, to the relevant people. You will be expected to work with minimum supervision, taking personal responsibility for your own actions and the way in which you carry out the required engineering activities.

Your underpinning knowledge will provide a good understanding of your work, and provide an informed approach to applying Statutory Regulations and organisational safety requirements and procedures. You will understand the safety requirements and their application, and will know about the safety requirements in adequate depth to provide a sound basis for carrying out the activities safely and correctly.
Unit 1
Complying with statutory regulations and organisational safety requirements

Performance statements:
You must:

a. Comply with your duties and obligations as defined in the Health and Safety at Work Act
b. Present yourself in the workplace suitably prepared for the activities to be undertaken
c. Follow organisational accident and emergency procedures
d. Recognise and control hazards in the workplace
e. Use correct manual lifting and carrying techniques
f. Apply safe working practices and procedures

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:

1. Demonstrate your understanding of your duties and obligations to health and safety by carrying out all of the following:
   - apply in principle your duties and responsibilities as an individual under the Health and Safety at Work Act and relevant current legislation
   - identifying within your organisation, appropriate sources of information and guidance on health and safety issues, to include:
     - Eye protection and personal protective equipment
     - COSHH regulations
     - Risk assessments
   - identifying the warning signs and labels of the main groups of hazardous or dangerous substances
   - complying with the appropriate Statutory Regulations at all times

2. Comply with all emergency requirements to include:
   - identifying the appropriate qualified first aiders or appointed person and the location of first aid facilities
   - identifying the procedures to be followed in the event of injury to self or others
   - following organisational procedures in the event of fire and the evacuation of premises
   - identifying the procedures to be followed in the event of dangerous occurrences or hazardous malfunctions

3. Identify the hazards and risks that are associated with all of the following:
   - your working environment
   - the tools and equipment that you use
   - materials and substances that you use
   - using working practices that do not follow laid down procedures

4. Demonstrate two methods of manual lifting and carrying techniques:
   - lifting alone
   - with assistance of others
   - with mechanical assistance
5 Apply safe working practices in an industrial environment to include all of the following:
   • maintaining a tidy workplace with exits and gangways free from obstructions
   • using tools and equipment safely and only for the purpose intended
   • observing organisational safety rules, signs and hazard warnings
   • taking measures to protect others from harm by any work you are carrying out

Knowledge statements:
You must have knowledge and understanding of:
1. The roles and responsibilities of yourself and others under the Health and Safety at Work Act 1974 and current legislation (e.g. The Management of Health and Safety at Work Regulations; Workplace Health and Safety and Welfare Regulations; Personal Protective Equipment at Work Regulations; Manual Handling Operations Regulations; Provision and use of Work Equipment Regulations; Display Screen at Work Regulations)
2. The specific regulations and safe working practices and procedures that apply to your work activities
3. The warning signs for the seven main groups of hazardous substances defined by Classification, Packaging and Labelling of Dangerous Substances Regulations
4. How to locate relevant health and safety information for your tasks and the sources of expert assistance when help is needed
5. What constitutes a hazard in the workplace (such as moving parts of machinery, electricity, slippery and uneven surfaces, dust and fumes, handling and transporting, contaminants and irritants, material ejection, fire, working at height, environment, pressure/stored energy systems, volatile or toxic materials, unshielded processes)
6. What are your responsibilities for dealing with hazards and reducing risks in the workplace (such as hazard spotting and safety inspections; the use of hazard check lists, carrying out risk assessments, COSHH assessments and safe systems of working)
7. What are the risks associated with your working environment, the tools, materials and equipment that you use, spillages of oil and chemicals, not reporting accidental breakages of tools or equipment and not following laid down working practices and procedures
8. What first aid facilities exist within your work area and within the organisation in general and the procedures to be followed in the case of accidents involving injury
9. What constitutes dangerous occurrences and hazardous malfunctions and why these must be reported even when no one was injured
10. The procedures for sounding the emergency alarms, evacuation procedures and escape routes to be used and the need to report your presence at the appropriate assembly point
11. What the organisational policy is with regard to fire fighting procedures, the common causes of fire and what you can do to help prevent them
12. What protective clothing and equipment is available for your areas of activity
13. How to safely lift and carry loads and the manual and mechanical aids available
14. How to prepare and maintain safe working areas, standards and procedures to ensure good housekeeping
15. The importance of safe storage of tools, equipment, materials and products
16. The extent of your own authority and whom you should report to, in the event of problems that you cannot resolve
# Unit 1
Complying with statutory regulations and organisational safety requirements

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<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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**Understanding health & safety application of duties and equipment (all)**
- H & S at Work Act
- PPE
- COSHH
- risk assessments
- hazardous substances
- statutory regulations

**Comply with emergency requirements (all)**
- first aider/facilities
- injury procedures
- fire procedures
- danger/hazard procedures

**Identify environmental hazards/risks (all)**
- working environment
- tools & equipment
- materials and substances
- bad working practices

**Demonstrate manual lifting & carrying techniques (two)**
- lifting alone
- with assistance of others
- with mechanical assistance

**Apply safe working practices (all)**
- tidy workplace
- tools & equipment
- safety/hazard warnings
- protect others

Knowledge and understanding reference:

Candidate: ________________________________  Date: __________________

Assessor: ________________________________  Date: __________________
Unit 2
Using engineering drawings and documents in maintenance activities

Unit summary
This unit identifies the competencies you need to make effective use of text, numeric and graphical information by interpreting and using technical information extracted from engineering drawings, technical manuals, reference tables, specifications and charts, in accordance with approved procedures. You will be required to extract the necessary information from the various drawings and related documents in order to establish and carry out the maintenance requirements and to make valid decisions about the quality and accuracy of the equipment being maintained.

Your responsibilities will require you to comply with organisational policy and procedures for obtaining and using the drawings and related specifications. You will be expected to report any problems with the use and interpretation of the drawings and specifications that you cannot personally resolve, or are outside your permitted authority, to the relevant people. You will be expected to work with minimum 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 the types of drawings and documents used within a maintenance environment, and will provide an informed approach to applying instructions and procedures. You will be able to read and interpret the drawings and documents used and will know about the conventions, symbols and abbreviations, in adequate depth to provide a sound basis for carrying out the maintenance activities to the required specification.
Unit 2
Using engineering drawings and documents in maintenance activities

Performance statements:
You must:
a. Use the approved source to obtain the required drawings and specifications
b. Correctly interpret the drawings and specifications
c. Identify, extract and interpret the required information
d. Use the information obtained to ensure that work output meets the specification
e. Deal promptly and effectively with any problems within your control and report those which cannot be solved
f. Report any inaccuracies or discrepancies in drawings and specifications

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:
1 Use approved sources to obtain the necessary drawings and related specifications, and carry out all of the following:
   • check the currency and validity of the drawings and documents used
   • exercise care and control over the documents at all times
   • correctly extract all necessary data in order to carry out the required tasks
   • seek out additional information where there are gaps or deficiencies in the information obtained
   • report any problems found with the drawings/specifications
   • make valid decisions based on the data extracted from the documents
   • return all drawings and related documents to the approved location on completion of the work

2 Use information extracted from engineering drawings and related documentation, to include three of the following:
   • general assembly drawings
   • fluid power drawings
   • wiring/circuit diagrams
   • installation drawings
   • manufacturers' manuals
   • routing diagrams (such as piping, cables etc)
   • layout diagrams (such as schematic, block, physical, system)
   • approved sketches
   • technical illustrations

3 Use information extracted from related documentation to include two from the following:
   • maintenance log/reports
   • fault diagnosis guides
   • test schedules
   • test results
   • manufacturers' instructions
   • reference tables/charts (such as logic tables, ladder diagrams)
   • national, international and organisational standards
   • health and safety standards relating to activity (such as COSHH)
   • environmental requirements

4 Extract information that includes three of the following:
- materials or components required
- dimensions
- dismantling/assembly sequence required
- location/orientation of parts
- connections to be made
- process or treatments required
- installation requirements
- tolerances and quality requirements
- circuit characteristics (such as pressure, flow, current, voltage, speed)

Knowledge statements:

You must have knowledge and understanding of:

1. The information sources used for the drawings and specifications that you use in your work activities
2. How drawings and documents are obtained, and how to check that they are current and valid
3. How to use other sources of information to support the drawings (such as electronic component pin configuration specifications, standard reference charts for limits and fits, tapping drill reference charts, cable current carrying capacities, thread reference tables)
4. The procedures for reporting discrepancies in the drawings or documents and for reporting lost or damaged drawings/documents
5. Care and control procedures for the drawings and documents, and the importance of returning them to the designated location on completion of the work activities
6. The basic drawing conventions that are used, and why there needs to be different types of drawings
7. The types of drawings used, and how they interrelate (such as isometric and orthographic, first and third angle, assembly drawings, circuit and wiring diagrams, block and schematic diagrams)
8. Imperial and metric systems of measurement, tolerancing and fixed reference points
9. The meaning of the different symbols and abbreviations found on the drawings that you use (such as surface finish, electronic components, weld symbols, linear and geometric tolerances, pressure and flow characteristics)
10. How damage or graffiti on drawings can lead to scrapped work
11. The extent of your own responsibility, when to act on your own initiative to find, clarify and evaluate information, and whom you should report to if you have problems that you cannot resolve
# Unit 2
Using engineering drawings and documents in maintenance activities

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Unit 2
Using engineering drawings and documents in maintenance activities

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Knowledge and understanding reference:

Candidate: ____________________________ Date: ______________

Assessor: ____________________________ Date: ______________
Unit 3
Working efficiently & effectively in engineering

Unit summary
This unit identifies the competencies you need to work efficiently and effectively in the workplace, in accordance with approved procedures and practices. Prior to undertaking the engineering activity, you will be required to carry out all necessary preparations within the scope of your responsibility. This may include preparing the work area and ensuring that it is in a safe condition to carry out the intended activities, ensuring you have the appropriate job specifications and instructions and that any tools, equipment, materials and other resources required are available and in a safe and usable condition.

On completion of the engineering activity, you will be required to return your immediate work area to an acceptable condition before recommencing further work requirements. This may involve placing completed work in the correct location, returning and/or storing any tools and equipment in the correct area, identifying any waste and/or scrapped materials and arranging for their disposal, and reporting any defects or damage to tools and equipment used.

In order to be efficient and effective in the workplace, you will also be required to demonstrate that you can create and maintain effective working relationships with colleagues and line management. You will be expected to review objectives and targets for your personal development and contribute to, and communicate any opportunities for, improvements that could be made to working practices and procedures.

Your responsibilities will require you to comply with organisational policy and procedures for the engineering activities undertaken, and to report any problems with the activities, tools or equipment that you cannot personally resolve, or are outside your permitted authority, to the relevant people. You will be expected to take 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 working efficiently and effectively in an engineering environment. You will understand the need to work efficiently and effectively, and will know about the things you need to consider when preparing and tidying up the work area, how to contribute to improvements, deal with problems, maintain effective working relationships, and agree your development objectives and targets, in adequate depth to provide a sound basis for carrying out the activities safely and correctly.

You will understand the safety precautions required when carrying out engineering activities. You will be required to demonstrate safe working practices throughout, and will understand the responsibility you owe to yourself and others in the workplace.
Unit 3
Working efficiently & effectively in engineering

Performance statements:
You must:
a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Prepare the work area to carry out the engineering activity
c. Check there are sufficient supplies of materials and/or consumables and that they meet work requirements
d. Ensure completed products or resources are stored in the appropriate location on completion of the activities
e. Tidy up the work area on completion of the engineering activity
f. Deal promptly and effectively with problems within you control and report those that cannot be resolved
g. Contribute and communicate opportunities for improvement to working practices and procedures
h. Maintain effective working relationships with colleagues
i. Review personal training and development as is appropriate to the job role

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:
1 Prepare to carry out the engineering activity taking into consideration all of the following as is applicable to the work to be undertaken:
   • the work area is free from hazards and suitably prepared for the activities to be undertaken
   • any required safety procedures are implemented
   • any necessary personal protection equipment is obtained and is in a usable condition
   • tools and equipment required are obtained and checked that they are in a safe and useable condition
   • all necessary drawings, specifications and associated documentation is obtained
   • job instructions are obtained and understood
   • the correct materials or components are obtained
   • storage arrangements for work are appropriate
   • appropriate authorisation to carry out the work is obtained

2 Complete work activities to include all of the following:
   • completing all necessary documentation accurately and legibly
   • returning tools and equipment
   • returning drawings and work instructions
   • identifying where appropriate any unusable tools, equipment and components
   • arranging for disposal of waste materials
3 Contribute to organisational procedures for identifying opportunities for improvement to **one** of the following:
- working practices
- working methods
- quality
- safety
- tools and equipment
- suppliers
- internal communication
- customer service
- training and development
- teamwork other

4 Deal with problems affecting the engineering process to include **two** of the following:
- materials
- tools and equipment
- drawings
- job specification
- quality
- people
- timescales
- safety
- activities or procedures

5 Maintain effective working relationships to include **two** of the following:
- colleagues within own working group
- colleagues outside normal working group
- line management
- external contacts

6 Review personal development objectives and targets to include **one** of the following:
- dual or multi skilling
- training on new equipment / technology
- increased responsibility
- understanding of company working practices, procedures, plans and policies other specific requirements
Knowledge statements:
You must have a knowledge and understanding of:
1. The safe working practices and procedures to be followed whilst preparing and tidying up your work environment
2. The correct use of any equipment used to protect the health and safety of you and your colleagues
3. The procedure for ensuring that all documentation relating to the work being carried out is available and current prior to starting the activity
4. The action that should be taken if documentation received is incomplete and / or incorrect
5. The procedure for ensuring all tools and equipment are available prior to undertaking the activity
6. The checks to be carried out to ensure tools and equipment are in full working order prior to undertaking the activity
7. The action that should be taken if tools and equipment are not in full working
8. The checks to be carried out to ensure all materials required are correct and complete prior to undertaking the activity
9. The action that should be taken if materials do not meet the requirements of the activity
10. Who to inform when the work activity has been completed
11. The information and / or documentation they require to confirm the activity has been completed
12. What materials, equipment and tools can be re-used
13. How any waste materials and / or products are transferred, stored and disposed of
14. Where tools and equipment should be stored and located
15. The importance of making a contribution to improving working practices
16. The procedure and format for making suggestions for improvements
17. What the benefits are to you and the organisation if improvements can be identified
18. The importance of maintaining effective working relationships within the workplace
19. The procedures to deal with and report any problems that can affect working relationships
20. The type of difficulties that can occur in working relationships
21. The regulations that affect how you should be treated at work (such as Equal Opportunities Act, Race and Sex Discrimination, Working Time Directive)
22. The benefits of continuous personal development
23. The training opportunities that are available in the workplace
24. The importance of why your training and development should be reviewed
25. Who to discuss training and development issues with
26. The extent of your own responsibility and whom you should report to if you have any problems that you cannot resolve
Unit 3
Working efficiently & effectively in engineering

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<th>evidence record sheet</th>
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Working Efficiently & Effectively in Engineering

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### Maintain effective working relationships (two)
- own working group
- outside own working group
- line management
- external contacts

### Review personal development objectives (one)
- dual or multi-skilling
- new equipment/technology
- responsibility
- company working policies
- other

Knowledge and understanding reference:

Candidate: ___________________________ Date: ________________
Assessor: ___________________________ Date: ________________
Unit 4
Handing over and confirming completion of maintenance activities

Unit summary
This unit identifies the competencies you need to hand over equipment that has been repaired, or on which some form of maintenance activity has taken place, and to confirm that the equipment is now ready to return to service. Following the maintenance activity, you will be required to either set up the equipment and hand it over to another person to complete the required start-up procedures, or complete the run-up operation yourself, ensuring that the equipment is ready for operation before handover. This will involve checking that all the required equipment and safety devices are operable and correctly set and/or calibrated, and that the equipment functions safely and correctly to the required specification.

On handing over the equipment, you will be expected to highlight any unusual or changed operating features of the equipment, and to inform the appropriate person of any future maintenance requirements. You must also ensure that you receive confirmation that everyone involved in the handover accepts that the maintained equipment is in a satisfactory condition to return to service.

Your responsibilities will require you to comply with organisational policy and procedures for the handover activities undertaken, and to report any problems with the handing over procedure that you cannot personally resolve, or are outside your permitted authority, to the relevant people. You will be expected to work with minimum 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 maintenance handover procedures. You will understand the equipment being handed over, and its application, and will know about the operating procedures and potential problems, in adequate depth to provide a sound basis for carrying out the activities safely and correctly.

You will understand the safety precautions required when carrying out the maintenance activities, especially those for isolating the equipment. 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.
Unit 4
Handing over and confirming completion of maintenance activities

Performance statements:
You must:

a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Confirm that everyone involved accepts the product or asset is in a satisfactory condition for handover to take place
c. Clearly identify any unusual features of the condition of the product or asset
d. Make the handover and obtain agreement between everyone involved on the precise moment of transfer of responsibility
e. Deal promptly and effectively with problems within your control and report those that you cannot solve
f. Make sure that clear, accurate and complete records of the handover are made

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:

1. Confirm that the equipment is ready for restart by carrying out all of the following checks, as applicable to the equipment being handed over:
   • the maintenance activity has been completed and the equipment functions to specification
   • all safety systems are functioning correctly
   • any waste materials, safety barriers and warning signs have been removed
   • any auxiliary systems or equipment involved are connected and operable
   • environmental controls are operable
   • others involved in using the equipment are aware of impending restart

2. Carry out correct handover procedures for one type of equipment/service from the following:
   • manual
   • semi-automatic
   • fully automatic
   • process/control
   • computer controlled
   • engineering services
   • other specific equipment

3. Carry out all of the following during the handover procedures:
   • run the maintained equipment through a complete cycle in the presence of the appropriate person
   • confirm that the other person accepts that the equipment functions satisfactorily to specification
   • highlight to the appropriate person any modifications or unusual features in the operating procedure
   • inform the appropriate person of any future maintenance activities that may be required
   • obtain agreement from the other person that they now accept responsibility for the equipment to be returned to service
   • complete any necessary handover documentation
   • confirm the other person knows how and who to contact for future maintenance requirements
4. Carry out handover procedures to **one** of the following:
   - production/process operator
   - supervisor of production/process
   - maintenance supervisor
   - other specific person

5. Carry out the handover following **two** of the following maintenance activities:
   - breakdown
   - preventative maintenance activity
   - scheduled servicing
   - modification to equipment

6. Complete **all** relevant paperwork from the following, and pass it to the appropriate people:
   - job card
   - maintenance log or report
   - other handover paperwork

**Knowledge statements:**

You must have knowledge and understanding of:

1. The health and safety requirements of the area in which the handover is to take place, and the responsibility they place on you
17. The isolation and lock-off procedure or permit-to-work procedure that applies to the equipment being maintained
18. The specific health and safety precautions to be applied during the handover procedure, and their effects on others
19. The importance of wearing protective clothing and other appropriate safety equipment during the handover, and where it may be obtained
20. The checking process to be followed before handing over the equipment (are the safety and quality systems operable, does the equipment function to specification)
21. The appropriate handover procedure, depending on the maintenance activity carried out (repair, modification, preventative maintenance, scheduled servicing)
22. The procedure for involving the appropriate people when restarting the equipment
23. The need to highlight any unusual or changed operating features of the maintained equipment
24. The importance of informing the appropriate person of any future maintenance requirements
25. The need to confirm that the other person understands the equipment operating procedures before leaving them to return the equipment to service
26. The need to ensure that the person you are handing over the equipment to accepts that it is in a satisfactory condition
27. The organisational documentation procedures with regard to handover
28. How to create and maintain effective working relationships with appropriate people (encouraging, helping, politeness, open discussions both ways)
29. The problems that can occur during handover, and how they can be overcome
30. The extent of your own authority and whom you should report to if you have problems that you cannot resolve
## Unit 4
Handing over and confirming completion of maintenance activities

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<td>all safety systems are functioning correctly</td>
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<td>any waste materials/safety barriers/warning signs removed</td>
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<td>any auxiliary systems or equipment connected and operable</td>
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<td>others involved are aware of impending restart</td>
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<td>Carry out handover procedures for equipment/service (one)</td>
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<td>Carry out during handover (all)</td>
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<td>run maintained equipment through a complete cycle in the presence of appropriate person</td>
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<td>confirm that the other person accepts that the equipment functions satisfactorily to specification</td>
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<td>highlight to the appropriate person any modifications or unusual features in the operating procedure</td>
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# Unit 4
Handing over and confirming completion of maintenance activities

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<td>obtain agreement from the other person that they now accept responsibility for the equipment to be returned to service</td>
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<td>confirm the other person knows how and who to contact for future maintenance requirements</td>
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**Carry out handover procedures to (one)**
- production/process operator
- supervisor of production/process
- maintenance supervisor
- other specific person

**Carry out handover involving (two)**
- breakdown
- preventative maintenance activity
- scheduled servicing
- modification to equipment

**Complete relevant paperwork (all)**
- job card
- maintenance log/report
- other paperwork

Knowledge and understanding reference

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Candidate: ______________________________ Date: __________________
Assessor: ______________________________ Date: __________________
Unit 5
Carrying out fault diagnosis on mechanical equipment

Unit summary
This unit identifies the competencies you need to carry out efficient and effective fault diagnosis on mechanical equipment, in accordance with approved procedures. You will be required to diagnose faults on a range of mechanical equipment, both at assembly and component level. This will include equipment such as machine tools, gearboxes, processing plant, engines, pumps, process control valves, compressors, transfer equipment, lifting and handling equipment, mechanical structures and other company-specific equipment. You will be expected to use a variety of fault diagnosis methods and techniques, and to utilise a number of diagnostic aids and equipment. From the evidence gained, you will be expected to identify the fault and its probable cause, and to suggest action to remedy the problem.

Your responsibilities will require you to comply with organisational policy and procedures for the fault diagnostic activities undertaken, and to report any problems with these activities or the tools and equipment used, that you cannot personally resolve or are outside your permitted authority, to the relevant people. You will be expected to work with minimum supervision, taking full 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 fault diagnosis procedures on mechanical equipment. You will understand the various fault diagnosis methods and techniques used, and their application. You will also know how to apply and interpret information obtained from diagnostic aids and equipment, in adequate depth to provide a sound basis for carrying out the activities and for identifying faults or conditions that are outside the required specification.

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.
Unit 5
Carrying out fault diagnosis on mechanical equipment

Performance statements:
You must:

a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Review and use all relevant information on the symptoms and problems associated with the products or assets
c. Investigate and establish the most likely causes of the faults
d. Select, use and apply diagnostic techniques, tools and aids to locate faults
e. Complete the fault diagnosis within the agreed time and inform the appropriate people when this cannot be achieved
f. Determine the implications of the fault for other work and for safety considerations
g. Use the evidence gained to draw valid conclusions about the nature and probable cause of the fault
h. Record details on the extent and location of the faults in an appropriate format

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:
1. Carry out all the following during the fault diagnostic activity:
   • plan the fault diagnosis prior to commencement
   • use the correct issue of company and/or manufacturer’s drawings and maintenance documentation
   • adhere to risk assessment, COSHH and other relevant safety standards
   • ensure safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
   • provide safe access and working arrangements for the maintenance area
   • carry out the fault diagnostic activities using approved procedures
   • identify the fault and determine appropriate corrective action
   • dispose of waste items in a safe and environmentally acceptable manner, and leave work area in a safe condition

2. Carry out fault diagnosis on five of the following types of equipment:
   • gearboxes
   • machine tools
   • lifting and handling equipment
   • processing plant
   • engines
   • pumps
   • process control valves
   • compressors
   • workholding devices
   • transfer equipment
   • mechanical structures
   • company-specific equipment
3 Collect evidence regarding the fault from **four** of the following sources:
- person or operator who reported the fault
- monitoring equipment or gauges
- recording devices
- sensory input (such as sight, sound, smell, touch)
- plant/machinery records
- condition of end product

4 Use a range of fault diagnostic techniques to include:
- half split technique

Plus **one** more from the following:
- emergent sequence
- input/output
- six point
- unit substitution
- function testing
- injection and sampling

5 Use a variety of diagnostic aids and equipment, to include **two** of the following:
- manufacturer's manual
- algorithms
- probability charts/reports
- equipment self diagnostics
- physical layout diagrams
- flow charts
- fault analysis charts (such as fault trees)
- trouble shooting guides

6 Apply **two** of the following monitoring or testing procedures to help in the fault diagnosis:
- alignment checks
- force/pressure checks (such as spring pressure, hydraulic or pneumatic pressures)
- leakage
- vibration
- thermal checks (such as bearings, friction surfaces)
- movement checks (such as travel, clearance, levers and links)

7 Use **two** of the following types of test equipment to aid fault diagnosis:
- measuring instruments/devices
- dial test indicators
- torque measuring devices
- other specific test equipment
- thermal indicators
- audio test devices
- self diagnostic equipment

8 Find faults that have resulted in **two** of the following breakdown categories:
- intermittent problem
- partial failure/out-of-specification output
- complete breakdowns

9 Provide a record of the outcome of fault diagnosis, using **one** of the following:
- step-by-step analytical report
- preventative maintenance log/report
- corrective action report
- company-specific reporting procedure
Unit 5
Carrying out fault diagnosis on mechanical equipment

Knowledge statements
You must have knowledge and understanding of:
1. The health and safety requirements of the area in which you are carrying out the fault diagnosis activities, and the responsibility these requirements place on you
2. The specific safety precautions to be taken when carrying out fault diagnosis of the specific piece of equipment
3. The isolation and lock-off procedure or permit-to-work procedure that applies
4. The importance of wearing protective clothing and other appropriate safety equipment during the fault diagnosis activities
5. Hazards associated with carrying out fault diagnosis on mechanical equipment (moving machinery, handling oils and greases, stored pressure/force, misuse of tools, using practices or procedures that do not follow laid-down procedures), and how they can be minimised
6. Where to obtain, and how to interpret drawings, specifications, manufacturers’ manuals and other documents needed in the fault diagnosis process
7. The procedure to be adopted to establish the background of the fault
8. 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)
9. 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)
10. How to use a range of fault diagnostic equipment to investigate the problem (such as measuring devices, torque and run-out devices)
11. How to use various items of test equipment, and how to calibrate it and check that it is free from damage and defects
12. How to evaluate sensory information (sight, sound, smell, touch)
13. The procedure(s) to be followed for investigating the faults, and how to deal with intermittent faults
14. How to analyse and evaluate possible characteristics and causes of specific faults/problems
15. How to relate previous reports/records of similar fault conditions
16. 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
17. How to prepare and produce a risk analysis report (where appropriate)
18. How to prepare a report and take follow-up action which satisfies the company policy on concluding fault diagnosis
19. The extent of your own authority and whom you should report to if you have problems that you cannot resolve
# Unit 5
Carrying out fault diagnosis on mechanical equipment

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**Carry out during fault diagnosis (all)**
- plan the fault diagnosis prior to commencement
- use correct drawings and documentation
- adhere to relevant safety standards
- ensure safe isolation of equipment
- provide safe access and working arrangements
- carry out fault diagnostic activities using approved procedures
- identify fault and determine corrective action
- dispose of waste

**Carry out fault diagnosis on (five)**
- gearboxes
- machine tools
- lifting and handling equipment
- processing plant
- engines
- pumps
- process control valves
- compressors
- workholding devices
- transfer equipment
- mechanical structures
- company-specific equipment

**Collect evidence regarding fault from (four)**
- person or operator who reported the fault
- monitoring equipment or gauges
- recording devices
- sensory input
- plant/machinery records
## Unit 5
Carrying out fault diagnosis on mechanical equipment

<table>
<thead>
<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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<tbody>
<tr>
<td>use range of techniques</td>
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<td>half split</td>
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<td>plus one from</td>
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<td>emergent sequence</td>
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<td>input/output</td>
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<td>six point</td>
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<td>unit substitution</td>
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<td>function testing</td>
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<tr>
<td>injection/sampling</td>
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### Use diagnostic aids/equipment (two)
- manufacturer's manual
- algorithms
- probability charts/reports
- equipment self diagnostics
- physical layout diagrams
- flow charts
- fault analysis charts
- trouble shooting guides

### Apply monitoring/testing procedures (two)
- alignment
- force/pressure
- leakage
- vibration
- thermal
- movement

### Use test equipment to aid diagnosis (two)
- measuring instruments/devices
- dial test indicators
- torque measuring devices
- other specific test equipment
- thermal indicators
- audio test devices
- self diagnostic equipment
## Unit 5
Carrying out fault diagnosis on mechanical equipment

<table>
<thead>
<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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</thead>
<tbody>
<tr>
<td><strong>Find faults resulting in (two)</strong></td>
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<td>intermittent problem</td>
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<td>partial failure/out-of-specification output</td>
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<tr>
<td>complete breakdowns</td>
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<td><strong>Provide record of outcome of diagnosis (one)</strong></td>
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<tr>
<td>step-by-step analytical report</td>
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<tr>
<td>preventative maintenance log/report</td>
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<td>corrective action report</td>
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<tr>
<td>company-specific reporting procedure</td>
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</tbody>
</table>

Knowledge and understanding reference:

Candidate: _______________________________________________  Date: ___________________

Assessor: ________________________________________________   Date: ___________________
Unit 6
Maintaining mechanical equipment

Unit summary
This unit identifies the competencies you need to carry out corrective maintenance activities on mechanical equipment, in accordance with approved procedures. You will be required to maintain a range of mechanical equipment, such as gear boxes, pumps, machine tools, conveyor systems, workholding arrangements, engines, processing plant and equipment, and other organisation-specific 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 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 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 minimum 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 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. In addition, you will have sufficient in-depth knowledge of these components to ensure 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.
Unit 6
Maintaining mechanical equipment

Performance statements:
You must:
a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Follow the relevant maintenance schedules to carry out the required work
c. Carry out the maintenance activities within the limits of your personal authority
d. Carry out the maintenance activities in the specified sequence and in an agreed time scale
e. Report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
f. Complete relevant maintenance records accurately and pass them on to the appropriate person
g. Dispose of waste materials in accordance with safe working practices and approved procedures

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:
1. Carry out all the following during the maintenance activity:
   • plan the maintenance activities to cause minimum disruption to normal working
   • use the correct issue of company and/or manufacturer’s drawings and maintenance documentation
   • adhere to risk assessment, COSHH and other relevant safety standards
   • ensure safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
   • provide safe access and working arrangements for the maintenance area
   • carry out the maintenance activities using appropriate techniques and procedures
   • re-connect and return the system to service on completion of activities
   • dispose of waste items in a safe and environmentally acceptable manner and leave the work area in a safe condition

2. Carry out maintenance activities on five of the following types of equipment:
   • gearboxes
   • machine tools
   • lifting and handling equipment
   • processing plant
   • engines
   • pumps
   • process control valves
   • compressors
   • transfer equipment
   • mechanical structures
   • workholding devices
   • company-specific equipment
3 Carry out all of the following maintenance techniques, as applicable to the equipment being maintained:
   • dismantling equipment to unit/sub-assembly level
   • dismantling units to component level
   • proof marking/labelling of components
   • checking components for serviceability
   • replacing all lifed items (such as seals, bearings, gaskets)
   • replacing damaged/defective components
   • setting, aligning and adjusting replaced components
   • tightening fastenings to the required torque
   • making ‘off-load’ checks before starting up
   • replenishing oils and greases
   • functionally testing the completed system

4 Replace a range of mechanical components, to include twelve of the following:
   • shafts
   • couplings
   • gears
   • clutches
   • valves and seats
   • pistons
   • brakes
   • splines
   • bearing and seals
   • fitting keys
   • springs
   • diaphragms
   • cams and followers
   • chains & sprockets
   • pulleys and belts
   • levers and links
   • slides
   • rollers
   • housings
   • actuating mechanisms
   • structural components
   • locking & retaining devices (such as circlips, pins)
   • other specific components

5 Maintain mechanical equipment which complies with one or more of the following quality and accuracy standards:
   • organisational guidelines and codes of practice
   • equipment manufacturer’s operation range
   • BS and/or ISO standards

6 Complete all relevant paperwork, to include the following, and pass it to the appropriate people:
   • Job cards
   • permit to work/formal risk assessment
   • maintenance log or report


Unit 6
Maintaining mechanical equipment

Knowledge statements:
You must have knowledge and understanding of:
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. The isolation and lock-off procedures or permit-to-work procedure that applies
3. The specific health and safety precautions to be applied during the maintenance procedure, and their effects on others
4. Hazards associated with carrying out mechanical maintenance activities (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 them
5. The importance of wearing protective clothing and other appropriate safety equipment during maintenance process
6. How to obtain and interpret drawings, specifications, manufacturers’ manuals and other documents needed in the maintenance process
7. The procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance activities
8. Company policy on repair/replacement of components during the maintenance process
9. The sequence to be adopted for the dismantling/re-assembly of various types of assemblies
10. The methods and techniques used to dismantle/assemble mechanical equipment (release of pressures/force, proof marking, extraction, pressing, alignment)
11. Methods of checking components are fit for purpose, and how to identify defects and wear characteristics
12. The basic principles of how the equipment functions, operation sequence, the working purpose of individual units/components and how they interact
13. The identification, application, fitting and removal of different types of bearings (roller, ring, thrust etc)
14. Methods and techniques of fitting keys and splines
15. Identification, application, fitting and removal of different types of gears
16. How to correctly tension belts and chains
17. The identification and application of different types of locking devices
18. Methods of checking that removed components are fit for purpose, and the need to replace ‘lifed’ items such as seals and gaskets
19. The uses of measuring equipment, such as micrometers, verniers, run-out devices and other measuring devices
20. How to make adjustments to components/assemblies to ensure they function correctly (setting working clearance, setting travel, setting backlash in gears, preloading bearings)
21. The importance of making ‘off-load’ checks before running the equipment under power
22. 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
23. The importance of maintenance documentation and/or reports following the maintenance activity, and how to generate them
24. The equipment operating and control procedures to be applied during the maintenance activity
25. How to use lifting and handling equipment in the maintenance activity
26. The problems associated with the maintenance activity, and how they can be overcome
27. The organisational procedure(s) to be adopted for the safe disposal of waste of all types of materials
28. The extent of your own authority and whom you should report to when you have a problem you cannot resolve

Unit 6
Maintaining mechanical equipment

<table>
<thead>
<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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<td>evidence type</td>
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**Carry out during maintenance (all)**

- Plan maintenance activities to cause minimum disruption
- Use correct drawings and documentation
- Adhere to risk assessment, COSHH and other relevant safety standards
- Ensure safe isolation of equipment
- Provide safe access/working arrangements
- Carry out the maintenance activities using appropriate techniques and procedures
- Re-connect and return the system to service
- Dispose of waste items safely/environmentally acceptable

**Carry out maintenance on (five)**

- Gearboxes
- Machine tools
- Lifting and handling equipment
- Processing plant
- Engines
- Pumps
- Process control valves
- Compressors
- Transfer equipment
- Mechanical structures
- Workholding devices
- Company-specific equipment

**Carry out maintenance techniques (all as applicable)**

- Dismantling equipment to unit/subassembly level
- Dismantling units to component level
<table>
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<tr>
<th>evidence record sheet</th>
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<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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<tr>
<td>proof marking/labelling of components</td>
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<td>checking components for serviceability</td>
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<td>replacing all lifed items</td>
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<td>setting, aligning and adjusting replaced components</td>
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<td>tightening fastenings to required torque</td>
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<td>making 'off-load' checks before starting up</td>
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<tr>
<td>replenishing oils/greases</td>
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<td>functionally testing</td>
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<td><strong>Replace range of components (twelve)</strong></td>
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<tr>
<td>shafts</td>
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<td>clutches</td>
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<td>valves and seats</td>
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<td>pistons</td>
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<td>bearing and seals</td>
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<td>springs</td>
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<td>diaphragms</td>
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<td>cams and followers</td>
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<td>chains &amp; sprockets</td>
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<td>pulleys and belts</td>
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<td>levers and links</td>
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<td>actuating mechanisms</td>
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## Unit 6
Maintaining mechanical equipment

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<tr>
<th>evidence record sheet</th>
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<th>additional performance evidence (if required)</th>
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<tbody>
<tr>
<td>structural components</td>
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<tr>
<td>locking &amp; retaining devices</td>
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<td>other specific</td>
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**Maintain mechanical equipment to quality/accuracy standards (one)**

- BS and or ISO
- manufacturer's range
- organisational guidelines

**Complete relevant paperwork (all)**

- job cards
- permit to work
- maintenance log

Knowledge and understanding reference:

Candidate: _______________________________  Date: __________________

Assessor: _______________________________  Date: __________________
Unit 7
Restoring mechanical components to usable condition by repair

Unit summary
This unit identifies the competencies you need to restore mechanical components to usable condition by repair, in accordance with approved procedures. You will be required to restore a range of mechanical components and equipment to operational condition, by repairing assemblies/sub-assemblies and components, by reforming, reworking the surface, replacing threads or the replacement of worn parts. You will also be required to select the appropriate equipment to use, based on the nature of the repair, the operations that will need to be carried out and the accuracy to be achieved.

In producing the components, you will be expected to use a range of hand tools, machine tools, portable power tools, and shaping and fitting techniques, that are appropriate to the type of material and repair being performed. These activities will include such things as sawing (hand, band), drilling, reaming, grinding (hand or machine), filing, scraping or lapping, threading (internal or external), turning, milling, and thermal processes. Materials to be used will include ferrous, non-ferrous, non-metallic and composites, which may be in sheet form, bar sections (such as square/rectangular, round, angle), and part-machined components.

Your responsibilities will require you to comply with organisational policy and procedures for the repairing activities undertaken, and to report any problems with these activities or with the tools, equipment or materials used, that you cannot personally resolve or are outside your permitted authority, to the relevant people. You will be expected to work with minimum 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 component repair procedures. You will understand the function and operating conditions of the components being repaired, in sufficient depth to determine a suitable repair sequence and to ensure that the repairs carried out are safe and practical in operation. You will also understand the organisational policy on repairing components, and its application.

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.
Unit 7
Restoring mechanical components to usable condition by repair

Performance statements:
You must:
a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Follow the relevant specifications for the component to be repaired
c. Prepare the component for repair
d. Carry out the repairs within agreed timescale using approved materials and components and methods and procedures
e. Ensure that the repaired component meets the specified operating conditions
f. Produce accurate and complete records of all repair work carried out

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:
1. Carry out all the following activities during the maintenance activity:
   • plan the repair activities to cause minimum disruption to normal working
   • adhere to risk assessment, COSHH and other relevant safety standards
   • ensure safe isolation of equipment (such as mechanical, electricity, gas, air or fluids) provide safe access and working arrangements for the maintenance area
   • carry out the repair activities using appropriate techniques and procedures
   • record the repair using appropriate methods or documentation
   • dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition

2. Use appropriate techniques to carry out six of the following types of repair:
   • reforming component surface by adding metal
   • recondition unit by replacement of worn components
   • rework surface finish (using techniques such as filing, scraping, grinding)
   • sleeving worn components
   • making stepped dowels or studs
   • cutting new keyways
   • make temporary fix
   • bushing worn holes
   • replacement of internal thread (inserts)
   • rework fit (shimming)
   • making new or stepped keys
   • replacing damaged or missing gear teeth
   • plugging holes
   • stopping cracks running and filling them
   • other specific repair procedures
3 Use a range of methods and techniques to repair components, to include **six** of the following:

- sawing (hand, band)
- drilling
- reaming
- grinding (hand or machine)
- filing
- scrapping or lapping
- threading external
- threading internal
- turning
- milling
- thermal processes (such as brazing, welding, metal spraying)

4 Repair components made from different types of material, to include **two** from the following:

- low carbon steel
- high carbon steel
- cast iron
- aluminium
- brass/bronze
- stainless steel
- plastic/synthetic
- composite

5 Carry out repairs to mechanical equipment which complies with **one or more** of the following quality and accuracy standards:

- organisational guidelines and codes of practice
- equipment manufacturer’s operation range
- BS and/or ISO standards
Unit 7
Restoring mechanical components to usable condition by repair

Knowledge statements:
You must have knowledge and understanding of:
1. The health and safety requirements of the area in which the repairing activity is to take place, and the responsibility these requirements place on you
2. The isolation procedures or permit-to-work procedure that applies
3. The specific health and safety precautions needed to be applied during the repairing procedure, and their effects on others
4. The importance of wearing protective clothing and other appropriate safety equipment during maintenance activities
5. The hazards associated with the repair/restoration operations being carried out (sawing (hand, band), drilling, reaming, grinding (hand or machine), filing, scraping or lapping, threading (internal or external), turning, milling and thermal processes), and how they can be minimised
6. Where to obtain, and how to interpret drawings, specifications, manufacturers’ manuals, maintenance schedules and other relevant documents
7. The methods, techniques and company procedures to be followed for repairing mechanical equipment
8. The types of repairs that can be made to components in order to prolong their useful life (such as bushing worn holes, fitting thread inserts, building up surfaces by thermal process or metal spraying, making stepped keys, cutting new keyways, making stepped/oversize dowels or studs)
9. The factors to be taken into account when deciding if a repair is practical and possible (is a replacement component available, cost of replacing, safety of repair, age and condition of equipment etc)
10. The need to liaise with other departments in order to have specialised operations carried out on the components (such as thermal processes, metal spraying)
11. How to use filing, scraping and lapping to achieve the required surface finish (various types of files/scrapers, checking that file/scraper handles are in good condition, the range of lapping mediums)
12. How to cut internal and external threads (using hand dies and taps, machine cutting)
13. How to produce a sliding or mating fit, and the techniques to be adopted
14. How to select saw blades (for different materials and different operations)
15. The types and application of portable power tools that can be used for the fitting operations
16. How to check that portable power tools and extension cables are in a safe usable condition
17. How to use hand power tools and specialist equipment correctly (electrical, pneumatic, lifting equipment)
18. The operating requirements of the machine tools and accessories being used (guards, workholding devices, taper turning attachments, steadies, dividing heads, specific statutory regulations such as Abrasive Wheels Regulations)
19. The various shapes and types of tooling that can be used (solid high-speed tooling, brazed tip tooling, interchangeable tipped tooling)
20. How to handle and store tools and equipment safely and correctly
21. Factors which affect the selection of cutting feeds and speeds, and the depth of cut that can be taken (workpiece rigidity, machine condition, type of tooling being used, material type, finish and tolerance required)
22. The application of cutting fluids with regard to a range of different materials and processes
23. The techniques and implications of clamping of a workpiece in a chuck/work holding device (safely secured for the process, causing distortion in the finished components)
24. How to recognise machining faults, and how to identify when tools need re-sharpening/dressing
25. The operating requirements of the thermal processes and accessories being used (any statutory regulations and quality standards to be observed, guards, workholding devices, fume extraction, gas storage)
31. The methods that can be used to position the workpiece in relation to the cutting tools
32. The effects of backlash in the machine slides and how this can be overcome
33. The company recording procedures to be used following repair, and how to apply them
34. The problems associated with repair, and how to resolve them
35. The extent of your own authority and whom you should report to if you have problems that you cannot resolve
**Unit 7**
Restoring mechanical components to usable condition by repair

<table>
<thead>
<tr>
<th>evidence type</th>
<th>date</th>
<th>Carry out activities during the maintenance activity (all)</th>
<th>additional performance evidence (if required)</th>
</tr>
</thead>
</table>

- Evidence record sheet
- Performance evidence 1
- Performance evidence 2
- Performance evidence 3

**Plan the repair activities to cause minimum disruption**

**Adhere to risk assessment, COSHH and other relevant safety standards**

**Ensure safe isolation of equipment**

**Provide safe access and working arrangements**

**Carry out repair using appropriate techniques/procedures**

**Record the repair using appropriate methods or documentation**

**Dispose of waste safely and environmentally acceptably**

**Use appropriate techniques to carry out repairs (six)**

- Reforming component surface by adding metal
- Recondition unit by replacement of worn components
- Rework surface finish (using techniques such as filing, scraping, grinding)
- Sleeving worn components
- Making stepped dowels or studs
- Cutting new keyways
- Make temporary fix
- Bushing worn holes
- Replacement of internal thread (inserts)
**Unit 7**
Restoring mechanical components to usable condition by repair

<table>
<thead>
<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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<tbody>
<tr>
<td>rework fit (shimming)</td>
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<td>making new or stepped keys</td>
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<td>replacing damaged or missing gear teeth</td>
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<td>plugging holes</td>
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<td>stopping cracks running and filling them</td>
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<tr>
<td>other specific repair procedures</td>
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**Use a range of methods and techniques to repair components (six)**
- sawing (hand, band)
- drilling
- reaming
- grinding (hand or machine)
- filing
- scrapping or lapping
- threading external
- threading internal
- turning
- milling
- thermal processes

**Repair components made from different types of material (two)**
- low carbon steel
- high carbon steel
- cast iron
- aluminium
- brass/bronze
- stainless steel
- plastic/synthetic
- composite
**Unit 7**  
Restoring mechanical components to usable condition by repair

<table>
<thead>
<tr>
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<tbody>
<tr>
<td><strong>Carry out repairs to mechanical equipment which comply with the following quality and accuracy standards: (one or more)</strong></td>
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<td>organisational guidelines and codes of practice</td>
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<td>equipment manufacturer’s operation range</td>
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<td>BS and/or ISO standards</td>
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<td>Knowledge and understanding reference:</td>
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Candidate: ___________________________  Date: ________________  
Assessor: ___________________________  Date: ________________
Unit 8
Producing replacement components for maintenance activities

Unit summary
This unit identifies the competencies you need to produce replacement components resulting from maintenance activities, in accordance with approved procedures. You will produce these components using manual machining techniques, such as milling, turning, grinding, shaping/slotting, drilling/boring, combined with hand fitting techniques. You will be expected to produce components that require you to use a range of different machines, and this will involve setting up the workholding arrangements, workpiece and machine tooling.

You will also be expected to use a range of hand tools, portable power tools, and shaping and fitting techniques, that are appropriate to the type of material and operations being performed. These activities will include such things as hand sawing, band sawing, filing, drilling, chiselling, threading, and off-hand grinding. The components produced will, typically, be such things as shafts, bushes, sleeves, distance pieces/spacers, packings, plates, studs, slides, pulleys, gear blanks, handles, levers or linkages.

Your responsibilities will require you to comply with organisational policy and procedures for the machining activities undertaken, and to report any problems with the machines, tooling, materials or activities that you cannot personally resolve, or are outside your personal responsibilities, to the relevant people. You will be expected to work with minimum 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 replacement component manufacturing procedures and instructions. You will understand the machining and fitting processes used, and their application, and will know about the machine, tooling, ancillary equipment, materials and consumables, in adequate depth to provide a sound basis for carrying out the activities, correcting faults and producing the components to the required specification.

You will understand the safety precautions required when working with the machines and their associated tools and equipment. You will be required to demonstrate safe working practices throughout, and will understand the responsibility you owe to yourself and others in the workplace.
Unit 8
Producing replacement components for maintenance activities

Performance statements:
You must:
a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Follow instructions and any relevant specifications to produce the component
c. Produce the required components using appropriate manufacturing methods and techniques
d. Check that the finished component meets the requirements and make any necessary adjustments
e. Deal promptly and effectively with problems within your control and report those that cannot be solved

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:
1. Carry out all the following during the manufacturing activities:
   - obtain and use the correct drawing, sketch or sample/damaged component to be replaced
   - check that machines used are in a safe and usable condition
   - check that cutting tools and equipment are in a serviceable condition
   - ensure that workpieces are held securely without distortion
   - apply safe and appropriate manufacturing techniques at all times
   - use correctly adjusted machine guards and safety devices

2. Produce replacement components using a range of hand fitting methods, to include five from the following:
   - hand sawing
   - drilling
   - off-hand grinding
   - lapping
   - band/power sawing
   - chiselling
   - scraping
   - filing
   - threading external
   - threading internal

3. Produce replacement components using two of the following machining processes:
   - turning
   - drilling
   - milling
   - spark/wire erosion
   - grinding
   - shaping or slotting
4 Produce replacement components which cover **five** of the following features:
- external diameters
- internal diameters
- flat faces
- parallel faces
- steps/shoulders
- faces that are square to each other
- angular/tapered surfaces
- threads
- circular/curved/radial profiles
- slots/recesses
- drilled holes
- bored holes
- reamed holes
- concave or convex form
- special forms

5 Produce components which comply with **all** of the following quality and accuracy standards:
- dimensional tolerances are to specification/replacement component requirements
- the surface finish complies to replacement component requirements
- components are free from false tool cuts, burrs and sharp edges
- components are fit for purpose

6 Produce replacement components from **two** different types of material from:
- low carbon steel
- high carbon steel
- stainless steel
- cast iron
- aluminium
- brass
- bronze
- plastic/synthetic
- composite
- special steels or alloys
Unit 8
Producing replacement components for maintenance activities

Knowledge statements:
You must have knowledge and understanding of:

1. The safe working practices and procedures to be followed whilst carrying out the machining activities
2. The safety mechanisms on the machine, and the procedure for checking that they are operating correctly
3. How to operate all the machine controls, in both hand and power modes, and how to stop the machine in case of an emergency
4. The importance of wearing appropriate protective clothing and equipment, and of keeping the work area clean and tidy
5. How to obtain and interpret drawings, specifications, manufacturers’ manuals and other documents needed in the manufacturing process
6. How to take measurements and produce working sketches of parts to be made, where no drawings are available
7. How to use filing, scraping and lapping to achieve the required surface finish (various types of files/scrapers, checking that file/scraper handles are in good condition, types of lapping mediums)
8. How to cut external threads using hand dies, and the method of fixing and adjusting the dies to give the correct thread fit
9. How to determine the drill size for tapped holes and the importance of using the taps in the correct sequence
10. How to produce a sliding or mating fit
11. How to select saw blades (for different materials and different operations)
12. The use of vice jaw plates to protect the workpiece from damage
13. How to correctly use hand power tools and specialist equipment (such as electrical, pneumatic, lifting equipment)
14. How to check that portable power tools, extension cables and air hoses are free from damage and are in a safe, usable condition
15. The operating requirements of the machine tools and accessories being used (guards, workholding devices, taper turning attachments, steadies, dividing heads, specific statutory regulations)
16. The various shapes and types of tooling that can be used (solid high-speed tooling, brazed tip tooling, interchangeable tipped tooling)
17. How to handle and store tools and equipment safely and correctly
18. Factors which affect the selection of cutting feeds and speeds, and the depth of cut that can be taken (workpiece rigidity, machine condition, type of tooling being used, material type, finish and tolerance required)
19. The application of cutting fluids with regard to a range of different materials and processes
20. The techniques and implications of clamping a workpiece in a chuck/work holding device (safely secured for the process, not causing distortion in the finished components)
21. How to recognise machining faults and identify when tools need re-sharpening/dressing
22. Types and applications of grinding wheels, and methods of mounting, and why some wheels require balancing (Abrasive Wheels Regulations)
23. The methods that can be used to position the workpiece in relation to the cutting tools
24. The effects of backlash in the machine slides, and how this can be overcome
25. The problems that can occur with the machining and fitting activities, and how these can be overcome
26. The extent of your own authority and whom you should report to if you have problems that you cannot resolve
# Unit 8
## Producing replacement components for maintenance activities

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**Carry out during the manufacturing activities (all)**

- Obtain and use the correct drawing, sketch or sample/damaged component
- Machines used are in a safe and usable condition
- Cutting tools and equipment are in a serviceable condition
- Workpieces are held securely without distortion
- Apply safe and appropriate manufacturing techniques at all times
- Use correctly adjusted machine guards and safety devices

**Produce replacement components using hand fitting methods (five)**

- Hand sawing
- Drilling
- Off-hand grinding
- Lapping
- Band/power sawing
- Chiselling
- Scraping
- Filing
- Threading external
- Threading internal

**Produce replacement components using machining processes (two)**

- Turning
- Drilling
- Milling
- Spark/wire erosion
- Grinding
- Shaping or slotting
## Unit 8
Producing replacement components for maintenance activities

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<td><strong>Produce replacement components which cover the following features (five)</strong></td>
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<td>external diameters</td>
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<td>parallel faces</td>
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<td>steps/shoulders</td>
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<td>faces that are square to each other</td>
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<td>angular/tapered surfaces</td>
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<td>threads</td>
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<td>concave or convex forms</td>
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<td>special forms</td>
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<td><strong>Produce components which comply with quality and accuracy standards (all)</strong></td>
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<td>dimensional tolerances to specification/replacement component requirements</td>
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<td>surface finish complies to replacement component requirements</td>
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<td>components free from false tool cuts, burrs and sharp edges</td>
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<td>components are fit for purpose</td>
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<td><strong>Produce replacement components from different types of material (two)</strong></td>
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<td>low carbon steel</td>
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<td>high carbon steel</td>
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<td>stainless steel</td>
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<td>aluminium</td>
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<td>brass</td>
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# Unit 8
Producing replacement components for maintenance activities

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<td>bronze</td>
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<td>plastic/synthetic</td>
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<td>composite</td>
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<td>special steels or alloys</td>
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**Knowledge and understanding reference:**

Candidate: _______________________________________________  Date: ___________________

Assessor: ________________________________________________   Date: ___________________
Unit 9
Carrying out planned maintenance on mechanical equipment

Unit summary
This unit identifies the competencies you need to carry out planned maintenance activities on mechanical equipment, in accordance with approved procedures. You will be required to carry out planned maintenance activities on a range of mechanical equipment, such as machine tools, processing plant and equipment, transfer devices, gear mechanisms, mechanical control devices, pumps, compressors, valves, lifting and handling equipment, and mechanical structures, in order to minimise down time and ensure that they perform at optimum level and function to specification.

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 process, tools or equipment used that you cannot personally resolve, or 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 minimum 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 planned maintenance procedures to mechanical equipment. You will understand the process of developing planned maintenance, and its application, and will know about the criteria in adequate depth to provide a sound basis for carrying out the activities to the required specification. In addition, you will be expected to report where the outcome identifies further investigation or maintenance work.

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.
Unit 9
Carrying out planned maintenance on mechanical equipment

Performance statements:
You must:

a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Follow the relevant maintenance schedules to carry out the required work
c. Carry out the maintenance activities within the limits of your personal authority
d. Carry out the maintenance activities in the specified sequence and in an agreed time scale
e. Report any instances where the maintenance activities cannot be fully met or where there are identified
f. Defects outside the planned schedule
g. Complete relevant maintenance records accurately and pass them on to the appropriate person
h. Dispose of waste materials in accordance with safe working practices and approved procedures

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:

1. Carry out all of the following during the planned maintenance activities:
   - plan the maintenance activities to cause minimum disruption to normal working
   - use the correct issue of company and/or manufacturers’ drawings and maintenance documentation
   - adhere to risk assessment, COSHH and other relevant safety standards
   - ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
   - provide safe access and working arrangements for the maintenance area
   - carry out the maintenance activities using appropriate techniques and procedures
   - functionally test and adjust equipment to specification
   - re-connect and return the system to service on completion of the maintenance activities
   - dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition

2. Carry out planned maintenance activities on five of the following:
   - gearboxes
   - machine tools
   - lifting and handling equipment
   - processing plant
   - engines
   - pumps
   - process control valves
   - compressors
   - workholding devices
   - transfer equipment
   - mechanical structures
   - company-specific equipment
Follow planned maintenance activities using **one** of the following types of maintenance schedules:
- condition based maintenance
- scheduled maintenance
- total preventative maintenance

Carry out **all** of the following planned maintenance activities:
- visual examination and testing of equipment against maintenance schedule
- replacing ‘lifed’ consumables (such as oils, grease, belts, gaskets and seals etc)
- checking condition of drive belts, chains, bearings, seals, guards
- checking operation of all gauges and sensors
- monitoring component condition/deterioration
- making sensory checks (such as sight, sound, smell, touch)
- carrying out equipment self analysis checks
- checking alignment of running/sliding components
- making routine adjustments
- carrying out leak checks on all connections
- testing and reviewing system operation
- removing excessive dirt and grime
- recording the results of the maintenance and reporting any defects found

Ensure the maintained equipment meets **all** of the following quality and accuracy standards:
- all maintenance activities have been completed to the required schedule
- equipment operates within acceptable limits for successful continuous operation
- any potential defects are identified and reported for future action
- all relevant documentation is completed accurately and legibly

Complete **all** relevant paperwork and pass it to the appropriate people:
- job cards
- maintenance log or report
- permit to work/formal risk assessment
Unit 9
Carrying out planned maintenance on mechanical equipment

Knowledge statements:
You must have knowledge and understanding of:
1. The health and safety requirements of the area in which the preventative maintenance activity is to take place, and the responsibility these requirements place on you
2. The isolation procedures or permit-to-work procedure that applies to the equipment being maintained
3. The specific health and safety precautions to be applied during the planned maintenance activity, and their effects on others
4. The importance of wearing protective clothing and other appropriate safety equipment during the maintenance activities
5. Hazards associated with carrying out planned maintenance activities on mechanical equipment (such as handling oils/greases, stored pressure/force, misuse of tools), and how they can be minimised
6. Where to obtain, and how to interpret drawings, specifications, manufacturers’ manuals, maintenance schedules and other relevant documents
7. The various planned maintenance schedules that are generally used (such as condition based maintenance, scheduled maintenance, and total preventative maintenance [TPM])
8. The procedure for obtaining consumables to be used during the planned maintenance activity
9. How to make appropriate sensory checks (sight, sound, smell and touch)
10. The appropriate testing procedures to be adopted during the maintenance activity
11. How to make adjustments to components/assemblies to ensure they function to specification
12. The functionality of various mechanical components and their interrelationship with other components and assemblies
13. How to compile planned maintenance records/logs/reports in accordance with company policy and procedures
14. The equipment operating and control procedures, and how to apply them in order to carry out planned maintenance
15. The problems that can occur whilst carrying out the planned maintenance activities, and how they can be avoided
16. The organisational procedure(s) to be adopted for the safe disposal of waste of all types of materials
17. The extent of your own authority and whom you should report to if you have problems that you cannot resolve
## Unit 9
Carrying out planned maintenance on mechanical equipment

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### Carry out during the planned maintenance activities: (all)
- plan the maintenance activities to cause minimum disruption to normal working
- use the correct issue of company and/or manufacturers’ drawings and maintenance documentation
- adhere to risk assessment, COSHH and other relevant safety standards
- ensure the safe isolation of equipment
- provide safe access and working arrangements
- carry out the maintenance activities using appropriate techniques and procedures
- functionally test and adjust equipment to specification
- re-connect and return the system to service on completion of the maintenance activities
- dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition

### Carry out planned maintenance activities on: (five)
- gearboxes
- machine tools
- lifting and handling equipment
- processing plant
- gearboxes
- engines
- pumps
### Unit 9
Carrying out planned maintenance on mechanical equipment

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<td>company-specific equipment</td>
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**Follow planned maintenance activities using types of maintenance schedules (one)**

- condition based maintenance
- scheduled maintenance
- total preventative maintenance

**Carry out planned maintenance activities (all)**

- visual examination/testing of equipment
- replace lifed consumables
- checking drive belts, chains, bearings, seals, guards
- checking operation of all gauges and sensors
- monitoring component condition/deterioration
- making sensory checks
- carrying out equipment self analysis checks
- checking alignment of running/sliding components
- routine adjustments
- carrying out leak checks on all connections
- testing and reviewing system operation
- removing excessive dirt and grime
# Unit 9
Carrying out planned maintenance on mechanical equipment

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- recording results/reporting any defects found

**ensure the maintained equipment meets quality and accuracy standards (all)**

- all maintenance activities completed to schedule
- equipment operates within acceptable limits
- any potential defects identified/reported
- all relevant documentation completed

**complete relevant paperwork and pass to the appropriate people (all)**

- job cards
- maintenance log or report
- permit to work/formal risk assessment

Knowledge and understanding reference:

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Candidate: ___________________________ Date: ________________

Assessor: ___________________________ Date: ________________
Unit 10
Carry out condition monitoring on plant and equipment

Unit summary
This unit identifies the competencies you need to carry out condition monitoring of plant and equipment, in accordance with approved procedures. You will be required to select the appropriate monitoring equipment to use, based on the type of plant or equipment being monitored and the conditions you wish to check. You will be expected to check that the equipment is in a suitable condition to use (undamaged, correctly calibrated, appropriate range, etc) and set up the equipment ready for use. You will then use this equipment to carry out diagnostic condition monitoring (fault diagnosis or prognosis) on a range of equipment such as mechanical, electrical, process controller, fluid power or integrated systems.

Your responsibilities will require you to comply with organisational policy and procedures for the condition monitoring activities undertaken, and to report any problems with the diagnostic equipment or monitoring activities that you cannot personally resolve, or are outside your permitted authority, to the relevant people. You will be expected to work with minimum 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 a good understanding of your work, and will provide an informed approach to applying condition monitoring techniques. You will understand the monitoring methods and procedures used, and their application, and will know about the various monitoring units, and peripheral components, in adequate depth to provide a sound basis for carrying out the monitoring activities safely and correctly.

You will understand the safety precautions required when carrying out the monitoring 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.
Unit 10
Carry out condition monitoring on plant and equipment

Performance statements:
You must:
a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Correctly set up and check-calibrate the equipment required for the monitoring being carried out
c. Carry out the monitoring activities with the minimum disruption to normal activities
d. Record and review the outcomes and take appropriate actions

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:
1. Carry out all of the following during the monitoring activities:
   • plan the condition monitoring activities to cause minimum disruption to normal working
   • adhere to risk assessment, COSHH and other relevant safety standards
   • select the appropriate condition monitoring equipment for the intended purpose
   • check the calibration of the monitoring equipment before use
   • set up the monitoring equipment in accordance with the appropriate procedures
   • check that the monitoring equipment is functioning correctly
   • carry out the monitoring activities using appropriate techniques and procedures
   • apply safe working practices and procedures at all times

2. Use appropriate monitoring techniques to set up machinery protection systems, or predictive maintenance system monitoring techniques, on two of the following types of equipment:
   • engines (such as piston or turbine)
   • rotating or reciprocating machinery (such as pumps, compressors)
   • mechanical equipment (such as cyclic and rotational devices, gearboxes, drives and linkages)
   • production machinery (such as machine tools, presses, transfer mechanisms)
   • process equipment (such as furnaces, chemical baths)
   • rotating electrical machinery (such as generators, motors)
   • stationary electrical equipment (such as transformers, switchgear)
   • stationary plant and equipment (such as air receivers, accumulators, tanks, piping)
   • emergency standby or alarm/warning systems and equipment
   • fluid power equipment (such as pipework, cylinders & actuators and pumps)
   • process controller (eg, program controller, input/output interfacing, wiring/cabling, monitoring sensors)
   • electrical components (such as power supplies, switch gear and distribution panels, control systems)
   • environmental systems (such as air conditioning, fume extraction)
3 Use **two** of the following condition monitoring methods:
- off-line/portable monitoring
- sampled monitoring
- continuous monitoring
- protection monitoring
- human sensory monitoring (sight, sound, touch, smell)

4 Use **two** of the following monitoring techniques:
- vibration analysis
- temperature analysis
- flow analysis
- particle analysis
- crack detection analysis
- leak detection analysis
- humidity analysis
- pressure analysis
- voltage/current analysis
- radio telemetry analysis
- thickness analysis
- oil analysis
- corrosion detection
- environmental pollutant analysis

5 Use monitoring systems in **one** of the following monitoring conditions:
- equipment operating under the effects of weather, natural hazards, temperature or pressure
- equipment operating in environments with potential flammable or explosive conditions (such as dust, vapours, liquids or gases)
- equipment working in wet, dirty, dusty or corrosive conditions
- equipment operating in a benign or clean room environment

6 Complete **all** relevant paperwork and pass it to the appropriate people:
- job cards
- predictive maintenance log or report
- permit to work/formal risk assessment
Unit 10
Carry out condition monitoring on plant and equipment

Knowledge statements:
You must have knowledge and understanding of:
1. The specific health and safety precautions needed to be applied during the monitoring procedure, and their effects on others
2. The health and safety requirements of the area in which the monitoring activity is to take place, and the responsibility these requirements place on you
3. Hazards associated with carrying out monitoring activities on plant and equipment (electrical supplies, moving machinery, process controller interface, using damaged or badly maintained tools and equipment, not following laid-down procedures), and how they can be minimised
4. How to obtain and interpret drawings, charts, specifications, manufacturers’ manuals, history/maintenance reports, symbols used on monitoring instrument documents, and other documents needed in the monitoring/maintenance process
5. The basic principles of how the plant or equipment to be monitored functions, the operation sequence, the working purpose of individual units/components, and how they interact
6. The basic principles of condition monitoring, and how it helps prevent equipment failure
7. The different types of monitoring component or sensor (temperature, force, pressure, vibration, rotational, voltage, current), their fittings, and their application
8. The various monitoring systems and the methods that can be employed to make test measurements for the purposes of machinery protection or predictive maintenance
9. Methods of attaching monitoring components to different parts of the plant, equipment or system
10. The need to check that monitoring instruments are fit for purpose, undamaged, and have a suitable monitoring range and value
11. The importance of monitoring equipment calibration and authorisation procedures
12. The need to set up and operate condition monitoring equipment correctly
13. Care and control procedures for condition monitoring equipment
14. The problems that can occur during the monitoring activity, and how they can be overcome
15. Recording the results from condition monitoring, and the documentation to be used
16. Control procedures for reporting the results from condition monitoring
17. The organisational procedure(s) to be adopted for the safe disposal of waste of all types of materials
18. The extent of your own authority and whom you should report to when you have a problem you cannot resolve
## Unit 10
### Carry out condition monitoring on plant and equipment

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<tr>
<th>evidence record sheet</th>
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## Unit 10
 Carry out condition monitoring on plant and equipment

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**Unit 10**
**Carry out condition monitoring on plant and equipment**

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**Complete relevant paperwork and pass to the appropriate people (all)**

- job cards
- predictive maintenance log or report
- permit to work/formal risk assessment

**Knowledge and understanding reference:**

Candidate: ___________________________________________  Date: ___________________

Assessor: ___________________________________________  Date: ___________________
Unit 11
Carrying out fault diagnosis on electrical equipment and circuits

Unit summary
This unit identifies the competencies you need to carry out efficient and effective fault diagnosis on electrical equipment and circuits, in accordance with approved procedures. You will be required to diagnose faults on a range of electrical equipment, such as single and three-phase power supplies, motors and starters, switchgear and distribution panels, electrical plant, control systems and equipment, and luminaires. You will be expected to use a variety of fault diagnosis methods and techniques, and to utilise a number of diagnostic aids and equipment. From the evidence gained, you will be expected to identify the fault and its probable cause, and to suggest action to remedy the problem.

Your responsibilities will require you to comply with organisational policy and procedures for the fault diagnostic activities undertaken, and to report any problems with these activities or the tools and equipment used that you cannot personally resolve, or are outside your permitted authority, to the relevant people. You will be expected to work with minimum 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 fault diagnosis procedures on electrical equipment and circuits. You will understand the various fault diagnosis methods and techniques used, and their application. You will also know how to interpret and apply information obtained from the diagnostic aids and equipment, in adequate depth to provide a sound basis for carrying out the activities and for identifying faults or conditions that are outside the required specification.

You will understand the safety precautions required when carrying out the fault diagnosis 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.
Unit 11
Carrying out fault diagnosis on electrical equipment and circuits

Performance statements:
You must:

a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Review and use all relevant information on the symptoms and problems associated with the products or assets
c. Investigate and establish the most likely causes of the faults
d. Select, use and apply diagnostic techniques, tools and aids to locate faults
e. Complete the fault diagnosis within the agreed time and inform the appropriate people when this cannot be achieved
f. Determine the implications of the fault for other work and for safety considerations
g. Use the evidence gained to draw valid conclusions about the nature and probable cause of the fault
h. Record details on the extent and location of the faults in an appropriate format

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:

1. Carry out all of the following during the fault diagnostic activity:
   • plan the fault diagnosis, based on the available information about the fault
   • use the correct issue of company and/or manufacturers drawings and maintenance documentation
   • adhere to risk assessment, COSHH and other relevant safety standards
   • ensure safe isolation of equipment (such as electricity, mechanical, gas, air or fluids)
   • provide safe access and working arrangements for the faultfinding/maintenance area
   • carry out the fault diagnostic activities using approved procedures
   • collect equipment fault diagnostic evidence from ‘live’ and isolated circuits
   • disconnect or isolate components or parts of circuits, when appropriate, to confirm diagnosis
   • identify the fault and determine appropriate corrective action
   • dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition

2. Carry out fault diagnosis on six of the following types of equipment:
   • single-phase power circuits
   • three-phase power circuits
   • direct current power circuits
   • switchgear and distribution panels
   • motors and starters
   • control systems and components
   • electrical plant
   • luminaires
3 Collect fault diagnostic evidence from four of the following sources:
- the person or operator who reported the fault
- test instrument measurements (eg, watt meters, multimeter, earth-loop impedance testers)
- circuit meters (such as voltmeter, power factor meter, ammeter)
- recording devices
- sensory input (sight, sound, smell, touch)
- plant/equipment records
- condition of end product
- equipment self-diagnostics

4 Use a range of fault diagnostic techniques, to include:
- half-split technique

Plus one more from the following
- input/output technique
- injection and sampling
- six point technique
- emergent sequence
- unit substitution
- function testing

5 Use a variety of diagnostic aids and equipment to include two of the following:
- logic diagrams
- flow charts or algorithms
- manufacturers’ manuals
- equipment self diagnosis
- fault analysis charts (such as fault trees)
- trouble shooting guides
- electronic aids

6 Use all of the following fault diagnosis procedures:
- inspection (such as breakages, wear/deterioration, signs of overheating, missing parts, loose fittings)
- operation (such as manual switching off and on, RCD test buttons, automatic switching/timing/sequencing, desired outputs)
- measurement (such as voltage, current, continuity, power, temperature, luminescence)

7 Use three of the following types of test equipment to aid fault diagnosis
- multimeter
- watt meter
- voltmeter
- ammeter
- earth-loop impedance tester
- insulation resistance tester
- portable appliance tester
- light meter
- other specific test equipment

8 Find faults that have resulted in two of the following breakdown categories:
- intermittent action or circuit failure
- partial failure or reduced performance
- complete breakdown
Provide a record of the outcome of the fault diagnosis using one of the following:

- step-by-step analytical report
- preventative maintenance log/report
- corrective action report
- company-specific reporting procedure
Knowledge statements:
You must have knowledge and understanding of:
1. The health and safety requirements of the area in which the fault diagnosis activity is to take place, and the responsibility these requirements place on you
2. The isolation and lock-off procedure or permit-to-work procedure that applies
3. How to recognise and deal with victims of electric shock (to include methods of safely removing victim from power source, isolating the power source, and methods of first aid resuscitation)
4. The importance of wearing protective clothing and other appropriate safety equipment during fault diagnosis activities
5. Hazards associated with carrying out fault diagnosis on electrical equipment (live electrical components, stored energy, misuse of tools), and how they can be minimised
6. The procedure to be adopted to establish the background of the fault
7. How to evaluate the various types of information available for fault diagnosis
8. How to use the various aids and reports available for fault diagnosis
9. How to use various items of fault diagnostic equipment to investigate the problem
10. The various fault finding techniques that can be used, and how they are applied (such as half-split, input-to-output, emergent problem sequence, six point technique, function testing, unit substitution, injection and sampling techniques and equipment self-diagnostics)
11. How to evaluate sensory information (sight, sound, smell, touch)
12. How to analyse evidence and evaluate possible characteristics and causes of specific faults/problems
13. How to relate previous reports/records of similar fault conditions
14. The care, handling and application of watt meters, multimeters and other electrical test instruments
15. How to calibrate electrical test instruments and check that they are free from damage and defects
16. How to obtain and interpret drawings, circuit and physical layouts, charts, specifications, manufacturers’ manuals, history/maintenance reports, graphical electrical symbols, IEE wiring regulations, and other documents needed in the maintenance process
17. The basic principles of how the circuit functions, the operating sequence, the purpose of individual units/components and how they interact
18. The different types of cabling (multi-core cables, single-core cables, SWA cables, MI cables, screened cables), their associated fittings, and their application
19. The different types of motors and starters, and their operation
20. The different types of control systems and components, and their operation
21. The different types of electrical components (plugs, switches, lighting and fittings, junction boxes, consumer units), and their operation
22. How to evaluate the likely risk to yourself and others, and the effects the fault could have on the overall process or system
23. How to prepare and produce a risk analysis report, where appropriate
24. How to prepare a report or take follow-up action which satisfies the company policy on concluding fault diagnosis
25. The extent of your own authority and whom you should report to if you have problems that you cannot resolve
Unit 11
Carrying out fault diagnosis on electrical equipment and circuits

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**Carry out all of the following during the fault diagnostic activity:**

- plan the fault diagnosis, based on the available information about the fault
- use the correct issue of company and/or manufacturers drawings and maintenance documentation
- adhere to risk assessment, COSHH and other relevant safety standards
- ensure safe isolation of equipment (such as electricity, mechanical, gas, air or fluids)
- provide safe access and working arrangements for the fault finding/maintenance area
- carry out the fault diagnostic activities using approved procedures
- collect equipment fault diagnostic evidence from ‘live’ and isolated circuits
- disconnect or isolate components or parts of circuits, when appropriate, to confirm diagnosis
- identify the fault and determine appropriate corrective action
- dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition

**Carry out fault diagnosis on six of the following types of equipment:**

- single-phase power circuits
- three-phase power circuits
- direct current power circuits
- switchgear and distribution panels
- motors and starters
- control systems and components
- electrical plant
- luminaires
### Unit 11
Carrying out fault diagnosis on electrical equipment and circuits

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#### Collect fault diagnostic evidence from four of the following sources:

- the person or operator who reported the fault
- test instrument measurements (e.g., watt meters, multimeter, earth-loop impedance testers)
- circuit meters (such as voltmeter, power factor meter, ammeter)
- recording devices
- sensory input (sight, sound, smell, touch)
- plant/equipment records
- condition of end product
- equipment self-diagnostics

#### Use a range of fault diagnostic techniques, to include:

- half-split technique
- Plus one more from the following
  - input/output technique
  - injection and sampling
  - six point technique emergent sequence
  - unit substitution
  - function testing

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

- logic diagrams
- flow charts or algorithms
- manufacturers’ manuals
- equipment self diagnosis
- fault analysis charts (such as fault trees)
- trouble shooting guides
- electronic aids

#### Use all of the following fault diagnosis procedures:

- inspection (such as breakages, wear/deterioration, signs of overheating, missing parts, loose fittings)

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Carrying out fault diagnosis on electrical equipment and circuits

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Use three of the following types of test equipment to aid fault diagnosis:
- multimeter
- watt meter
- voltmeter
- ammeter
- earth-loop impedance tester
- insulation resistance tester
- portable appliance tester
- light meter
- other specific test equipment

Find faults that have resulted in two of the following breakdown categories:
- intermittent action or circuit failure
- partial failure or reduced performance
- complete breakdown

Provide a record of the outcome of the fault diagnosis using one of the following:
- step-by-step analytical report
- preventative maintenance log/report
- corrective action report
- company-specific reporting procedure

Knowledge and understanding reference:

Candidate: ___________________________ Date: ______________
Assessor: ___________________________ Date: ______________
Unit 12
Maintaining electrical equipment

Unit summary
This unit identifies the competencies you need to carry out corrective maintenance activities on electrical equipment, in accordance with approved procedures. You will be required to maintain a range of electrical equipment, such as single, three-phase and direct current power supplies and control systems, motors and starters, switchgear and distribution panels, control systems, electrical equipment, wiring enclosures and luminaires. This will involve dismantling, removing and replacing faulty equipment, at component or unit level, on a variety of different types of electrical assemblies and sub-assemblies. You will be expected to apply a range of dismantling and reassembly methods and techniques, such as soldering, crimping, harnessing and securing cables and components.

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 that you cannot personally resolve, or 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 minimum 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 a good understanding of your work, and will provide an informed approach to applying electrical maintenance procedures. You will understand the dismantling and reassembly methods and procedures used, and their application. You will know about the electrical equipment worked on, component properties, functions 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.

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.
Unit 12
Maintaining electrical equipment

Performance statements:
You must:
a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Follow the relevant maintenance schedules to carry out the required work
c. Carry out the maintenance activities within the limits of your personal authority
d. Carry out the maintenance activities in the specified sequence and in an agreed time scale
e. Report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
f. Complete relevant maintenance records accurately and pass them on to the appropriate person
g. Dispose of waste materials in accordance with safe working practices and approved procedures

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:
1. Carry out all of the following maintenance activities:
   - plan the maintenance activities to cause minimum disruption to normal working
   - use the correct issue of company and/or manufacturers’ drawings and maintenance documentation
   - adhere to risk assessment, COSHH and other relevant safety standards
   - ensure the safe isolation of equipment (such as electricity, mechanical, gas, air or fluids)
   - provide safe access and working arrangements for the maintenance area
   - carry out the maintenance activities using appropriate techniques and procedures
   - re-connect and return the equipment to service on completion of the maintenance activities
   - dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition

2. Carry out maintenance activities on eight of the following types of electrical equipment:
   - single-phase power supplies
   - three-phase power supplies
   - direct current power supplies
   - motors and starters
   - switchgear and distribution panels
   - control systems and components
   - electrical plant
   - wiring enclosures
   - luminaires
   - other specific electrical equipment
3 Carry out all of the following maintenance activities, as applicable to the equipment being maintained:
- isolating and locking off equipment
- disconnecting and reconnecting wires and cables
- attaching suitable cable identification markers
- removing electrical units/components
- checking components for serviceability
- replacing damaged/defective components
- removing and replacing damaged wires and cables
- removing and replacing wiring enclosures
- setting and adjusting replaced components
- making ‘off-load’ checks before powering up
- functionally testing the completed system

4 Replace a range of electrical components, to include ten of the following groups of components:
- cables and connectors
- contactors
- relay components
- overload protection devices
- locking & retaining devices (cable ties, clips, proprietary fasteners)
- capacitors
- rectifiers
- encoders or resolvers
- inverter and servo controllers
- circuit boards
- thermistors or thermocouples
- lighting fixtures
- batteries
- switches and sensors
- solenoids
- transformers
- other specific components

5 Maintain electrical equipment to one or more of the following quality and accuracy standards:
- organisational guidelines and codes of practice
- equipment manufacturers operation range
- IEE wiring regulations
- BS and ISO standards

6 Complete all relevant paperwork from the following, and pass it to the appropriate people:
- job cards
- permits to work/formal risk assessment
- maintenance logs or reports
Knowledge statements:
You must have knowledge and understanding of:

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. The isolation and lock-off procedure or permit-to-work procedure that applies to maintenance activities (electrical isolation, locking off switchgear, removal of fuses, placing of maintenance warning notices, proving the isolation has been achieved and secured).
3. How to recognise and deal with victims of electric shock (to include methods of safely removing victim from power source, isolating the power source, and methods of first aid resuscitation).
4. The importance of wearing protective clothing and other appropriate safety equipment during the maintenance activities.
5. How to obtain and interpret drawings, circuit and physical layouts, charts, specifications, manufacturers’ manuals, history/maintenance reports, graphical electrical symbols, IEE wiring regulations, and other documents needed for the maintenance activities.
6. The basic principle of operation of the equipment/circuits being maintained, and the purpose of individual components within the circuit.
7. The different types of cabling and their application (such as multicore cables, single core cables, steel wire armoured (SWA), mineral insulated (MI), screened cables).
8. The different types of electric motors and motor starters.
9. The different types of control systems and their various components.
10. The application and use of a range of electrical components (such as plugs, switches, sockets, lighting and fittings, junction boxes, consumer units).
11. The various lighting systems used (including tungsten, sodium, mercury vapour and fluorescent).
12. The different types of wiring enclosures that are used (to include conduit, trunking and traywork systems).
13. The care, handling and application of ohmmeters, multimeters and other electrical measuring instruments.
15. How to check that the replacement components meet the required specification/operating conditions (values, tolerance, current carrying capacity, voltage rating, power rating, working temperature range).
16. The techniques used to dismantle/assemble electrical equipment (unplugging, de-soldering, removal of screwed, clamped and crimped connections).
17. Methods of removing and replacing cables and wires in wiring enclosures without causing damage to existing cables.
18. The use of IEE wiring, and other, regulations when selecting wires and cables and when carrying out tests on systems.
19. Methods of attaching identification markers/labels to removed components or cables to assist with re-assembly.
20. The tools and equipment used in the maintenance activities (including the use of cable stripping tools, crimping tools, soldering irons and torches, gland connecting tools).
21. Methods of checking that components are fit for purpose, and the need to replace ‘lifed’ items (such as motor brushes, seals and gaskets, overload protection devices).
22. How to make adjustments to components/assemblies to ensure they function correctly.
23. 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.
24. The importance of making ‘off-load’ checks before proving the equipment with the electrical supply on.
25 The generation of maintenance documentation and/or reports following the maintenance activity
26 The equipment operating and control procedures to be applied during the maintenance activity
27 How to use appropriate lifting and handling equipment in the maintenance activity
28 The problems that can occur during the electrical maintenance activity, and how they can be overcome
29 The organisational procedure(s) to be adopted for the safe disposal of waste of all types of materials
30 The extent of your own authority and whom you should report to when you have a problem you cannot resolve
## Evidence Record Sheet

### Evidence Type

<table>
<thead>
<tr>
<th>Evidence Record Sheet</th>
<th>Performance Evidence 1</th>
<th>Performance Evidence 2</th>
<th>Performance Evidence 3</th>
<th>Additional Performance Evidence (if required)</th>
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<td>evidence type</td>
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### Carry out all of the following maintenance activities:

- Plan the maintenance activities to cause minimum disruption to normal working
- Use the correct issue of company and/or manufacturers’ drawings and maintenance documentation
- Adhere to risk assessment, COSHH and other relevant safety standards
- Ensure the safe isolation of equipment (such as electricity, mechanical, gas, air or fluids)
- Provide safe access and working arrangements for the maintenance area
- Carry out the maintenance activities using appropriate techniques and procedures
- Re-connect and return the equipment to service on completion of the maintenance activities
- Dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition

### Carry out maintenance activities on eight of the following types of electrical equipment:

- Single-phase power supplies
- Three-phase power supplies
- Direct current power supplies
- Motors and starters
- Switchgear and distribution panels
- Control systems and components
- Electrical plant
- Wiring enclosures
- Luminaires
- Other specific electrical equipment
Unit 12
Maintaining electrical equipment

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<thead>
<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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<tbody>
<tr>
<td>Carry out all of the following maintenance activities, as applicable to the equipment being maintained:</td>
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<td>isolating and locking off equipment</td>
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<td>disconnecting and reconnecting wires and cables</td>
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<td>attaching suitable cable identification markers</td>
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<td>removing electrical units/components</td>
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<td>checking components for serviceability</td>
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<td>replacing damaged/defective components</td>
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<td>removing and replacing damaged wires and cables</td>
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<td>setting and adjusting replaced components</td>
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<td>making 'off-load' checks before powering up</td>
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<tr>
<td>functionally testing the completed system</td>
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<td>Replace a range of electrical components, to include 10 of the following groups of components:</td>
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<td>cables and connectors</td>
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<td>contactors</td>
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<td>relay components</td>
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<td>overload protection devices</td>
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<td>locking &amp; retaining devices (cable ties, clips, proprietary fasteners)</td>
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<td>capacitors</td>
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<td>rectifiers</td>
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<td>encoders or resolvers</td>
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<td>inverter and servo controllers</td>
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<td>thermistors or thermocouples</td>
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<td>lighting fixtures</td>
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<td>batteries</td>
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<td>switches and sensors</td>
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<td>solenoids</td>
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# Unit 12
Maintaining electrical equipment

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<tr>
<td>transformers</td>
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<td>other specific components</td>
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</table>

**Maintain electrical equipment to one or more of the following quality and accuracy standards:**

- organisational guidelines and codes of practice
- equipment manufacturer’s operation range
- IEE wiring regulations
- BS and ISO standards

**Complete all relevant paperwork from the following, and pass it to the appropriate people:**

- job cards
- permits to work/formal risk assessment
- maintenance logs or reports

Knowledge and understanding reference:

Candidate: ____________________________  Date: _________________

Assessor: ____________________________  Date: _________________
Unit 13
Modifying or rewiring electrical circuits

Unit summary
This unit identifies the competencies you need to modify electrical circuits, in accordance with approved procedures. You will be required to modify, rewire and update circuits in accordance with specifications and latest issue drawings and standards. You will be expected to remove and replace cables, add new cables, change breakout points and change the routing of cables. You will also be expected to change components, units and trays. You will need to show proficiency in using various tools and equipment for cutting, stripping, crimping and soldering, and in the installation of the various wires, cables and components that make up the electrical system and circuits worked on.

Your responsibilities will require you to comply with organisational policy and procedures for the modification or rewiring activities undertaken, and to report any problems with the activities, components or equipment that you cannot personally resolve, or are outside your permitted authority, to the relevant people. You must ensure that all tools, equipment, and materials used in the modifying or rewiring 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 minimum supervision, taking full 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 modification or rewiring procedures. You will understand the modification or rewiring to be carried out, and its application, and will know about the methods, tools and equipment to be used, in adequate depth to provide a sound basis for carrying out the activities, correcting faults and ensuring the modification is carried out to the required specification.

You will understand the safety precautions required when carrying out the modification activities. You will be required to demonstrate safe working practices throughout, and will understand the responsibility you owe to yourself and others in the workplace.
Unit 13
Modifying or rewiring electrical circuits

Performance statements:
You must:
   a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
   b. Obtain and follow the relevant modification specifications and job instructions
   c. Confirm and agree what modifications are to be carried out to meet the specification
   d. Prepare the electrical system for the required modification
   e. Carry out the system modification using approved materials, methods and procedures
   f. Complete the modification within the agreed timescale
   g. Ensure the modified electrical system meets the specified operating conditions
   h. Produce accurate and complete records of all modification work carried out
   i. Deal promptly and effectively with problems within your control and report those that cannot be solved

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:
1. Carry out all the following during the modification and rewiring activities:
   - use the correct issue of company and/or manufacturers' drawings and planning documentation
   - adhere to risk assessment, COSHH and other safety standards
   - ensure the safe isolation of equipment (such as electricity, mechanical, gas, air or fluids)
   - provide safe access and working arrangements for the modification area
   - modify or rewire electrical circuits using approved techniques and procedures
   - apply safe working practices and procedures at all times
   - dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition

2. Carry out modifications or rewiring of six of the following electrical systems:
   - single-phase power circuits
   - three-phase power circuits
   - direct current power circuits
   - motors and starters
   - switchgear and distribution panels
   - control systems and components
   - electrical plant
   - wiring enclosures (conduit, trunking or tray work)
   - luminaires • other specific electrical equipment
3 Carry out six of the following types of modifications:
- replacing cables of different size or length
- changing or adding components to panels or sub-assemblies
- changing the position or angle of breakout points
- adding or removing components from circuits
- changing the route of cables
- adding further looms or mains circuits
- making changes to looms or mains circuits
- changing position of electrical units
- fitting new electrical systems
- removal of cables
- addition of cables

4 Carry out six of the following processes:
- terminating mineral and armoured cables
- bending and forming conduit
- bending and forming trunking and trays
- sealing and protecting cable connections
- making mechanical/screwed/clamped connections
- soldering and de-soldering
- heat shrinking (devices and boots)
- crimping (tags and pins)
- stripping cable insulation/protection
- removing cable end fittings
- extracting/inserting components
- allocating identification markings

5 Produce modified or rewired electrical systems in accordance with one or more of the following standards:
- organisational guidelines and codes of practice
- equipment manufacturers’ operation range
- IEE wiring regulations
- BS and/or ISO standards

6 Complete all relevant paperwork, from the following, and pass it to the appropriate people:
- job cards
- maintenance log or report
- permits to work/formal risk assessment
Unit 13
Modifying or rewiring electrical circuits

Knowledge statements:
You must have knowledge and understanding of:
1. The specific safety precautions and procedures to be observed whilst carrying out the modifications or rewiring of the electrical systems (including any specific legislation, regulations or codes of practice relating to the activities, equipment or materials)
2. The health and safety requirements of the work area in which you are carrying out the modification or rewiring activities, and the responsibility these requirements place on you
3. The hazards associated with carrying out modifications or rewiring of electrical systems, and how they can be minimised
4. How to recognise and deal with victims of electric shock (to include methods of safely removing victim from the power source, isolating the power source, and methods of first aid resuscitation)
5. The personal protective equipment and clothing that needs to be worn during the modification or rewiring activities
6. How to obtain and interpret drawings, circuit and physical layouts, charts, specifications, manufacturers' manuals, graphical electrical symbols, IEE wiring regulations, and other documentation used during the modification or rewiring activities
7. The basic principles of how the system functions, the operating sequence, the working purpose of individual units/components, and how they interact
8. The different types of cabling (multicore cables, single core cables, SWA cables, MI cables, screened cables), their fittings and their application
9. The different types of electrical components (plugs, switches, lighting and fittings, junction boxes, consumer units)
10. Preparations that need to be undertaken on the system prior to the modification or rewiring
11. How to extract and insert new cables in wiring enclosures (such as conduit, trunking and traywork) without causing damage to other cables or components
12. The methods and techniques to be used for soldering and de-soldering, and the importance of adhering to these procedures
13. The methods and techniques to be used for crimping and heat shrinking, and the importance of adhering to these procedures
14. The various mechanical fasteners that can be used, and their methods of installation or removal
15. The procedure for obtaining replacement parts, materials and other consumables necessary for the modification or rewiring activities
16. The importance of ensuring that the completed circuit is free from foreign objects, and that all terminations are electrically and mechanically sound and secure
17. How to conduct any necessary checks to ensure that the completed modification or rewiring complies with all appropriate standards
18. The methods and equipment used to transport, handle and lift components/cabling into position, and how to check that the equipment is within its current certification dates
19. 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
20. The problems that can occur with the modification or rewiring operations, and how these can be overcome
21. The recording documentation that needs to be completed for the activities undertaken
22. The extent of your own authority and whom you should report to if you have problems that you cannot resolve
### Unit 13
Modifying or rewiring electrical circuits

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<thead>
<tr>
<th>evidence record sheet</th>
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Carry out all the following during the modification and rewiring activities:

- Use the correct issue of company and/or manufacturers’ drawings and planning documentation
- Adhere to risk assessment, COSHH and other safety standards
- Ensure the safe isolation of equipment (such as electricity, mechanical, gas, air or fluids)
- Provide safe access and working arrangements for the modification area
- Modify or rewire electrical circuits using approved techniques and procedures
- Apply safe working practices and procedures at all times
- Dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition

Carry out modifications or rewiring of six of the following electrical systems:

- Single-phase power circuits
- Three-phase power circuits
- Direct current power circuits
- Motors and starters
- Switchgear and distribution panels
- Control systems and components
- Electrical plant
- Wiring enclosures (conduit, trunking or tray work)
- Luminaires
- Other specific electrical equipment
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<tr>
<td>replacing cables of different size or length</td>
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<td>changing or adding components to panels or sub-assemblies</td>
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<td>changing the position or angle of breakout points</td>
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<td>fitting new electrical systems</td>
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<td>removal of cables</td>
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<td>addition of cables</td>
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<td><strong>Carry out six of the following processes:</strong></td>
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<td>terminating mineral and armoured cables</td>
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<td>bending and forming conduit</td>
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<td>bending and forming trunking and trays</td>
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<td>sealing and protecting cable connections</td>
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<td>making mechanical/screwed/clamped connections</td>
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<tr>
<td>soldering and de-soldering</td>
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<td>heat shrinking (devices and boots)</td>
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<td>crimping (tags and pins)</td>
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<td>stripping cable insulation/protection</td>
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<td>removing cable end fittings</td>
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<tr>
<td>extracting/inserting components</td>
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<tr>
<td>allocating identification markings</td>
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</table>
Unit 13
Modifying or rewiring electrical circuits

<table>
<thead>
<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
</tr>
</thead>
</table>

Produce modified or rewired electrical systems in accordance with one or more of the following standards:
- organisational guidelines and codes of practice
- equipment manufacturers’ operation range
- IEE wiring regulations
- BS and/or ISO standards

Complete all relevant paperwork, from the following, and pass it to the appropriate people:
- job cards
- maintenance log or report
- permits to work/formal risk assessment

Knowledge and understanding reference:

Candidate: _______________________________________________  Date: ___________________
Assessor: ________________________________________________   Date: ___________________
Unit 14
Testing electrical equipment and circuits

Unit summary
This unit identifies the competencies you need to carry out inspections and tests on electrical equipment, such as switchgear, wiring systems, power, heating and lighting systems, motors and motor drives, contactors and relays, control panels, sensors and actuators, and power electronic systems, in accordance with approved procedures. You will be required to carry out formal inspections and tests, which will include protective insulation and resistance values, load current, voltage levels and power ratings, on a range of electrical equipment, to establish that it is functioning at optimal level and to specification.

Your responsibilities will require you to comply with organisational policy and procedures for the testing activities undertaken, and to report any problems with these activities, or with the tools and equipment used that you cannot personally resolve, or are outside your permitted authority, to the relevant people. You will be expected to work with minimum 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 sound understanding of your work, and will provide an informed approach to applying test procedures to electrical equipment and circuits. You will understand the equipment being worked on, the test equipment to be used, and the various test procedures, in adequate depth to provide a sound basis for carrying out the activities to the required specification. In addition, you will be expected to review the outcome of the tests, compare the results with appropriate standards, determine the action required, and record and report the results in the appropriate format.

You will understand the safety precautions required when carrying out the inspection and testing activities, especially those for isolating the equipment and 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.
Unit 14
Testing electrical equipment and circuits

Performance statements:
You must:

a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Follow the appropriate procedures for use of tools and equipment to carry out the required tests
c. Set up and carry out the tests using the correct procedures and within agreed timescales
d. Record the results of the tests in the appropriate format
e. Review the results and carry out further tests if necessary

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:

1. Carry out all of the following during the testing activities:
   - plan the inspection and testing activities to cause minimum disruption to normal working
   - use the correct issue of company and/or manufacturers’ drawings and maintenance documentation
   - adhere to risk assessment, COSHH and other relevant safety standards
   - ensure the safe isolation of equipment
   - provide safe access and working arrangements for the testing area
   - carry out the inspection and testing activities using appropriate techniques and procedures
   - re-connect and return the system to service on completion of the testing activities
   - dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition

2. Carry out inspections and tests on six of the following types of electrical equipment:
   - distribution switchgear
   - wiring systems
   - electric motors
   - contactors and relays
   - control panels
   - PLC systems
   - power electronic systems
   - motor drives
   - sensors
   - actuators
   - power, heating and lighting systems
   - accessories

3. Carry out tests using a range of tools and test equipment, to include four of the following:
   - Oscilloscope
   - Ohmmeter
   - Ammeter
   - Voltmeter
   - Insulation Resistance Tester
   - Loop Impedance Tester
   - Residual Current Device (RCD) tester
   - Multimeter
   - portable appliance tester (PAT)
   - specialist test equipment (sound, speed, light, temperature)
Unit 14
Testing electrical equipment and circuits

4 Use appropriate test equipment to carry out five of the following tests, as applicable to the equipment being maintained:
  • protective resistance values
  • insulation resistance values
  • load current
  • voltage levels
  • power rating
  • resistance
  • capacitance
  • frequency values
  • inductance
  • safety device trip speed
  • specialised tests (such as speed, sound, light, temperature)

5 Carry out all the following checks to ensure the accuracy and quality of the tests carried out:
  • the test equipment is correctly calibrated
  • test equipment used is appropriate for the tests being carried out
  • test procedures used are as recommended in the appropriate electrical codes of practice (IEE)
  • test equipment is operated within its specification range

6 Provide a record/report of the test outcome using one of the following:
  • preventative maintenance log/report
  • company-specific reporting procedure
  • inspection schedule
  • specific test report
Unit 14
Testing electrical equipment and circuits

Knowledge statements:
You must have knowledge and understanding of:
1. The health and safety requirements of the work area where you are carrying out the testing activities, and the responsibility these requirements place on you
2. The equipment isolation and lock-off procedure or permit-to-work procedure that applies to the testing activities (electrical isolation, locking off switchgear, removal of fuses, placing of maintenance warning notices, proving the isolation has been achieved and secured)
3. The specific safety precautions to be taken when carrying out formal inspection and testing of electrical equipment
4. How to recognise and deal with victims of electrical shock (to include methods of safely removing victim from the power source, isolating the power source, and methods of first aid resuscitation)
5. The importance of wearing protective clothing and other appropriate safety equipment during the electrical testing activities
6. Protection techniques for electrical systems (to prevent burn or fire risk)
7. How to obtain and interpret drawings, circuit and physical layouts, charts, specifications, manufacturers’ manuals, history/maintenance reports, graphical electrical symbols, IEE wiring regulations, and other documents needed in the testing activities
8. Types of test equipment to be used, and their selection for particular types of tests
9. How to ensure that the test equipment is maintained and correctly calibrated, in accordance with the appropriate organisational procedures
10. How to connect the appropriate test equipment for the measurement of resistance, current, voltage, power, capacitance, inductance, frequency, power factor, and protective device disconnection/trip times
11. The various testing methods and procedures, as recommended in approved electrical codes of practice, and how to apply them to different operating conditions
12. Displaying/recording test results, and the documentation to be used
13. How to interpret the value and significance of the test readings
14. How to analyse test results using tables in approved electrical codes of practice, and how to use comparison and sequential techniques
15. The importance of ensuring that test equipment is used only for its intended purpose and within its specified range and limits
16. Problems or errors that may occur and which could affect the test results, and how they can be avoided
17. The environmental control and company operating procedures relating to the testing activities
18. The documentation required and the procedures to be observed following the test
19. The extent of your own authority and whom you should report to if you have problems that you cannot resolve
## Unit 14
Testing electrical equipment and circuits

<table>
<thead>
<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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<tbody>
<tr>
<td>evidence type</td>
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<td>date</td>
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</table>

**Carry out all of the following during the testing activities:**

- plan the inspection and testing activities to cause minimum disruption to normal working
- use the correct issue of company and/or manufacturers’ drawings and maintenance documentation
- adhere to risk assessment, COSHH and other relevant safety standards
- ensure the safe isolation of equipment
- provide safe access and working arrangements for the testing area
- carry out the inspection and testing activities using appropriate techniques and procedures
- re-connect and return the system to service on completion of the testing activities
- dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition

**Carry out inspections and tests on six of the following types of electrical equipment:**

- distribution switchgear
- wiring systems
- electric motors
- contactors and relays
- control panels
- PLC systems
- power electronic systems
- motor drives
- sensors
- actuators
- power, heating and lighting systems
- accessories
### Unit 14
Testing electrical equipment and circuits

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<tbody>
<tr>
<td>Carry out tests using a range of tools and test equipment, to include four of the following:</td>
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<tr>
<td>Oscilloscope</td>
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<tr>
<td>Ohmmeter</td>
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<tr>
<td>Ammeter</td>
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<tr>
<td>Voltmeter</td>
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<tr>
<td>Insulation Resistance Tester</td>
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<td>Loop Impedance Tester</td>
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<tr>
<td>Residual Current Device (RCD) tester</td>
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<tr>
<td>Multimeter</td>
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<tr>
<td>portable appliance tester (PAT)</td>
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<tr>
<td>specialist test equipment (sound, speed, light, temperature)</td>
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<tr>
<td>Use appropriate test equipment to carry out five of the following tests, as applicable to the equipment being maintained:</td>
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<tr>
<td>protective resistance values</td>
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<tr>
<td>load current</td>
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<td>voltage levels power rating</td>
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<tr>
<td>resistance</td>
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<td>capacitance</td>
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<tr>
<td>frequency values inductance</td>
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<tr>
<td>safety device trip speed</td>
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<tr>
<td>specialised tests (such as speed, sound, light, temperature)</td>
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<tr>
<td>Carry out all the following checks to ensure the accuracy and quality of the tests carried out:</td>
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<tr>
<td>the test equipment is correctly calibrated</td>
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<tr>
<td>test equipment used is appropriate for the tests being carried out</td>
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<tr>
<td>test procedures used are as recommended in the appropriate electrical codes of practice (IEE)</td>
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<tr>
<td>test equipment is operated within its specification range</td>
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</tbody>
</table>
### Unit 14
Testing electrical equipment and circuits

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</table>

Provide a record/report of the test outcome using one of the following:

- preventative maintenance log/report
- company-specific reporting procedure
- inspection schedule
- specific test report

Knowledge and understanding reference:

Candidate: ____________________________  Date: ________________

Assessor: ______________________________  Date: ________________
Unit 15
Carrying out planned maintenance on electrical equipment

Unit summary
This unit identifies the competencies you need to carry out planned maintenance activities on electrical equipment, in accordance with approved procedures. You will be required to carry out planned maintenance activities on a range of electrical equipment, such as single, three-phase and direct current power supplies and their control systems, motors and starters, switchgear and distribution panels, control systems, electrical equipment, wiring enclosures and luminaries, in order to minimise down time and ensure that they perform at optimal level and function to specification.

Your responsibilities will require you to comply with organisational policy and procedures for the planned maintenance activities undertaken, and to report any problems with these activities, or with the tools and equipment that are used that you cannot personally resolve, or 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 minimum supervision, taking full 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 planned maintenance procedures to electrical equipment. You will understand the process of developing planned maintenance, and its application, and will know about the maintenance criteria in adequate depth to provide a sound basis for carrying out the activities to the required specification. In addition, you will be expected to report where the outcome identifies the need for further investigation or maintenance work.

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.
Unit 15
Carrying out planned maintenance on electrical equipment

Performance statements:
You must:
a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Follow the relevant maintenance schedules to carry out the required work
c. Carry out the maintenance activities within the limits of your personal authority
d. Carry out the maintenance activities in the specified sequence and in an agreed time scale
e. Report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
f. Complete relevant maintenance records accurately and pass them on to the appropriate person
g. Dispose of waste materials in accordance with safe working practices and approved procedures

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:
1. Carry out all of the following planned maintenance activities:
   • plan the maintenance activities to cause minimum disruption to normal working
   • use the correct issue of company and/or manufacturers' drawings and maintenance documentation
   • adhere to risk assessment, COSHH and other relevant safety standards
   • ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
   • provide safe access and working arrangements for the maintenance area
   • carry out the planned maintenance activity using appropriate techniques and procedures
   • re-connect and return the equipment to service on completion of the maintenance activities
   • functionally test and adjust the equipment to meet the specification
   • dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition

2. Carry out planned maintenance on two of the following groups of electrical equipment:
   • power supplies
   • motors and starters
   • switchgear and distribution panels
   • other specific electrical equipment
   • control systems
   • electrical plant
   • luminaires

3. Follow planned maintenance activities using one of the following types of maintenance categories:
   • condition based maintenance
   • scheduled maintenance
   • total preventative maintenance
4 Carry out all of the following planned maintenance activities:
• visual examination of condition and security of wiring enclosures (conduit, trunking, traywork)
• checking and replacing ‘lifed’ items (such as batteries, emergency lights, motor brushes)
• checking the integrity of connections
• inspecting and cleaning sensors
• monitoring condition/deterioration of contactors
• sensory checks (sight, sound, smell, touch)
• making insulation resistance checks
• portable appliance testing (PAT)
• removing excessive dirt and dust from panels
• checking condition of cables
• making routine adjustments
• testing and reviewing system function
• checking integrity and security of earth bonding
• recording the results of the maintenance and reporting any defects found

5 Ensure that the maintained equipment meets all of the following quality and accuracy standards:
• all components and sub-assemblies are fit for purpose
• all connections are electrically and mechanically safe and sound
• equipment and associated cabling meets IEE wiring regulations
• equipment functions to specification
• all potential defects are identified and reported for future action

6 Complete all relevant paperwork, from the following, and pass it to the appropriate people:
job cards
maintenance log or report
permit to work/formal risk assessment
Unit 15
Carrying out planned maintenance on electrical equipment

Knowledge statements:
You must have knowledge and understanding of:
1. The health and safety requirements of the area in which the planned maintenance activity is to take place, and the responsibility these requirements place on you.
2. The isolation and lock-off procedure or permit-to-work procedure that applies to maintenance activities (electrical isolation, locking off switch gear, removal of fuses, placing of maintenance warning notices, proving the isolation has been achieved and secured).
3. The specific health and safety precautions to be applied during the planned maintenance activities, and their effects on others.
4. The importance of wearing protective clothing and other appropriate safety equipment during the maintenance activities.
5. How to recognise and deal with victims of electric shock (to include methods of safely removing the victim from the power source, isolating the power source, and methods of first aid resuscitation).
6. Hazards associated with carrying out planned maintenance activities on electrical equipment (such as exposure to live conductors, misuse of tools), and how they can be minimised.
7. How to obtain and interpret drawings, circuit and physical layouts, charts, specifications, manufacturers’ manuals, history/maintenance reports, graphical electrical symbols, IEE wiring regulations, and other documents needed in the maintenance activities.
8. The maintenance schedules and methods to be followed in order to comply with company procedures for planned maintenance on electrical equipment.
9. The basic principle of operation of the equipment/circuits being maintained, and the function/purpose of individual components within the circuit.
10. The different types of cabling, and their application (such as multicore cables, single core cables, steel wire armoured (SWA), mineral insulated (MI), screened cables).
11. The different types of electric motors and motor starters, and their maintenance requirements.
12. The different types of control systems, their various components and maintenance requirements.
13. The application and use of a range of electrical components (such as plugs, switches, sockets, lighting and fittings, junction boxes, consumer units), and the types of checks required by each of them.
14. The various lighting systems used (including tungsten, sodium, mercury vapour and fluorescent), and their maintenance requirements.
15. The different types of wiring enclosures that are used (to include conduit, trunking and traywork systems) and what to check during the maintenance activities.
16. Methods of checking that components are fit for purpose, and the need to replace ‘lifed’ items (such as motor brushes, seals and gaskets, and overload protection devices).
17. How to make sensory checks (by sight, sound, smell, touch).
18. How to check that the replacement components meet the required specification/operating conditions (such as values, tolerance, current carrying capacity, voltage rating, power rating, working temperature range).
19. The various planned maintenance categories that are generally used (such as condition based maintenance, scheduled maintenance and total preventative maintenance (TPM)).
20. The procedure for obtaining the consumables to be used during the planned maintenance activity.
21. The appropriate testing procedures to be adopted during the maintenance activity.
22. How to compile planned maintenance records/logs/reports that comply with company policy and procedures.
23 The equipment operating and control procedures, and how to apply them in order to carry out planned maintenance
24 The problems that can occur whilst carrying out the planned maintenance activities, and how they can be avoided
25 The organisational procedure to be adopted for the safe disposal of waste of all types of materials
26 The extent of your own authority and whom you should report to if you have problems that you cannot resolve
## Unit 15
Carrying out planned maintenance on electrical equipment

<table>
<thead>
<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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</thead>
</table>

### Carry out all of the following planned maintenance activities:

- plan the maintenance activities to cause minimum disruption to normal working
- use the correct issue of company and/or manufacturers’ drawings and maintenance documentation
- adhere to risk assessment, COSHH and other relevant safety standards
- ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
- provide safe access and working arrangements for the maintenance area
- carry out the planned maintenance activity using appropriate techniques and procedures
- re-connect and return the equipment to service on completion of the maintenance activities
- functionally test and adjust the equipment to meet the specification
- dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition

### Carry out planned maintenance on two of the following groups of electrical equipment:

- power supplies
- motors and starters
- switchgear and distribution panels
- other specific electrical equipment
- control systems
- electrical plant
- luminaires
## Unit 15
Carrying out planned maintenance on electrical equipment

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<tbody>
<tr>
<td><strong>Follow planned maintenance activities using one of the following types of maintenance categories:</strong></td>
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<tr>
<td>condition based maintenance</td>
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<tr>
<td>scheduled maintenance total</td>
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<tr>
<td>preventative maintenance</td>
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<tr>
<td><strong>Carry out all of the following planned maintenance activities:</strong></td>
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<tr>
<td>visual examination of condition and security of wiring enclosures (conduit, trunking, traywork)</td>
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<tr>
<td>checking and replacing ‘lifen’ items (such as batteries, emergency lights, motor brushes)</td>
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<tr>
<td>checking the integrity of connections</td>
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<tr>
<td>inspecting and cleaning sensors</td>
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<tr>
<td>monitoring condition/deteriation of contactors</td>
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<td>sensory checks (sight, sound, smell, touch)</td>
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<tr>
<td>making insulation resistance checks</td>
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<tr>
<td>portable appliance testing (PAT)</td>
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<tr>
<td>removing excessive dirt and dust from panels</td>
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<tr>
<td>checking condition of cables</td>
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<tr>
<td>making routine adjustments</td>
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<tr>
<td>testing and reviewing system function</td>
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<tr>
<td>checking integrity and security of earth bonding</td>
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<tr>
<td>recording the results of the maintenance and reporting any defects found</td>
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</table>
### Unit 15
Carrying out planned maintenance on electrical equipment

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<tr>
<td><strong>Ensure that the maintained equipment meets all of the following quality and accuracy standards:</strong></td>
<td></td>
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<tr>
<td>all components and sub-assemblies are fit for purpose</td>
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<tr>
<td>all connections are electrically and mechanically safe and sound</td>
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<tr>
<td>equipment and associated cabling meets IEE wiring regulations</td>
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<tr>
<td>equipment functions to specification</td>
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<tr>
<td>all potential defects are identified and reported for future action</td>
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<tr>
<td><strong>Complete all relevant paperwork, from the following, and pass it to the appropriate people:</strong></td>
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<tr>
<td>job cards</td>
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<tr>
<td>maintenance log or report</td>
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<td>permit to work/formal risk assessment</td>
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**Knowledge and understanding reference:**

Candidate: _______________________________ Date: ________________

Assessor: _______________________________ Date: ________________
**Unit 16**  
Carrying out fault diagnosis on electronic equipment and circuits

**Unit Summary**  
This unit identifies the competencies you need to carry out efficient and effective fault diagnosis on electronic equipment/circuits, in accordance with approved procedures. You will be required to diagnose faults on a range of electronic equipment, such as power supply systems, motor control systems, sensors and actuators, digital circuits and systems, analogue circuits and systems, and hybrid circuits and systems, both at assembly and component level. You will be expected to use a variety of fault diagnosis methods and techniques, and to utilise a number of diagnostic aids and equipment. From the evidence gained, you will be expected to identify the fault and its probable cause, and to suggest appropriate action to remedy the problem.

Your responsibilities will require you to comply with organisational policy and procedures for the fault diagnostic activities undertaken, and to report any problems with these activities or the tools and equipment used that you cannot personally resolve, or are outside your permitted authority, to the relevant people. You will be expected to work with minimum supervision, taking personal responsibility for your own actions and for the quality and accuracy of the work that you produce.

Your underpinning knowledge will provide a good understanding of your work, and will provide an informed approach to applying fault diagnosis procedures on electronic equipment and circuits. You will understand the various fault diagnosis methods and techniques used, and their application. You will also know how to interpret and apply information obtained from diagnostic aids and equipment, in adequate depth to provide a sound basis for carrying out the activities and for identifying faults or conditions that are outside the required specification.

You will understand the safety precautions required when carrying out the fault diagnosis 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.
Unit 16
Carrying out fault diagnosis on electronic equipment and circuits

Performance statements:

You must:

a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Review and use all relevant information on the symptoms and problems associated with the products or assets
c. Investigate and establish the most likely causes of the faults
d. Select, use and apply diagnostic techniques, tools and aids to locate faults
e. Complete the fault diagnosis within the agreed time and inform the appropriate people when this cannot be achieved
f. Determine the implications of the fault for other work and for safety considerations
g. Use the evidence gained to draw valid conclusions about the nature and probable because of the fault
h. Record details on the extent and location of the faults in an appropriate format

Scope of the unit:

The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:

1. Carry out all of the following during the fault diagnostic activity:
   - Plan the fault diagnosis using available information about the fault
   - Use the correct issue of company and/or manufacturers’ drawings and maintenance documentation
   - Adhere to risk assessment, COSHH and other relevant safety standards
   - Ensure safe isolation of equipment
   - Provide safe access and working arrangements for the faultfinding/maintenance area
   - Use grounded wrist straps and other electrostatic discharge (ESD) precautions as appropriate
   - Carry out the fault diagnosis activities using appropriate procedures
   - Collect equipment fault diagnosis evidence from ‘live’ and isolated circuits
   - Disconnect or isolate components, or parts of circuits when appropriate, to confirm the diagnosis
   - Identify the fault and determine the appropriate corrective action
   - Dispose of waste items in a safe and environmentally acceptable manner and leave the work area in a safe condition

2. Carry out fault diagnosis on four of the following types of equipment:
   - Power supply systems (such as switched mode, series regulation, shunt regulation)
   - Motor control systems (such as closed-loop servo/proportional, inverter control)
   - Sensors and actuators (such as linear, rotational, temperature, level, photo-optic, pressure, flow)
   - Digital circuits and systems (eg, programmable controller, microprocessor, ROM/RAM, logic gates, etc)
   - Analogue circuits and systems (eg, frequency modulation/demodulation, amplifiers, filters, oscillators)
   - Hybrid circuits and systems (eg, analogue to digital convertors [ADC], d-to-a convertors [DAC])
3 Collect fault diagnosis evidence from **four** of the following sources:
- the person or operator who reported the fault
- test instrument measurements (such as multimeter, oscilloscope, logic probe, signal tracer, signal generator)
- circuit meters (such as voltmeter, power factor meter, ammeter)
- equipment self-diagnosis
- recording devices
- sensory input (sight, sound, smell, touch)
- plant/equipment records
- equipment outputs

4 Use a range of fault diagnostic techniques to include:
- half-split technique

   **Plus one** more from the following
   - input/output technique
   - six point technique
   - unit substitution
   - injection and sampling
   - emergent sequence
   - function testing

5 Use a variety of diagnostic aids to include **two** of the following:
- logic diagrams
- flow charts or algorithms
- probability charts/reports
- computer-aided test equipment
- fault analysis charts (such as fault trees)
- manufacturers’ manuals
- trouble shooting guides
- electronic aids

6 Use **all** of the following fault diagnosis procedures:
- inspection (such as breakages, wear/deterioration, signs of overheating, missing parts, loose fittings)
- operation (such as manual switching off and on, automatic switching/timing/sequencing, outputs)
- measurement (such as voltage, current, continuity, logic state, noise, frequency, signal shape and level)

7 Use **four** of the following types of test equipment to aid fault diagnosis:
- oscilloscope
- multimeter
- logic probe
- signal tracer
- signal generator
- other specific test equipment

8 Find faults that have resulted in **two** of the following breakdown categories:
- intermittent action or circuit failure
- partial failure or reduced performance
- complete breakdown

9 Provide a record of the outcome of the fault diagnosis using one of the following:
- step-by-step analytical report
- preventative maintenance log/report
- corrective action report
- company specific reporting procedure
Unit 16
Carrying out fault diagnosis on electronic equipment and circuits

Knowledge statements:
You must have knowledge and understanding of:

1. The health and safety requirements of the area in which the fault diagnosis activity is to take place, and the responsibility these requirements place on you
2. The isolation and lock-off procedure or permit-to-work procedure that applies
3. How to recognise and deal with victims of electric shock (to include methods of safely removing the victim from the power source, isolating the power source, and methods of first aid resuscitation)
4. The importance of wearing protective clothing and other appropriate safety equipment during the fault diagnosis activities
5. Hazards associated with carrying out fault diagnosis on electronic equipment (mains electricity, stored capacitive/inductive/electrostatic energy, misuse of tools), and how they can be minimised
6. The procedure to be adopted to establish the background of the fault
7. How to evaluate the various types of information available for fault diagnosis
8. How to use the various aids and reports available for fault diagnosis
9. How to use various types of fault diagnostic equipment needed to investigate the problem
10. Digital circuits and their operation (including logic truth tables and Boolean algebra for AND, OR, NAND, NOR, NOT and EXCLUSIVE-OR gates)
11. The various fault finding techniques that can be used, and how they are applied (such as half-split, input-to-output, emergent problem sequence, six point technique, function testing, unit substitution, injection and sampling techniques, and equipment self-diagnostics)
12. How to evaluate sensory conditions (by sight, sound, smell, touch)
13. How to analyse evidence and evaluate possible characteristics and causes of specific faults/problems
14. How to relate previous reports/records of similar fault conditions
15. The care, handling and application of electronic test instruments (such as multimeters, logic probes, oscilloscopes, signal tracers, signal generators)
16. How to calibrate electronic test instruments and check that they are free from damage and defects
17. The precautions (use of wrist straps, special packaging and handling areas) to be taken to prevent electrostatic discharge (ESD) damage to electronic circuits and components
18. How to obtain and interpret drawings, circuit and physical layouts, charts, specifications, manufacturers' manuals, history/maintenance reports, graphical electronic/electrical symbols, IEE wiring regulations, and other documents needed in the fault diagnosis activities
19. The basic principles of how the circuit functions, its operating sequence, the function/purpose of individual units/components, and how they interact
20. The different types of cabling (multicore, single core, ribbon, screened cables), fittings/connectors (including insulation displacement), and their application
21. The different types of control systems and components, and their operation
22. The functions of different types of electronic components (analogue and digital), and their operation
23. How to evaluate the likely risk to yourself and others, and the effects the fault could have on the overall system or process
24. How to prepare and produce a risk analysis report, where appropriate
25. How to prepare a report, or take follow-up action, on conclusion of the fault diagnosis, in accordance with company policy
26. The extent of your own authority and whom you should report to if you have problems that you cannot resolve
## Unit 16
Carrying out fault diagnosis on electronic equipment and circuits

<table>
<thead>
<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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**evidence type**

**date**

**Carry out all of the following during the fault diagnostic activity:**

- Plan the fault diagnosis using available information about the fault
- Use the correct issue of company and/or manufacturers' drawings and maintenance documentation
- Adhere to risk assessment, COSHH and other relevant safety standards
- Ensure safe isolation of equipment
- Provide safe access and working arrangements for the fault finding/maintenance area
- Use grounded wrist straps and other electrostatic discharge (ESD) precautions as appropriate
- Carry out the fault diagnosis activities using appropriate procedures
- Collect equipment fault diagnosis evidence from 'live' and isolated circuits
- Disconnect or isolate components, or parts of circuits when appropriate, to confirm the diagnosis
- Identify the fault and determine the appropriate corrective action
- Dispose of waste items in a safe and environmentally acceptable manner and leave the work area in a safe condition
## Unit 16
Carrying out fault diagnosis on electronic equipment and circuits

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<th>evidence record sheet</th>
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<th>performance evidence 2</th>
<th>performance evidence 3</th>
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<tbody>
<tr>
<td><strong>Carry out fault diagnosis on four of the following types of equipment:</strong></td>
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<td>power supply systems (such as switched mode, series regulation, shunt regulation)</td>
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<td>motor control systems (such as closed-loop servo/proportional, inverter control)</td>
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<td>sensors and actuators (such as linear, rotational, temperature, level, photo-optic, pressure, flow)</td>
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<td>digital circuits and systems (eg, programmable controller, microprocessor, ROM/RAM, logic gates, etc)</td>
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<td>analogue circuits and systems (eg, frequency modulation/demodulation, amplifiers, filters, oscillators)</td>
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<td>hybrid circuits and systems (eg, analogue to digital convertors [ADC], d-to-a convertors [DAC])</td>
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<td><strong>Collect fault diagnosis evidence from four of the following sources:</strong></td>
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<td>equipment outputs</td>
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### Unit 16
Carrying out fault diagnosis on electronic equipment and circuits

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<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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</table>

**Use a range of fault diagnostic techniques to include:**

- half-split technique
- Plus **one** more from the following
  - input/output technique
  - six point technique
  - unit substitution
  - injection and sampling
  - emergent sequence
  - function testing

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

- logic diagrams
- flow charts or algorithms
- probability charts/reports
- computer-aided test equipment
- fault analysis charts (such as fault trees)
- manufacturers’ manuals
- trouble shooting guides
- electronic aids

**Use all of the following fault diagnosis procedures:**

- inspection (such as breakages, wear/deterioration, signs of overheating, missing parts, loose fittings)
- operation (such as manual switching off and on, automatic switching/timing/sequencing, outputs)
- measurement (such as voltage, current, continuity, logic state, noise, frequency, signal shape and level)

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

- oscilloscope
- multimeter
- logic probe
- signal tracer
- signal generator
- other specific test equipment
## Unit 16
Carrying out fault diagnosis on electronic equipment and circuits

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<td>complete breakdown</td>
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<td>Provide a record of the outcome of the fault diagnosis using one of the following:</td>
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<td>step-by-step analytical report</td>
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<td>preventative maintenance log/report</td>
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<td>corrective action report</td>
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<td>company specific reporting procedure</td>
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<td>Knowledge and understanding reference:</td>
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Candidate: ___________________________ Date: _____________________

Assessor: ___________________________ Date: _____________________
Unit 17
Testing electronic equipment and circuits

Unit summary
This unit identifies the competencies you need to carry out inspections and tests on electronic equipment and circuits, in accordance with approved procedures. You will be required to carry out tests on a range of electronic equipment, such as power supply systems, motor control systems, sensors and actuators, digital circuits and systems, analogue circuits and systems, hybrid circuits and systems, to establish that they functioning at optimal level and to specification. You will be required to carry out inspections and tests which will include voltage and current levels, resistance values, waveform, clock/timer switching, pulse width/rise time, open/short circuit, logic state, frequency modulation/demodulation, and signal-to-noise ratio / interference levels.

Your responsibilities will require you to comply with organisational policy and procedures for carrying out the testing activities, and to report any problems with these activities that you cannot personally resolve, or are outside your permitted authority, to the relevant people. You will be expected to work with minimum 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 the procedures for carrying out the required inspections and tests, and will provide an informed approach to applying the necessary test procedures. You will understand the equipment being worked on, the test equipment being used, and the various testing procedures and their application, in adequate depth to provide a sound basis for carrying out the activities to the required specification. In addition, you will be expected to review the outcome of the tests, compare the results with appropriate specifications, determine the action required, and record/report the results in the appropriate format.

You will understand the safety precautions required when carrying out the inspection and testing activities, especially those for isolating the equipment and 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.
Unit 17
Testing electronic equipment and circuits

Performance statements:
You must:

a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Follow the appropriate procedures for use of tools and equipment to carry out the required tests
c. Set up and carry out the tests using the correct procedures and within agreed timescales
d. Record the results of the tests in the appropriate format
e. Review the results and carry out further tests if necessary

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:

1. Carry out all of the following during the testing activities:
   - plan the inspection and testing activities to cause minimum disruption to normal working
   - use the correct issue of company and/or manufacturers’ drawings and maintenance documentation
   - adhere to risk assessment, COSHH and other relevant safety standards
   - ensure the safe isolation of equipment
   - provide safe access and working arrangements for the testing area
   - carry out the inspection and testing activities using appropriate techniques and procedures
   - take electrostatic precautions when handling sensitive components and circuit boards
   - re-connect and return the equipment to service on completion of the testing activities
   - dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition

2. Carry out inspections and tests on four of the following types of electronic equipment:
   - power supplies (such as switch mode, series regulation, shunt regulation)
   - motor control systems (such as closed loop servo/ proportion, inverter control)
   - sensor/actuator circuit (such as linear, rotational, temperature, photo-optic, flow, level, pressure)
   - digital circuit (such as process control, microprocessor, logic devices, display devices)
   - signal processing circuit (such as frequency modulating/demodulating, amplifiers, filters)
   - alarms and protection circuits
   - ADC and DAC hybrid circuits

3. Carry out tests using a range of tools and test equipment, to include four of the following:
   - oscilloscope
   - ammeter
   - logic analyser
   - logic probe
   - signal tracer
   - signal generator
   - multimeter
   - automatic test equipment
   - computer-aided diagnostic equipment
   - special purpose testing equipment
   - temperature measuring devices
4 Carry out all of the following tests/measurements, as applicable to the equipment being tested:
- logic states
- dc voltage/current levels
- ac voltage/current levels
- clock/timer switching
- pulse width/rise time
- open/short circuit
- resistance
- heat dissipation
- frequency modulation/demodulation
- performance of circuit
- condition of assemblies and components
- signal noise/interference levels

5 Carry out all of the following checks to ensure the accuracy and quality of the tests carried out:
- the test equipment is correctly calibrated
- test equipment used is appropriate for the tests being carried out
- ESD precautions and procedures are applied
- test procedures to be used are up-to-date and follow laid-down procedures
- test equipment is operated within its specified range

6 Provide a record/report of the test outcome using one of the following:
- preventative maintenance log/report
- company specific reporting procedure
- inspection schedule
- specific test report
Unit 17
Testing electronic equipment and circuits

Knowledge statements:
You must have knowledge and understanding of:
1. The health and safety requirements of the area in which the testing activity is to take place, and the responsibility these requirements place on you
2. Your responsibilities under regulations relevant to the electronic testing activities being undertaken
3. The isolation and lock-off procedure or permit-to-work procedure that applies to the testing activities (electrical isolation, locking off switchgear, removal of fuses, placing of warning notices, proving the isolation has been achieved and secured)
4. The isolation procedure(s) unique or specific to the electronic circuits
5. The specific safety precautions to be taken when carrying out formal inspection, safety and circuit testing of electronic equipment
6. The hazards associated with testing electronic equipment and circuits, and with the equipment that is used, and how these hazards can be minimised
7. The importance of wearing protective clothing, and other appropriate safety equipment, during the testing activities
8. The importance of keeping the work area clean, tidy and free from waste and surplus materials
9. How the testing activities may affect the work of others, and the procedure for informing them of the work to be carried out
10. The procedures and precautions to be adopted to eliminate/protect against electrostatic discharge
11. How to obtain and interpret drawings, Boolean algebra, truth tables, logic symbols, circuit diagrams, specifications, manufacturers' manuals, test procedures and documents needed to carry out the tests
12. The basic principles of how the electronic circuit functions, the operation sequence, the function/purpose of individual units/components, and how they interact
13. How to determine the most suitable test points within the circuit
14. How to set up and apply the appropriate test equipment
15. 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 their intended purpose
16. How to ensure the test equipment is correctly calibrated
17. The various testing methods and procedures, and how to apply them to different operating conditions
18. How to analyse test results, and use comparison and sequential techniques
19. The environmental control requirements and company operating procedures relating to functional testing
20. The documentation required, and the procedures to be followed, at the conclusion of the test
21. The extent of your own authority and whom you should report to if you have problems that you cannot resolve
## Unit 17
Testing electronic equipment and circuits

<table>
<thead>
<tr>
<th>evidence record sheet</th>
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**Carry out all of the following during the testing activities:**

- Plan the inspection and testing activities to cause minimum disruption to normal working
- Use the correct issue of company and/or manufacturers' drawings and maintenance documentation
- Adhere to risk assessment, COSHH and other relevant safety standards
- Ensure the safe isolation of equipment
- Provide safe access and working arrangements for the testing area
- Carry out the inspection and testing activities using appropriate techniques and procedures
- Take electrostatic precautions when handling sensitive components and circuit boards
- Re-connect and return the equipment to service on completion of the testing activities
- Dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition
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<tr>
<td>Testing electronic equipment and circuits</td>
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<tr>
<td>Carry out inspections and tests on four of the following types of electronic equipment:</td>
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<td>power supplies (such as switch mode, series regulation, shunt regulation)</td>
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<td>ammeter</td>
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<td>logic analyser</td>
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<td>logic probe</td>
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<td>temperature measuring devices</td>
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</table>
# Unit 17
Testing electronic equipment and circuits

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<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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</table>

**Carry out all of the following tests/measurements, as applicable to the equipment being tested:**

- logic states
- dc voltage/current levels
- ac voltage/current levels
- clock/timer switching
- pulse width/rise time
- open/short circuit
- resistance
- heat dissipation
- frequency modulation/demodulation
- performance of circuit
- condition of assemblies and components
- signal noise/interference levels

**Carry out all of the following checks to ensure the accuracy and quality of the tests carried out:**

- the test equipment is correctly calibrated
- test equipment used is appropriate for the tests being carried out
- ESD precautions and procedures are applied
- test procedures to be used are up-to-date and follow laid-down procedures
- test equipment is operated within its specified range

**Provide a record/report of the test outcome using one of the following:**

- preventative maintenance log/report
- company specific reporting procedure
- inspection schedule
- specific test report

Knowledge and understanding reference:

Candidate: ___________________________________________  Date: ___________________

Assessor: ___________________________________________  Date: ___________________
Unit 18
Repairing electronic equipment

Unit summary
This unit identifies the competencies you need to carry out repairs on electronic equipment, in accordance with approved procedures. You will be required to carry out repairs on a range of electronic equipment, such as power supply systems, motor control systems, sensors and actuators, digital circuits and systems, analogue circuits and systems, and hybrid circuits and systems. This will involve dismantling, removing and replacing faulty items at board and component level, on a variety of different types of electronic assemblies and sub-assemblies. You will be expected to apply a number of dismantling and reassembly 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 equipment/circuit during the repair activities and, therefore, the application of electrostatic discharge 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 are outside your permitted authority, to the relevant people. You will be expected to work with minimum 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 electronic repair procedures. You will understand the various repair procedures used, 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 to the required specification.

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, 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.
Unit 18
Repairing electronic equipment

Performance statements:

You must:

a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Follow the relevant maintenance schedules to carry out the required work
c. Carry out the maintenance activities within the limits of your personal authority
d. Carry out the maintenance activities in the specified sequence and in an agreed timescale
e. Report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
f. Complete relevant maintenance records accurately and pass them on to the appropriate person
g. Dispose of waste materials in accordance with safe working practices and approved procedures

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:

1. Carry out all of the following during the repair activities:
   • plan the repair activities to cause minimum disruption to normal working
   • use the correct issue of company and/or manufacturers’ drawings and maintenance documentation
   • adhere to risk assessment, COSHH and other relevant safety standards
   • ensure safe isolation of equipment
   • provide safe access and working arrangements for the maintenance area
   • carry out the repair activities using appropriate techniques and procedures
   • take electrostatic discharge precautions when handling sensitive components and circuit boards
   • re-connect and return the system to service on completion of the repair activities
   • dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition

2. Carry out repair activities on four of the following types of electronic equipment:
   • power supplies (such as switch mode, series regulation, parallel regulation)
   • motor control systems (such as closed loop servo systems, solid state drives, inverter control)
   • sensor/actuator circuits (such as linear, temperature, photo-optic, flow, rotational, level, pressure, mass/weight)
   • digital circuits (such as process control, microprocessor-based, logic devices, display devices)
   • signal processing circuits (such as frequency modulating/demodulating, oscillators, amplifiers, filters)
   • alarms and protection circuits
   • ADC and DAC hybrid circuits

3. Carry out all of the following repair activities:
   • applying electrostatic discharge precautions (ESD)
   • preparation of areas for repairing
   • disconnection/dismantling of required units/components
   • replacement of faulty units/components
   • reassembly of components/equipment in line with specification
   • functionally testing completed equipment
   • making any adjustments required
4 Replace a range of electronic components, to include ten of the following:
- cables and connectors
- printed circuit boards
- transformers
- fixed resistors
- variable resistors
- capacitors
- rectifiers
- thermistors
- transistors
- diodes
- sensors
- heat sinks
- protection devices
- decoders
- regulator ICs
- encoders or resolvers
- inverters or servo controllers
- analog or digital integrated circuits

5 Use appropriate joining/connecting techniques to deal with four of the following types of connection:
- push-fit connectors
- soldering or desoldering
- clip assemblies
- threaded connections
- crimped connections
- zero insertion force (zif) connectors
- adhesive joints/assemblies
- edge connectors

6 Maintain electronic equipment, in compliance with one or more of the following quality and accuracy standards:
- organisational guidelines and codes of practice
- equipment manufacturer’s operation range
- IEE wiring regulations
- BS and ISO standards

7 Complete all relevant paperwork from the following, and pass it to the appropriate people:
- job cards
- permits to work/formal risk assessment
- maintenance logs or reports

Knowledge statements:
Knowledge statements

You must have knowledge and understanding of:

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. Your responsibilities under regulations that apply to the electronic repair activities being undertaken
3. The isolation and lock-off procedure or permit-to-work procedure that applies to the maintenance activities (electrical isolation, locking off switchgear, removal of fuses, placing maintenance warning notices, proving the isolation has been achieved and secured) Isolation procedure and safety precautions unique to the electronic equipment or circuits being worked on
4. The importance of wearing protective clothing and other appropriate safety equipment during maintenance activities
5. The hazards associated with repairing electronic equipment, and with the materials, tools and equipment that are used (such as live electrical components, capacitor discharge), and how these can be minimised
6. The importance of keeping the work area clean and tidy, and free from waste and surplus materials
7. How the maintenance activities may affect the work of others, and the procedure for informing them of the work to be carried out
8. The procedures and precautions to be adopted to eliminate electrostatic discharge hazards
9. How to obtain and interpret drawings, boolean algebra, truth tables, logic symbols, circuit diagrams, specifications, manufacturers’ manuals, test procedures and other documents needed to carry out repairs
10. The basic principles of how the electronic circuit functions, its operation sequence, the working purpose of individual units/components and how they interact
11. Organisational policy on the repair or replacement of faulty components during the maintenance process
12. How to check that the replacement components meet the required specification/operating conditions (values, tolerance, current-carrying capacity, ambient temperatures)
13. Methods of removing and replacing the faulty components from the equipment (unplugging, desoldering, removal of screwed, clamped, edge connected, zero insertion force, and crimped connections)
14. The importance of removing faulty components, without causing damage to other components, wiring, or the surrounding structure
15. Methods of attaching identification marks/labels to removed components or connections, in order to assist with re-assembly
16. The tools and equipment used in the maintenance activities, including the use of wire-stripping tools, crimping tools, soldering irons, insertion devices and connecting tools
17. How to check that tools and equipment are free from damage or defects, that they are in a safe and usable condition and are configured correctly for the intended purpose
18. The sequence for reconnecting the equipment, and checks that need to be made prior to restoring power (checking components for correct polarity, ensuring there are no exposed conductors, cable insulation is not damaged, all connections are mechanically and electrically secure, casings are free from loose screws, wire ends or solder blobs that could cause short circuits, and all fuses/protection devices are installed)
19. The importance of making ‘off-load’ checks before proving the equipment with the electrical supply on
20. How to make adjustments to components/assemblies to ensure they function correctly
21 The maintenance documentation and/or reports that need to be completed following the maintenance activity, and the importance of ensuring these reports are completed accurately and legibly

22 The problems that can occur with the maintenance activity, and how they can be overcome

23 The organisational procedures to be adopted for the safe disposal of waste of all types of materials

24 The extent of your own authority and whom you should report to when you have a problem you cannot resolve
## Unit 18
Reparing electronic equipment

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<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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</table>

### Carry out all of the following during the repair activities:

- plan the repair activities to cause minimum disruption to normal working
- use the correct issue of company and/or manufacturers’ drawings and maintenance documentation
- adhere to risk assessment, COSHH and other relevant safety standards
- ensure safe isolation of equipment
- provide safe access and working arrangements for the maintenance area
- carry out the repair activities using appropriate techniques and procedures
- take electrostatic discharge precautions when handling sensitive components and circuit boards
- re-connect and return the system to service on completion of the repair activities
- dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition

### Carry out repair activities on four of the following types of electronic equipment:

- power supplies (such as switch mode, series regulation, parallel regulation)
- motor control systems (such as closed loop servo systems, solid state drives, inverter control)
- sensor/actuator circuits (such as linear, temperature, photo-optic, flow, rotational, level, pressure, mass/weight)
# Unit 18
Repairing electronic equipment

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<td>signal processing circuits (such as frequency modulating/demodulating, oscillators, amplifiers, filters)</td>
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<tr>
<td>alarms and protection circuits</td>
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<tr>
<td>ADC and DAC hybrid circuits</td>
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</table>

**Carry out all of the following repair activities:**

- applying electrostatic discharge precautions (ESD)
- preparation of areas for repairing
- disconnection/dismantling of required units/components
- replacement of faulty units/components
- reassembly of components/equipment in line with specification
- functionally testing completed equipment
- making any adjustments required

**Replace a range of electronic components, to include ten of the following:**

- cables and connectors
- printed circuit boards
- transformers
- fixed resistors
- variable resistors
- capacitors
- rectifiers
- thermistors
- transistors
- diodes
- sensors
- heat sinks
- protection devices
- decoders
### Unit 18
Repairing electronic equipment

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<td>regulator ICs</td>
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<td>encoders or resolvers</td>
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<td>inverters or servo controllers</td>
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<tr>
<td>analog or digital integrated circuits</td>
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</table>

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

- push-fit connectors
- soldering or desoldering
- clip assemblies
- threaded connections
- crimped connections
- zero insertion force (zif) connectors
- adhesive joints/assemblies
- edge connectors

**Maintain electronic equipment, in compliance with one or more of the following quality and accuracy standards:**

- organisational guidelines and codes of practice
- equipment manufacturer's operation range
- IEE wiring regulations
- BS and ISO standards

**Complete all relevant paperwork from the following, and pass it to the appropriate people:***

- job cards
- permits to work/formal risk assessment
- maintenance logs or reports

Knowledge statements:

Knowledge and understanding reference:

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Candidate: ___________________________  Date: __________________

Assessor: ___________________________  Date: __________________
Unit 19
Carrying out fault diagnosis on fluid power equipment and circuits

Unit summary
This unit identifies the competencies you need to carry out efficient and effective fault diagnosis on fluid power equipment and circuits, in accordance with approved procedures. You will be required to diagnose faults on a range of fluid power equipment, such as pneumatic, hydraulic and vacuum devices, both at assembly and component level. You will be expected to use a variety of fault diagnosis methods and techniques, and to utilise a number of diagnostic aids and equipment. From the evidence gained, you will be expected to identify the fault and its probable cause, and to suggest appropriate action to remedy the problem.

Your responsibilities will require you to comply with organisational policy and procedures for the fault diagnostic activities undertaken, and to report any problems with these activities or the tools and equipment used that you cannot personally resolve, or are outside your permitted authority, to the relevant people. You will be expected to work with minimum 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 fault diagnosis procedures on fluid power equipment. You will understand the various fault diagnosis methods and techniques used, and their application. You will also know how to apply and interpret information obtained from diagnostic aids and equipment, in adequate depth to provide a sound basis for carrying out the activities and identifying faults or conditions that are outside the required specification.

You will understand the safety precautions required when carrying out the fault diagnosis 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.
Unit 19
Carrying out fault diagnosis on fluid power equipment and circuits

Performance statements:
You must:
a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Review and use all relevant information on the symptoms and problems associated with the products or assets
c. Investigate and establish the most likely causes of the faults
d. Select, use and apply diagnostic techniques, tools and aids to locate faults
e. Complete the fault diagnosis within the agreed time and inform the appropriate people when this cannot be achieved
f. Determine the implications of the fault for other work and for safety considerations
g. Use the evidence gained to draw valid conclusions about the nature and probable cause of the fault
h. Record details on the extent and location of the faults in an appropriate format

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:
1. Carry out all the following during the fault diagnostic activity:
   • plan the fault diagnosis activities prior to beginning the work
   • use the correct issue of company and/or manufacturers’ drawings and maintenance documentation
   • adhere to risk assessment, COSHH and other relevant safety standards
   • ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
   • provide safe access and working arrangements for the maintenance area
   • carry out the fault diagnostic activities using approved procedures
   • identify the fault and determine appropriate corrective action
   • dispose of waste items in safe and environmentally acceptable manner, and leave the work area in a safe condition

2. Carry out fault diagnosis on two of the following types of equipment:
   • pneumatic system
   • hydraulic system
   • vacuum system

3. Carry out fault diagnosis on all of the following system components:
   • pumps
   • cylinders actuators
   • pipework connectors
   • hoses switches
   • valves
4 Collect fault diagnosis evidence from **four** of the following sources:
- the person or operator who reported the fault
- test instrument/rig measurements (such as pressure, flow, sequence)
- monitoring equipment or gauges
- recording devices sensory input (such as sight, sound, smell, touch)
- plant/machinery records
- condition of the end product

5 Use a range of fault diagnostic techniques, to include:
  - half-split technique

  Plus **one** more from the following:
  - Input/output
  - injection and sampling
  - six point technique
  - emergent sequence
  - unit substitution
  - functional testing

6 Use a variety of diagnostic aids and equipment, to include **two** of the following:
  - manufacturer's manual
  - algorithms
  - probability charts/reports
  - equipment self-diagnostics
  - physical layout diagrams
  - flow charts
  - fault analysis charts (such as fault trees)
  - troubleshooting guides

7 Use **all** of the following diagnosis procedures:
  - inspection (for leaks, loose fittings, breakages, wear/deterioration, damage)
  - to pipes/hoses, alignment) operation (such as manual operation, timing, sequencing)
  - measurement (such as pressure, flow, timing, sequence, movement)

8 Use **two** of the following types of test equipment to aid fault diagnosis:
  - measuring devices
  - flow indicators
  - pressure indicators
  - thermal indicators
  - test rigs
  - self-diagnosis equipment

9 Find faults that have resulted in **two** of the following breakdown categories:
  - intermittent problem
  - partial failure or reduced performance
  - complete breakdown

10 Provide a record of the outcome of fault diagnosis using **one** of the following:
  - step-by-step analytical report
  - preventative maintenance log/report
  - corrective action report
  - company-specific reporting procedure
Unit 19
Carrying out fault diagnosis on fluid power equipment and circuits

Knowledge statements:
You must have knowledge and understanding of:
1. The health and safety requirements of the area in which the fault diagnosis activity is to take place, and the responsibility these requirements place on you
2. The isolation and lock-off procedure or permit-to-work procedure that applies
3. The importance of wearing protective clothing and other appropriate safety equipment during the fault diagnosis process
4. Hazards associated with carrying out fault diagnosis on fluid power equipment (handling fluids, stored pressure/force, misuse of tools, using practices/procedures that do not follow laid-down procedures)
5. Regulations and codes of practice relating to working with fluid power equipment
6. How to obtain and interpret drawings, schematic and physical diagrams, specifications, flow charts, manufacturers’ manuals and other documents needed in the fault diagnostic activities
7. 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)
8. The procedure to be adopted to establish the background of the fault
9. How to evaluate the various types of information available for fault diagnosis
10. How to use the various aids and reports available for fault diagnosis
11. How to evaluate sensory information from sight, sound, smell, touch
12. How to use a range of fault diagnostic equipment to investigate the problem (such as measuring devices, pressure and flow testing devices)
13. How to calibrate the test equipment being used, or where to get the test instruments correctly calibrated
14. How to use the various test equipment, and how to connect it into the circuit at the appropriate points
15. The basic principles of how the circuit/equipment functions, and the working purpose of the individual units/components and their interrelations with other components and assemblies
16. How to analyse and evaluate possible characteristics and causes of specific faults/problems
17. How to make use of previous reports/records of similar fault conditions
18. How to evaluate the likely risk to others and yourself, and the effects the fault could have on the overall process
19. How to prepare and produce a risk analysis report, where appropriate
20. How to prepare a report or take follow-up action, which complies with the company policy on concluding fault diagnosis
21. The extent of your own authority and whom you should report to if you have problems that you cannot resolve
## Unit 19
Carrying out fault diagnosis on fluid power equipment and circuits

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### Carry out all the following during the fault diagnostic activity:

- Plan the fault diagnosis activities prior to beginning the work
- Use the correct issue of company and/or manufacturers' drawings and maintenance documentation
- Adhere to risk assessment, COSHH and other relevant safety standards
- Ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
- Provide safe access and working arrangements for the maintenance area
- Carry out the fault diagnostic activities using approved procedures
- Identify the fault and determine appropriate corrective action
- Dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition

### Carry out fault diagnosis on two of the following types of equipment:

- Pneumatic system
- Hydraulic system
- Vacuum system

### Carry out fault diagnosis on all of the following system components:

- Pumps
- Cylinders actuators
- Pipework connectors
- Hoses switches
- Valves
Unit 19  
Carrying out fault diagnosis on fluid power equipment and circuits

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<td>Collect fault diagnosis evidence from four of the following sources:</td>
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<td>the person or operator who reported the fault</td>
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<td>test instrument/rig measurements (such as pressure, flow, sequence)</td>
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<td>recording devices sensory input (such as sight, sound, smell, touch)</td>
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<td>condition of the end product</td>
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<td>Use a range of fault diagnostic techniques, to include:</td>
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<td>half-split technique</td>
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<td>Plus one more from the following:</td>
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<td>Input/output</td>
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<td>injection and sampling</td>
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<td>six point technique emergent sequence</td>
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<td>unit substitution</td>
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<tr>
<td>functional testing</td>
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<tr>
<td>Use a variety of diagnostic aids and equipment, to include two of the following:</td>
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<td>manufacturer’s manual</td>
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<tr>
<td>algorithms</td>
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<td>probability charts/reports</td>
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<td>equipment self-diagnostics</td>
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<td>physical layout diagrams</td>
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<td>flow charts</td>
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<td>fault analysis charts (such as fault trees)</td>
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<td>troubleshooting guides</td>
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<tr>
<td>Use all of the following diagnosis procedures:</td>
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<td>inspection (for leaks, loose fittings, breakages, wear/deterioration, damage to pipes/hoses, alignment)</td>
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<td>operation (such as manual operation, timing, sequencing)</td>
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<td>measurement (such as pressure, flow, timing, sequence, movement)</td>
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## Unit 19
Carrying out fault diagnosis on fluid power equipment and circuits

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<tr>
<td>measuring devices</td>
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<td>flow indicators</td>
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<td>pressure indicators</td>
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<td>thermal indicators</td>
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<td>test rigs</td>
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<tr>
<td>self-diagnosis equipment</td>
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<tr>
<td>Find faults that have resulted in two of the following breakdown categories:</td>
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<td>intermittent problem</td>
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<tr>
<td>partial failure or reduced performance</td>
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<tr>
<td>complete breakdown</td>
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<tr>
<td>Provide a record of the outcome of fault diagnosis using one of the following:</td>
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<tr>
<td>step-by-step analytical report</td>
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<tr>
<td>preventative maintenance log/report</td>
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<td>corrective action report</td>
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<tr>
<td>company-specific reporting procedure</td>
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</tbody>
</table>

Knowledge and understanding reference:

Candidate: ___________________________ Date: __________________

Assessor: ___________________________ Date: __________________
Unit 20
Maintaining fluid power equipment

Unit summary
This unit identifies the competencies you need to carry out corrective maintenance on fluid power equipment, in accordance with approved procedures. You will be required to maintain a range of fluid power equipment, such as hydraulic, pneumatic or vacuum equipment. This will involve dismantling, removing and replacing faulty items, at component and unit level, on such as pumps, valves, actuators, sensors, intensifiers, regulators, compressors, pipes and hoses, and other specific fluid power equipment. This will involve depressurising the system, and removing, replacing and repairing system components, as applicable.

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 are outside your permitted authority, to the relevant people. You will be expected to work with minimum 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 maintenance procedures to fluid power equipment. You will understand the dismantling and reassembly methods and procedures used, and their application. You will know how the equipment functions, and the purpose of the individual components, their function and associated defects, in adequate depth to provide a sound basis for carrying out the maintenance activity, correcting faults and ensuring the repaired equipment functions to the required specification. In addition, you will have sufficient depth of knowledge of the various components, to ensure they are fit for purpose and meet the specifications, thus providing a sound basis for carrying out reassembly of the equipment.

You will understand the safety precautions required when carrying out the maintenance activities, especially those for isolating the equipment and taking the necessary safeguards to protect yourself and others in the workplace. You will be required to demonstrate safe working practices throughout.
Unit 20
Maintaining fluid power equipment

Performance statements:
You must:
a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Follow the relevant maintenance schedules to carry out the required work
c. Carry out the maintenance activities within the limits of your personal authority
d. Carry out the maintenance activities in the specified sequence and in an agreed time scale
e. Report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
f. Complete relevant maintenance records accurately and pass them on to the appropriate person
   g. Dispose of waste materials in accordance with safe working practices and approved procedures

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:
1. Carry out all the following during the maintenance activity:
   • plan the maintenance activities to cause minimum disruption to normal working
   • use the correct issue of company and/or manufacturers’ drawings and maintenance documentation
   • adhere to risk assessment, COSHH and other relevant safety standards
   • ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
   • provide safe access and working arrangements for the maintenance area
   • carry out the maintenance activities using appropriate techniques and procedures
   • reconnect and return the system to service on completion of the maintenance activities
   • dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition

2. Carry out maintenance activities on two of the following types of fluid power equipment:
   • pneumatic
   • hydraulic
   • vacuum

3. Carry out all of the following maintenance activities, as applicable to the equipment being maintained:
   • chocking/supporting cylinders/rams/component
   • draining and removing fluids (as applicable)
   • removing and replacing units/components (such as pumps, cylinders, valves, actuators)
   • disconnecting/removing hoses and pipes
   • proof marking/labelling of removed components
   • checking components for serviceability
   • setting, aligning and adjusting replaced components
   • making ‘off-load’ checks before re-pressurising the system
   • functional testing of the maintained system
   • releasing stored pressure
   • replacing damaged/defective components
   • replacing all lifed items (such as seals, filters, gaskets)
   • tightening fastenings to the required torque
4 Carry out maintenance activities to component level on **all** of the following fluid power components:
   - pumps
   - valves
   - cylinders
   - actuators

5 Replace a range of fluid power components, to include **ten** of the following:
   - pumps
   - pistons
   - spools
   - valves
   - actuators
   - cylinders
   - bearings
   - reservoirs
   - accumulators
   - pressure intensifiers
   - compressors
   - receivers
   - gaskets and seals
   - pipework and hoses
   - switches
   - sensors
   - lubricators/filters
   - regulators
   - other specific components

6 Maintain fluid power equipment, in compliance with **one or more** of the following quality and accuracy standards:
   - organisational guidelines and codes of practice
   - equipment manufacturers’ operation range
   - BS and/or ISO standards

7 Complete **all** relevant paperwork from the following, and pass it to the appropriate people:
   - job cards
   - maintenance log or report
   - permit to work/formal risk assessment
Knowledge statements:
You must have knowledge and understanding of:

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. The isolation procedures or permit-to-work procedure that applies
3. The specific health and safety precautions to be taken during the maintenance activities, and their effects on others
4. The importance of wearing protective clothing and other appropriate safety equipment during maintenance activities
5. Hazards associated with carrying out maintenance activities on fluid power equipment (handling fluids, stored pressure/force, misuse of tools), and how these can be minimised
6. Regulations and codes of practice that apply to working with fluid power equipment
7. How to obtain and interpret drawings, charts, circuit and physical layouts, specifications, manufacturers' manuals, history/maintenance reports, symbols used in fluid power, and other documents needed in the maintenance activities
8. The procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance activities
9. Principles and theories associated with fluid power equipment, including cascading and logic/ladder tables
10. The basic principles of operation of the equipment to be maintained
11. Company policy on repair/replacement of components during maintenance process
12. How to construct and apply ladder logic or sequential charts/tables
13. Dry and lubricated systems, and their application
14. Selection of fluids for the system
15. How to determine pressure settings and their effect on the system
16. The different types of pipework, fittings and manifolds, and their application
17. The identification and application of different types of valves (such as poppet, spool, piston, disc)
18. The identification and application of different types of sensors and actuators (such as rotary, linear, mechanical, electrical)
19. The identification and application of different types of cylinders (such as single acting, double acting)
20. The identification and application of different types of pumps (such as positive and non-positive displacement)
21. The application and fitting of static and dynamic seals
22. Recognition of contaminants and the problems they can create, and the effects and likely symptoms of contamination in the system
23. The techniques used to dismantle/assemble fluid power equipment (release of pressures/force, proof marking, extraction)
24. Methods of checking that components are fit for purpose
25. How to make adjustments to components/assemblies to ensure they function correctly
26. The identification and working purpose of individual components, and how they interact
27. How to check tools and equipment are free from damage or defect, are in a safe and usable condition, and are configured correctly for the intended purpose
28. The generation of maintenance documentation and/or reports following the maintenance activity
29. Equipment operating and control procedures to be applied during the maintenance activity
30. How to use lifting and handling equipment safely and correctly in the maintenance activity
31. The problems associated with the maintenance activity, and how they can be overcome
32. The procedure to be adopted for the safe disposal of waste of all types of materials
33. The limit of your own authority and whom you should report to when you have a problem that you cannot resolve
### Unit 20
Maintaining fluid power equipment

<table>
<thead>
<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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<th>evidence type</th>
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<th>date</th>
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**Carry out all the following during the maintenance activity:**

- plan the maintenance activities to cause minimum disruption to normal working
- use the correct issue of company and/or manufacturers’ drawings and maintenance documentation
- adhere to risk assessment, COSHH and other relevant safety standards
- ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
- provide safe access and working arrangements for the maintenance area
- carry out the maintenance activities using appropriate techniques and procedures
- reconnect and return the system to service on completion of the maintenance activities
- dispose of waste items in safe and environmentally acceptable manner, and leave the work area in a safe condition

**Carry out maintenance activities on two of the following types of fluid power equipment:**

- pneumatic
- hydraulic
- vacuum
**Unit 20**  
Maintaining fluid power equipment

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<tbody>
<tr>
<td><strong>Carry out all of the following maintenance activities, as applicable to the equipment being maintained:</strong></td>
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<tr>
<td>chocking/supporting cylinders/rams/component</td>
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<td>draining and removing fluids (as applicable)</td>
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<td>removing and replacing units/components (such as pumps, cylinders, valves, actuators)</td>
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<td>disconnecting/removing hoses and pipes</td>
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<tr>
<td>proof marking/labelling of removed components</td>
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<tr>
<td>checking components for serviceability</td>
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<tr>
<td>setting, aligning and adjusting replaced components</td>
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<td>making ‘off-load’ checks before re-pressurising the system</td>
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<td>functional testing of the maintained system</td>
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<tr>
<td>releasing stored pressure</td>
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<td>replacing damaged/defective components</td>
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<tr>
<td>replacing all lifed items (such as seals, filters, gaskets)</td>
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<td>tightening fastenings to the required torque</td>
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<tr>
<td><strong>Carry out maintenance activities to component level on all of the following fluid power components:</strong></td>
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<tr>
<td>pumps valves</td>
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<td>cylinders</td>
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<td>actuators</td>
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## Unit 20
Maintaining fluid power equipment

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Replace a range of fluid power components, to include ten of the following:

- pumps
- pistons
- spools
- valves
- actuators
- cylinders
- bearings
- reservoirs
- accumulators
- pressure intensifiers
- compressors
- receivers
- gaskets and seals
- pipework and hoses
- switches
- sensors
- lubricators/filters
- regulators
- other specific components

Maintain fluid power equipment, in compliance with one or more of the following quality and accuracy standards:

- organisational guidelines and codes of practice
- equipment manufacturers’ operation range BS and/or ISO standards

Complete all relevant paperwork from the following, and pass it to the appropriate people:

- job cards
- maintenance log or report
- permit to work/formal risk assessment

Knowledge and understanding reference:

Candidate: ____________________________ Date: __________________
Assessor: ____________________________ Date: __________________
Unit 21
Carrying out planned maintenance on fluid power equipment

Unit summary
This unit identifies the competencies you need to carry out planned maintenance activities on fluid power equipment, in accordance with approved procedures. You will be required to carry out the maintenance activities on pneumatic, hydraulic or vacuum equipment. This will involve maintaining a range of equipment and components such as pumps, cylinders, valves, actuators, pipework and hoses, switches and sensors, in order to minimise down time, and to ensure that they perform at optimum level and function to specification.

Your responsibilities will require you to comply with organisational policy and procedures for the planned maintenance activities undertaken, and to report any problems with these activities or with the tools and equipment used that you cannot personally resolve, or are outside your permitted authority, to the relevant people. You must ensure that all the 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 minimum 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 planned maintenance procedures to fluid power equipment. You will understand the process of developing planned maintenance, and its application, and will know about the maintenance criteria in adequate depth to provide a sound basis for carrying out the activities to the required specification. In addition, you will be expected to report where the outcome of the maintenance activity identifies the need for further investigation or maintenance work.

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.
Unit 21
Carrying out planned maintenance on fluid power equipment

Performance statements:
You must:

a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Follow the relevant maintenance schedules to carry out the required work
c. Carry out the maintenance activities within the limits of your personal authority
d. Carry out the maintenance activities in the specified sequence and in an agreed time scale
e. Report any instances where the maintenance activities cannot be fully met or where there are identified
f. Defects outside the planned schedule
g. Complete relevant maintenance records accurately and pass them on to the appropriate person
h. Dispose of waste materials in accordance with safe working practices and approved procedures

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:
1. Carry out all of the following during the planned maintenance activities:
   • plan the maintenance activities to cause minimum disruption to normal working
   • use the correct issue of company and/or manufacturers’ drawings and maintenance documentation
   • adhere to risk assessment, COSHH and other relevant safety standards
   • ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
   • provide safe access and working arrangements for the maintenance area
   • carry out the maintenance activities using appropriate techniques and procedures
   • functionally test and adjust equipment to specification
   • re-connect and return the system to service on completion of the maintenance activities
   • dispose of waste items in safe and environmentally acceptable manner, and leave the work area in a safe condition

2. Carry out planned maintenance activities on two of the following types of fluid power equipment:
   • pneumatic equipment
   • hydraulic equipment
   • vacuum equipment

3. Carry out planned maintenance activities on all of the following:
   • pumps
   • cylinders
   • actuators
   • connectors
   • valves
   • switches and sensors
   • pipework and hoses
4 Follow planned maintenance activities using **one** of the following types of maintenance schedules:
- condition based maintenance
- scheduled maintenance
- total preventative maintenance

5 Carry out 10 of the following planned maintenance activities:
- visual examination and testing of the system against the maintenance schedule
- checking condition of seals, connections, pipework and hoses
- checking operation of all gauges and sensors
- monitoring of component condition/deterioration
- making sensory checks (such as sight, sound, smell, touch)
- replacing ‘lifed’ consumables (such as filters, fluids)
- carrying out system self-analysis checks
- recording the results of the maintenance, and reporting any defects found
- making routine adjustments
- carrying out leak checks on all connections
- testing and reviewing system operation
- removing excessive dirt and grime

6 Ensure the maintained equipment/system meets **all** of the following quality and accuracy standards:
- all maintenance activities have been completed to the required schedule
- equipment operates within acceptable limits for successful continuous operation
- any potential defects are identified and reported for future action
- all relevant documentation is completed accurately and legibly

7 Complete **all** relevant paperwork from the following, and pass it to the appropriate people:
- job cards
- maintenance log or report
- permit to work/formal risk assessment
Unit 21
Carrying out planned maintenance on fluid power equipment

Knowledge statements:
You must have knowledge and understanding of:
1. The health and safety requirements of the area in which the preventative maintenance activity is to take place, and the responsibility these requirements place on you
2. The isolation procedures or permit-to-work procedure that applies to the equipment being maintained
3. The specific health and safety precautions needed to be applied during the planned maintenance activities, and their effects on others
4. The importance of wearing protective clothing and other appropriate safety equipment during maintenance activities
5. Hazards associated with carrying out planned maintenance activities on fluid power equipment (such as handling fluids, stored pressure/force, misuse of tools), and how they can be minimised
6. How to make sensory checks by sight, sound, smell, touch
7. Where to obtain, and how to interpret drawings, schematic and physical diagrams, specifications, flow charts, manufacturers’ manuals, maintenance schedules and other documents required for the maintenance activities
8. The various planned maintenance schedules that are generally used (such as condition based maintenance, scheduled maintenance and total preventative maintenance (TPM))
9. The schedules and methods to be followed, in compliance with company procedures for planned maintenance on fluid power equipment
10. The procedure for obtaining consumables to be used during the planned maintenance activity
11. The appropriate testing procedures to be adopted during the maintenance activity
12. How to make adjustments to components/assemblies to ensure they function to specification
13. The functionality of various components, and their interrelationship with other components and assemblies
14. How to compile planned maintenance records/logs/reports, which comply with company policy and procedures
15. The equipment operating and control procedures, and how to apply them in order to carry out planned maintenance
16. The problems that can occur whilst carrying out planned maintenance activities, and how they can be avoided
17. The organisational procedure to be adopted for the safe disposal of waste of all types of materials
18. The extent of your own authority and whom you should report to if you have problems that you cannot resolve
## Unit 21
Carrying out planned maintenance on fluid power equipment

<table>
<thead>
<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
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<td>evidence type</td>
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**Carry out all of the following during the planned maintenance activities:**

- Plan the maintenance activities to cause minimum disruption to normal working
- Use the correct issue of company and/or manufacturers’ drawings and maintenance documentation
- Adhere to risk assessment, COSHH and other relevant safety standards
- Ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
- Provide safe access and working arrangements for the maintenance area
- Carry out the maintenance activities using appropriate techniques and procedures
- Functionally test and adjust equipment to specification
- Re-connect and return the system to service on completion of the maintenance activities
- Dispose of waste items in safe and environmentally acceptable manner, and leave the work area in a safe condition

**Carry out planned maintenance activities on two of the following types of fluid power equipment:**

- Pneumatic equipment
- Hydraulic equipment
- Vacuum equipment

**Carry out planned maintenance activities on all of the following:**

- Pumps
- Cylinders
- Actuators
- Connectors
- Valves
- Switches and sensors
- Pipework and hoses
## Unit 21
Carrying out planned maintenance on fluid power equipment

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<tbody>
<tr>
<td><strong>Follow planned maintenance activities using one of the following types of maintenance schedules:</strong></td>
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<tr>
<td>condition based maintenance</td>
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<td>scheduled maintenance</td>
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<tr>
<td>total preventative maintenance</td>
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<tr>
<td><strong>Carry out ten of the following planned maintenance activities:</strong></td>
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<tr>
<td>visual examination and testing of the system against the maintenance schedule</td>
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<tr>
<td>checking condition of seals, connections, pipework and hoses</td>
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<td>monitoring of component condition/deterioration</td>
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<td>making sensory checks (such as sight, sound, smell, touch)</td>
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<tr>
<td>replacing ‘lifed’ consumables (such as filters, fluids)</td>
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<tr>
<td>carrying out system self-analysis checks</td>
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<td>recording the results of the maintenance, and reporting any defects found</td>
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<td>making routine adjustments</td>
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<td>removing excessive dirt and grime</td>
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Carrying out planned maintenance on fluid power equipment

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<tbody>
<tr>
<td><strong>Ensure the maintained equipment/system meets all of the following quality and accuracy standards:</strong></td>
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<tr>
<td>all maintenance activities have been completed to the required schedule</td>
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<tr>
<td>equipment operates within acceptable limits for successful continuous operation</td>
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<td>any potential defects are identified and reported for future action</td>
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<tr>
<td>all relevant documentation is completed accurately and legibly</td>
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</tbody>
</table>

**Complete all relevant paperwork from the following, and pass it to the appropriate people:**

- job cards
- maintenance log or report
- permit to work/formal risk assessment

**Knowledge and understanding reference:**

Candidate: ______________________ Date: ________________

Assessor: ______________________ Date: ________________
Unit 22
Testing fluid power equipment and systems

Unit summary
This unit identifies the competencies you need to test fluid power equipment, in accordance with approved procedures. You will be required to carry out tests on a range of fluid power equipment, which includes pneumatic, hydraulic and vacuum systems. You will be expected to test a range of components, such as pumps, motors, valves and actuators, to establish that they are functioning at optimal level and to specification. You will also be required to use a range of test equipment, methods, procedures and diagnostic/analytical techniques, as applicable to the particular system under test.

Your responsibilities will require you to comply with organisational policy and procedures for the testing activities undertaken, and to report any problems with these activities or with the equipment used that you cannot personally resolve, or are outside your permitted authority, to the relevant people. You will be expected to work with minimum 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 test procedures to fluid power equipment. You will understand the system under test, the various test procedures, and their application, and will know about the appropriate test equipment, in adequate depth to provide a sound basis for carrying out the activities to the required specification. In addition, you will be expected to review the outcome of the tests, to compare the results with appropriate standards, to determine the action required, and to record and report the results in the appropriate format.

You will understand the safety precautions required when carrying out the test activities, especially those for isolating the equipment and taking the necessary safeguards to protect yourself and others in the workplace. You will be required to demonstrate safe working practices throughout.
Unit 22
Testing fluid power equipment and systems

Performance statements:
You must:

a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Follow the appropriate procedures for use of tools and equipment to carry out the required tests
c. Set up and carry out the tests using the correct procedures and within agreed timescales
d. Record the results of the tests in the appropriate format
e. Review the results and carry out further tests if necessary

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:

1. Carry out all of the following during the testing activities:
   - plan the testing activities to cause minimum disruption to normal working
   - use the correct issue of company and/or manufacturers drawings and testing documentation
   - adhere to risk assessment, COSHH and other relevant safety standards
   - ensure the safe isolation of equipment
   - provide safe access and working arrangements for the maintenance area
   - check all tools and test equipment are in date for calibration
   - carry out the testing activities using appropriate techniques and procedures
   - reconnect and return system to service on completion of activities
   - dispose of waste items in a safe and environmentally acceptable manner and leave the work area in a safe condition

2. Carry out tests on two of the following fluid power systems:
   - Pneumatic
   - Hydraulic
   - Vacuum

3. Test two types of fluid power generation/consumption equipment from the following:
   - gear pumps/motor
   - vane pumps/motor
   - piston pumps/motor

4. Test four types of fluid power valve equipment from:
   - stop valves
   - reversing valves
   - poppet valves
   - pressure sensitive
   - throttling valves (dwell)
   - sequence valves
   - spool valves
   - shuttle valves
   - relief valves
   - pilot valves
   - plate valves
5 Test **two** of the following types of fluid power actuator equipment:
- single acting cylinders
- double acting cylinders
- rotary actuators

6 Test **three** of the following types of fluid power conditioning equipment:
- moisture separators
- lubricators
- storage filters

7 Test fluid power systems equipment using tools or test equipment, to include **three** of the following:
- pressure devices
- testing rigs
- flushing blocks
- flushing pipes
- bleeding equipment
- blanking equipment
- connecting equipment
- sampling devices

8 Carry out **four** of the following types of test:
- return line pressure
- test pressure line
- pressure test fluid
- contamination test
- leak test flow speed sequence

9 Carry out **all** of the following checks to ensure the accuracy and quality of the tests carried out:
- the test equipment is correctly calibrated
- the test equipment used is appropriate for the tests being carried out
- test procedures used are as recommended in the appropriate specifications
- test equipment is operated within its specification range

10 Provide a record/report of the test outcome, using **one** of the following:
- preventative maintenance log/report
- company specific reporting procedure
- inspection/test schedule
- specific test report

Knowledge statements:
Knowledge statements

You must have knowledge and understanding of:

1. The health and safety requirements of the work area where you are carrying out the activities, and the responsibility these requirements place on you.
2. The equipment isolation procedure or permit-to-work procedure that applies to the testing activities, and the safety procedures that must be carried out before work is started on the equipment.
3. The specific safety practices and procedures that you need to observe when testing fluid power systems, including any specific legislation, regulations/codes of practice for the activities, equipment or materials.
4. Hazards associated with testing fluid power equipment (such as handling hydraulic fluids, stored pressures, moving cylinders or equipment), and how these can be minimised.
5. The importance of wearing protective clothing and other appropriate safety equipment during the testing activities.
6. How to obtain and interpret drawings, circuit and physical layouts, charts, specifications, manufacturers' manuals, history/maintenance reports, graphical symbols for fluid power circuits, and other documents needed for the testing activities.
7. The test specifications of the systems you are working on, their interpretation and currency/issue checks.
8. The basic operating principles and procedures of the fluid power equipment/system being tested.
9. Types of test equipment to be used, and their selection for particular tests.
10. How to calibrate the test equipment to be used, or the organisational procedures for ensuring that the test equipment is maintained and correctly calibrated.
11. How the test equipment is connected into the circuit, and the methods of doing this.
12. The techniques, methods and procedures to be used during the tests.
13. Displaying/recording test results, and the documentation used.
14. How to create and apply logic or sequential charts/tables.
15. Authorisation systems for changes to test procedures.
16. How to interpret the test readings obtained, and the significance of the readings gained.
17. The importance of ensuring that test equipment is used only for its intended purpose and within its specified range and limits.
18. Potential problems or errors that may occur and that could affect the test results.
19. The environmental control and company operating procedures relating to the testing activities.
20. The documentation required and the procedures to be followed on completion of the tests.
21. The extent of your own authority and whom you should report to if you have problems that you cannot resolve.
## Unit 22
Testing fluid power equipment and systems

<table>
<thead>
<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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<tbody>
<tr>
<td>evidence type</td>
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<td>date</td>
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</table>

**Carry out all of the following during the testing activities:**

- Plan the testing activities to cause minimum disruption to normal working
- Use the correct issue of company and/or manufacturers drawings and testing documentation
- Adhere to risk assessment, COSHH and other relevant safety standards
- Ensure the safe isolation of equipment
- Provide safe access and working arrangements for the maintenance area
- Check all tools and test equipment are in date for calibration
- Carry out the testing activities using appropriate techniques and procedures
- Reconnect and return system to service on completion of activities
- Dispose of waste items in a safe and environmentally acceptable manner and leave the work area in a safe condition

**Carry out tests on two of the following fluid power systems:**
- Pneumatic
- Hydraulic
- Vacuum

**Test two types of fluid power generation/consumption equipment from the following:**
- Gear pumps/motor
- Vane pumps/motor
- Piston pumps/motor

**Test four types of fluid power valve equipment from:**
- Stop valves
- Reversing valves
- Poppet valves
- Pressure sensitive
## Unit 22
Testing fluid power equipment and systems

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<tr>
<td>throttling valves (dwell)</td>
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<tr>
<td>sequence valves</td>
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<td>spool valves</td>
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<td>shuttle valves</td>
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<td>relief valves</td>
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<td>pilot valves</td>
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<td>plate valves</td>
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</table>

**Test two of the following types of fluid power actuator equipment:**
- single acting cylinders
- double acting cylinders
- rotary actuators

**Test three of the following types of fluid power conditioning equipment:**
- moisture separators
- lubricators
- storage filters

**Test fluid power systems equipment using tools or test equipment, to include three of the following:**
- pressure devices
- testing rigs
- flushing blocks
- flushing pipes
- bleeding equipment
- blanking equipment
- connecting equipment
- sampling devices

**Carry out four of the following types of test:**
- return line pressure
- test pressure line
- pressure test fluid
- contamination test
- leak test flow speed sequence

**Carry out all of the following checks to ensure the accuracy and quality of the tests carried out:**
- the test equipment is correctly calibrated
## Unit 22
Testing fluid power equipment and systems

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<td>the test equipment used is appropriate for the tests being carried out</td>
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<tr>
<td>test procedures used are as recommended in the appropriate specifications</td>
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<tr>
<td>test equipment is operated within its specification range</td>
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</table>

**Provide a record/report of the test outcome, using one of the following:**

- preventative maintenance log/report
- company specific reporting procedure
- inspection/test schedule
- specific test report

**Knowledge and understanding reference:**

Candidate: _______________________________  Date: __________________

Assessor: _______________________________  Date: __________________
**Unit 23**
Carrying out fault diagnosis on engineered systems

**Unit summary**
This unit identifies the competencies you need to carry out fault diagnosis on engineered systems, in accordance with approved procedures. You will be required to diagnose faults on an engineered system involving two or more of the following interactive technologies: mechanical, electrical, fluid power or process controller, at sub-assembly/component level. You will be expected to use a variety of fault diagnosis methods and techniques, and to utilise a number of diagnostic aids and equipment. From the evidence gained, you will be expected to identify the fault and its probable cause, and to suggest appropriate action to remedy the problem.

Your responsibilities will require you to comply with organisational policy and procedures for the fault diagnostic activities undertaken, and to report any problems with these activities or the tools and equipment used that you cannot personally resolve, or are outside your permitted authority, to the relevant people. You will be expected to work with minimum 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 fault diagnosis procedures within an integrated system. You will understand the various fault diagnosis methods and techniques used, and their application. You will know how to apply and interpret information obtained from diagnostic aids and equipment, in adequate depth to provide a sound basis for carrying out the activities and identifying faults or conditions that are outside the required specification. You will know about the interaction of the other associated integrated technologies, and will have sufficient knowledge to carry out effective fault diagnosis of the integrated system.

You will understand the safety precautions required when carrying out the fault diagnosis 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.
Unit 23
Carrying out fault diagnosis on engineered systems

Performance statements:
You must:
a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Review and use all relevant information on the symptoms and problems associated with the products or assets
c. Investigate and establish the most likely causes of the faults
d. Select, use and apply diagnostic techniques, tools and aids to locate faults
e. Complete the fault diagnosis within the agreed time and inform the appropriate people when this cannot be achieved
f. Determine the implications of the fault for other work and for safety considerations
g. Use the evidence gained to draw valid conclusions about the nature and probable cause of the fault
h. Record details on the extent and location of the faults in an appropriate format

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:
1. Carry out all of the following during the fault diagnostic activities:
   - plan the fault diagnosis activities prior to beginning the work
   - use the correct issue of company and/or manufacturers’ drawings and maintenance documentation
   - adhere to risk assessment, COSHH and other relevant safety standards
   - ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
   - provide safe access and working arrangements for the maintenance area
   - carry out the fault diagnostic activities using approved procedures
   - collect equipment fault diagnosis evidence from live and isolated systems
   - disconnect or isolate components or parts of the system, when appropriate, to confirm diagnosis
   - identify the fault and determine appropriate corrective action
   - dispose of waste items in safe and environmentally acceptable manner and leave the work area in a safe condition

2. Carry out fault diagnosis on two of the following types of interactive technologies, to sub-assembly or component level:
   - mechanical
   - fluid power
   - electrical
   - process controller

3. Collect information about the fault from four of the following sources:
   - the person or operator who reported the fault
   - monitoring equipment or gauges
   - recording devices
   - sensory (such as sight, sound, smell, touch)
   - plant or machinery records/history
   - condition of the end product
4 Use a range of fault diagnostic techniques, to include:
   • half-split technique

   Plus one more from the following:
   • emergent problem sequence
   • six point technique
   • functional testing
   • injection and sampling
   • input/output
   • unit substitution

5 Use a variety of diagnostic aids and equipment, to include two of the following:
   • manufacturer's manual
   • algorithms
   • probability charts/reports
   • equipment self diagnostics
   • circuit diagrams/specifications
   • logic diagrams
   • flow charts
   • fault analysis charts (such as fault trees)
   • troubleshooting guides

6 Use two of the following types of test equipment to help in the fault diagnosis:
   • mechanical measuring equipment (such as measuring instruments, dial test indicators, torque instruments)
   • electrical/electronic measuring instruments (such as multimeters, logic probes)
   • fluid power test equipment (such as test rigs, flow meters, pressure gauges)

7 Find faults that have resulted in two of the following breakdown categories:
   • intermittent problem
   • partial failure or reduced performance/out of specification product
   • complete breakdown

8 Provide a record of the outcome of the fault diagnosis, using one of the following:
   • step-by-step analytical report
   • preventative maintenance log/report
   • corrective action report
   • company-specific reporting procedure
Unit 23
Carrying out fault diagnosis on engineered systems

Knowledge statements
You must have knowledge and understanding of:
1. The health and safety requirements of the area in which you are carrying out the fault diagnosis activities, and the responsibility these requirements place on you
2. The specific safety precautions to be taken when carrying out the fault diagnosis of the particular engineered system
3. The isolation and lock-off procedures or permit-to-work procedure that applies
4. The importance of wearing protective clothing and other appropriate safety equipment during the fault diagnosis activities, the type of safety equipment to be used and where to obtain it
5. Hazards associated with carrying out fault diagnosis on engineered systems (such as handling fluids, stored pressure/force, electrical contact, process controller interface, using faulty or damaged tools and equipment, using practices and procedures that do not follow laid-down procedures), and how to minimise them
6. How to recognise and deal with victims of electric shock (to include methods of safely removing the victim from the power source, isolating the power source, and methods of first aid resuscitation)
7. Where to obtain, and how to interpret drawings, circuit diagrams, specifications, manufacturers’ manuals and other documents needed for the fault diagnosis activities
8. The basic principles of how the system functions, and the working purpose of the various integrated systems
9. 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)
10. 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)
11. How to evaluate sensory information from sight, sound, smell, touch
12. The procedures to be followed to investigate faults, and how to deal with intermittent conditions
13. How to use the various aids and reports available for fault diagnosis
14. Ring 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
15. The application of specific fault finding methods and techniques that are best suited to the problem
16. How to analyse and evaluate possible characteristics and causes of specific faults/problems
17. How to make use of previous reports/records of similar fault conditions
18. 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
19. How to prepare a report which complies with the company policy on fault diagnosis
20. The extent of your own authority and whom you should report to if you have problems that you cannot resolve
### Unit 23
Carrying out fault diagnosis on engineered systems

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</table>

**Carry out all of the following during the fault diagnostic activities:**

- plan the fault diagnosis activities prior to beginning the work
- use the correct issue of company and/or manufacturers’ drawings and maintenance documentation
- adhere to risk assessment, COSHH and other relevant safety standards
- ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
- provide safe access and working arrangements for the maintenance area
- carry out the fault diagnostic activities using approved procedures
- collect equipment fault diagnosis evidence from live and isolated systems
- disconnect or isolate components or parts of the system, when appropriate, to confirm diagnosis
- identify the fault and determine appropriate corrective action
- dispose of waste items in safe and environmentally acceptable manner and leave the work area in a safe condition

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

- mechanical
- fluid power
- electrical
- process controller
Carrying out fault diagnosis on engineered systems

<table>
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<th>evidence record sheet</th>
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</thead>
</table>

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

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

**Use a range of fault diagnostic techniques, to include: half-split technique**

- emergent problem sequence
- six point technique
- functional testing
- injection and sampling
- input/output
- unit substitution

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

- manufacturer's manual
- algorithms
- probability charts/reports
- equipment self diagnostics
- circuit diagrams/specifications
- logic diagrams
- flow charts
- fault analysis charts (such as fault trees)
- troubleshooting guides

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

- mechanical measuring equipment (such as measuring instruments, dial test indicators, torque instruments)
- electrical/electronic measuring instruments (such as multimeters, logic probes)
- fluid power test equipment (such as test rigs, flow meters, pressure gauges)
### Unit 23
Carrying out fault diagnosis on engineered systems

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</thead>
<tbody>
<tr>
<td>Find faults that have resulted in two of the following breakdown categories:</td>
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<tr>
<td>intermittent problem</td>
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<tr>
<td>partial failure or reduced performance/out of specification product</td>
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<tr>
<td>complete breakdown</td>
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<tr>
<td>Provide a record of the outcome of the fault diagnosis, using one of the following:</td>
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<tr>
<td>step-by-step analytical report</td>
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<td>preventative maintenance log/report</td>
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<td>corrective action report</td>
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<tr>
<td>company-specific reporting procedure</td>
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</tbody>
</table>

Knowledge and understanding reference:

Candidate: _______________________________ Date: ________________

Assessor: _______________________________ Date: ________________
Unit 24
Maintaining mechanical equipment within an engineered System

Unit summary
This unit identifies the competencies you need to carry out corrective maintenance on mechanical equipment within an engineered system, in accordance with approved procedures. You will be required to maintain a range of mechanical equipment, such as gearboxes, pumps, machine tools, conveyor systems, workholding arrangements, engines, processing plant and equipment, which are working in an integrated system involving two or more of the following interactive technologies: electrical, fluid power or process controller.

You will be expected to isolate and disconnect items and components of the interactive technologies in order to gain access to and remove the mechanical units and components that require replacing or repair. This will involve dismantling and reassembling a variety of different types of assemblies and sub-assemblies which, in some instances, will need to be dismantled to component level.

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, tools or equipment used that you cannot personally resolve, or 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 work, and that all necessary job/task documentation is completed accurately and legibly. You will be expected to work with minimum 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 mechanical maintenance procedures within an engineered system. You will know about the integrated technology assemblies and sub-assemblies, and their properties, functions and associated defects, in adequate depth to provide a sound basis for carrying out the dismantling and reassembly process safely and effectively. You will also understand the maintenance methods and procedures used, and their application within the engineered system, in sufficient depth to be able to carry out the maintenance activities, correct faults, and ensure the maintained equipment functions to specification.

You will understand the safety precautions required when carrying out the maintenance activities, especially those for isolating the equipment and taking the necessary safeguards to protect yourself and others in the workplace. You will be required to demonstrate safe working practices throughout.
Unit 24
Maintaining mechanical equipment within an engineered System

Performance statements:
You must:
a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Follow the relevant maintenance schedules to carry out the required work
c. Carry out the maintenance activities within the limits of your personal authority
d. Carry out the maintenance activities in the specified sequence and in an agreed timescale
e. Report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
f. Complete relevant maintenance records accurately and pass them on to the appropriate person
g. Dispose of waste materials in accordance with safe working practices and approved procedures

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:
1  Carry out all of the following during the maintenance activity:
   • plan the maintenance activities to cause minimum disruption to normal working
   • use the correct issue of company and/or manufacturers’ drawings and maintenance documentation
   • adhere to risk assessment, COSHH and other relevant safety standards
   • ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
   • provide safe access and working arrangements for the maintenance area
   • carry out the maintenance activities using appropriate techniques and procedures
   • reconnect and return the system to service on completion of the maintenance activities
   • dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition

2  Use appropriate dismantling and re-assembly techniques to deal with two of the following:
   Fluid power components:
   • releasing stored pressure
   • disconnecting/removing hoses and pipes
   • chocking/supporting cylinders/rams/components
   • removing and replacing units/components (such as pumps, cylinders, valves, actuators)

   Electrical components:
   • isolating the power supply
   • disconnecting and reconnecting wires/cables
   • removing and replacing major electrical components (such as motors, switch/control gear)
   • removing / replacing minor electrical components (such as relays, sensing devices, limit switches)
   • removing and replacing wiring enclosures (such as conduit, trunking and traywork)

   Process controller components:
   • de-activating and resetting program controller
   • re-loading programs and making minor amendments
   • removing and replacing input/output interfacing disconnecting/reconnecting wires/cables
   • removing and replacing program logic peripherals
3 Carry out maintenance activities on **four** of the following types of mechanical equipment:
- gearboxes
- machine tools
- lifting and handling equipment
- workholding arrangements
- processing plant
- pumps
- compressors
- transfer equipment
- mechanical structures
- conveyors/elevators
- other specific equipment
- process control valves
- engines

4 Carry out **all** of the following maintenance techniques, as applicable to the equipment being maintained:
- draining and removing fluids
- dismantling equipment to unit/sub-assembly level
- dismantling units to component level
- proofmarking/labelling of components
- checking components for serviceability
- setting, aligning and adjusting replaced components
- replacing all ‘lifed’ items (such as seals, bearings, gaskets)
- tightening fastenings to the required torque
- making ‘off-load’ checks before powering up
- replenishing oils and greases
- functionally testing the complete system
- replacing damaged/defective components

5 Replace a range of mechanical components, to include **seven** of the following:
- shafts
- couplings
- gears
- clutches
- valves and seats
- brakes
- bearing and seals
- fitting keys
- cams and followers
- springs
- chains and sprockets
- pulleys and belts
- slides
- levers and links
- locking and retaining devices (such as circlips, pins)

6 Ensure that the maintenance activities comply with **one or more** of the following quality and accuracy standards:
- organisational guidelines and codes of practice
- equipment manufacturer’s operation range
- IEE wiring regulations
- BS and ISO standards
Complete all relevant paperwork from the following, and pass it to the appropriate people:

- job cards
- maintenance log or report
- permits to work/formal risk assessment
Knowledge statements:
You must have knowledge and understanding of:
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. The isolation and lock-off procedure or permit-to-work procedure that applies to the system
3. The specific health and safety precautions to be applied during the maintenance activity, and their effects on others
4. How to recognise and deal with victims of electric shock (to include methods of safely removing the victim from the power source, isolating the power source, and methods of first aid resuscitation)
5. The importance of wearing protective clothing and other appropriate safety equipment during the maintenance activities
6. Hazards associated with carrying out maintenance activities on an integrated system (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 them
7. How to obtain and interpret drawings, charts, specifications, manufacturers’ manuals, history/maintenance reports and other documents needed for the maintenance activities
8. The basic principles of how the system functions, its operation sequence, the working purpose of individual units/components, and how they interact
9. The procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance
10. Company policy on repair/replacement of components during the maintenance activities
11. The sequence to be adopted for dismantling and reassembling the equipment, to both sub-assembly and individual component level
12. Methods of removing components that have interference fits (expansion, contraction or pressure)
13. The techniques used to dismantle/assemble integrated equipment (release of pressures/force, proof marking to aid assembly, plugging exposed pipe/component openings, dealing with soldered joints, screwed, clamped and cramped connections)
14. Methods of attaching identification marks/labels to removed components or cables, to assist with re-assembly
15. Methods of checking that components are fit for purpose, and the need to replace ‘lifed’ items (such as seals, gaskets and bearings)
16. How to make adjustments to components/assemblies, to ensure they function correctly
17. 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
18. The importance of making ‘off-load’ checks before proving the equipment with the electrical supply on
19. The generation of maintenance documentation and/or reports on completion of the maintenance activity
20. The equipment operating and control procedures to be applied during the maintenance activity
21. How to use lifting and handling equipment safely and correctly in the maintenance activity
22. The problems that can occur during the maintenance activity, and how they can be overcome
23. The organisational procedure to be adopted for the safe disposal of waste of all types of materials
24. The extent of your authority and whom you should report to when you have a problem you cannot resolve
### Unit 24
Maintaining mechanical equipment within an engineered System

<table>
<thead>
<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
</tr>
</thead>
</table>

#### evidence type

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<tr>
<th>date</th>
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</thead>
</table>

#### Carry out all of the following during the maintenance activity:

- Plan the maintenance activities to cause minimum disruption to normal working
- Use the correct issue of company and/or manufacturers’ drawings and maintenance documentation
- Adhere to risk assessment, COSHH and other relevant safety standards
- Ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
- Provide safe access and working arrangements for the maintenance area
- Carry out the maintenance activities using appropriate techniques and procedures
- Reconnect and return the system to service on completion of the maintenance activities
- Dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition

#### Use appropriate dismantling and reassembly techniques to deal with two of the following:

**Fluid power components:**
- Releasing stored pressure
- Disconnecting/removing hoses and pipes
- Chocking/supporting cylinders/rams/components
- Removing and replacing units/components (such as pumps, cylinders, valves, actuators)

**Electrical components:**
- Isolating the power supply
- Disconnecting and reconnecting wires/cables
### Unit 24
Maintaining mechanical equipment within an engineered System

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<thead>
<tr>
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<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
</tr>
</thead>
<tbody>
<tr>
<td>removing and replacing major electrical components (such as motors, switch/control gear)</td>
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<tr>
<td>removing / replacing minor electrical components (such as relays, sensing devices, limit switches)</td>
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<tr>
<td>removing and replacing wiring enclosures (such as conduit, trunking and traywork)</td>
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<tr>
<td>Process controller components:</td>
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<tr>
<td>de-activating and resetting program controller</td>
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<tr>
<td>re-loading programs and making minor amendments</td>
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<tr>
<td>removing and replacing input/output interfacing disconnecting/reconnecting wires/cables</td>
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<tr>
<td>removing and replacing program logic peripherals</td>
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</tbody>
</table>

**Carry out maintenance activities on four of the following types of mechanical equipment:**

- gearboxes
- machine tools
- lifting and handling equipment
- workholding arrangements
- processing plant
- pumps
- compressors
- transfer equipment
- mechanical structures
- conveyors/elevators
- other specific equipment
- process control valves
- engines
### Unit 24
Maintaining mechanical equipment within an engineered System

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</thead>
<tbody>
<tr>
<td>Carry out all of the following maintenance techniques, as applicable to the equipment being maintained:</td>
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<tr>
<td>draining and removing fluids</td>
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<tr>
<td>dismantling equipment to unit/subassembly level</td>
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<tr>
<td>dismantling units to component level</td>
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<tr>
<td>proofmarking/labelling of components</td>
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<tr>
<td>checking components for serviceability</td>
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<tr>
<td>setting, aligning and adjusting replaced components</td>
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<tr>
<td>replacing all ‘lifed’ items (such as seals, bearings, gaskets)</td>
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<tr>
<td>tightening fastenings to the required torque</td>
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<tr>
<td>making ‘off-load’ checks before powering up</td>
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<tr>
<td>replenishing oils and greases</td>
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<tr>
<td>functionally testing the complete system</td>
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<tr>
<td>replacing damaged/defective components</td>
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<tr>
<td>Replace a range of mechanical components, to include seven of the following:</td>
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<tr>
<td>shafts</td>
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<td>couplings</td>
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<td>gears</td>
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<tr>
<td>clutches</td>
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<td>valves and seats</td>
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<tr>
<td>brakes</td>
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<td>bearing and seals</td>
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<tr>
<td>fitting keys</td>
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<tr>
<td>cams and followers</td>
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<tr>
<td>springs</td>
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<tr>
<td>chains and sprockets</td>
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<tr>
<td>pulleys and belts</td>
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<tr>
<td>slides</td>
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<tr>
<td>levers and links</td>
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<tr>
<td>locking and retaining devices (such as circlips, pins)</td>
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</table>
### Unit 24
Maintaining mechanical equipment within an engineered System

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</table>

**Ensure that the maintenance activities comply with one or more of the following quality and accuracy standards:**
- organisational guidelines and codes of practice
- equipment manufacturer’s operation range
- IEE wiring regulations
- BS and ISO standards

**Complete all relevant paperwork from the following, and pass it to the appropriate people:**
- job cards
- maintenance log or report
- permits to work/formal risk assessment

Knowledge and understanding reference:

Candidate: _______________________________________________  Date: ___________________

Assessor: ________________________________________________   Date: ___________________
Unit 25
Maintaining electrical equipment within an engineered system

Unit summary
This unit identifies the competencies you need to carry out corrective maintenance activities on electrical equipment within an engineered system, in accordance with approved procedures. You will be required to maintain a range of electrical equipment, such as single and three-phase power supplies, motors and starters, switchgear and distribution panels, electrical plant, control systems and equipment, and luminaries, which are working in an integrated system involving two or more of the following interactive technologies: mechanical systems, fluid power or process controller.

You will be expected to isolate and disconnect items and components of the interactive technologies, in order to gain access to and remove the electrical units and components that require replacing or repair. This will involve dismantling and reassembling a variety of different types of electrical equipment which, in some instances, will need to be dismantled to component level.

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, tools or equipment used that you cannot personally resolve, or 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 minimum 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 electrical maintenance procedures. You will also know about the integrated technology assemblies and sub-assemblies, their properties, functions and associated defects, in adequate depth to provide a sound basis for carrying out the dismantling and reassembly process effectively. You will understand the maintenance methods and procedures used, and their application within an engineered system, in sufficient depth to be able to carry out the maintenance activities, correct faults, and ensure the repaired equipment functions to specification.

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.
Unit 25
Maintaining electrical equipment within an engineered system

Performance statements:
You must:
a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Follow the relevant maintenance schedules to carry out the required work
c. Carry out the maintenance activities within the limits of your personal authority
d. Carry out the maintenance activities in the specified sequence and in an agreed timescale
e. Report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
f. Complete relevant maintenance records accurately and pass them on to the appropriate person
g. Dispose of waste materials in accordance with safe working practices and approved procedures

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must
1. Carry out all of the following during the maintenance activity:
   • plan the maintenance activities to cause minimum disruption to normal working
   • use the correct issue of company and/or manufacturers’ drawings and maintenance documentation
   • adhere to risk assessment, COSHH and other relevant safety standards
   • ensure the safe isolation of equipment (such as electricity, mechanical, gas, air or fluids)
   • provide safe access and working arrangements for the maintenance area
   • carry out the maintenance activities using appropriate techniques and procedures
   • reconnect and return the system to service on completion of the maintenance activities
   • dispose of waste items in safe and environmentally acceptable manner, and leave the work area in a safe condition

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

   Fluid power components:
   • releasing stored pressure
   • disconnecting/removing hoses / pipes
   • chocking/supporting cylinders/rams/components
   • removing and replacing units/components (such as pumps, cylinders, valves, actuators)

   Mechanical components:
   • draining and replenishing fluids
   • removing and refitting locking and retaining devices
   • removing minor mechanical units/sub-assemblies (such as guards, structures)
   • removing major mechanical units (such as gear boxes, pumps, workholding/transfer equipment)
   • proofmarking components to aid reassembly
   • setting, aligning and adjusting replaced units
Process controller components:
- de-activating and resetting program controller
- reloading programs and making minor amendments
- removing and replacing input/output interfacing
- disconnecting/reconnecting wires/cables
- removing and replacing program logic peripherals

3 Carry out maintenance activities on six of the following types of electrical equipment:
- single-phase power supplies
- three-phase power supplies
- direct current power supplies
- motors and starters
- switchgear and distribution panels
- control systems and components
- electrical plant
- wiring enclosures
- luminaires
- other specific electrical equipment

4 Carry out all of the following maintenance activities, as applicable to the equipment being maintained:
- isolating and locking off equipment
- disconnecting/reconnecting wires and cables
- attaching suitable cable identification markers
- removing electrical units/components
- checking components for serviceability
- replacing damaged/defective components
- removing and replacing damaged wires/cables
- removing and replacing wiring enclosures
- setting and adjusting replaced components
- making ‘off-load’ checks before powering up
- functionally testing completed system

5 Replace a range of electrical components to include eight of the following:
- cables and connectors
- contactors
- relay components
- transformers
- overload protection devices
- switches and sensors
- solenoids
- capacitors
- rectifiers
- encoders or resolvers
- invertors and servo controllers
- circuit boards
- lighting fixtures
- batteries
- locking and retaining devices (such as cable ties, clips, proprietary fasteners)

6 Ensure that maintenance activities comply with one or more of the following quality and accuracy standards:
- organisational guidelines and codes of practice
- equipment manufacturer’s operation range
- IEE wiring regulations
- BS and ISO standards
Complete all relevant paperwork from the following, and pass it to the appropriate people:

- job cards
- maintenance log or report
- permits to work/formal risk assessment
Unit 25
Maintaining electrical equipment within an engineered system

Knowledge statements:
You must have knowledge and understanding of:
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. The isolation and lock-off procedure or permit-to-work procedure that applies to the system
3. The specific health and safety precautions to be applied during the maintenance activity, and their effects on others
4. How to recognise and deal with victims of electric shock (to include methods of safely removing the victim from the power source, isolating the power source, and methods of first aid resuscitation)
5. The importance of wearing protective clothing and other appropriate safety equipment during the maintenance activities
6. Hazards associated with carrying out electrical maintenance activities on an integrated system (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 them
7. How to obtain and interpret drawings, charts, specifications, manufacturers’ manuals, history/maintenance reports, graphical electrical symbols, IEE wiring regulations and other documents needed for the maintenance activities
8. The basic principles of how the system functions, its operation sequence, the working purpose of individual units/components, and how they interact
9. The different types of cabling and their application (such as multi-core cables, single-core cables, steel wire armoured (SWA), mineral insulated (MI), screened cables)
10. The different types of electric motors and motor starters
11. The different types of control systems and their various components
12. The application and use of a range of electrical components (such as plugs, switches, sockets, lighting and fittings, junction boxes, consumer units)
13. The various lighting systems used including tungsten, sodium, mercury vapour and fluorescent
14. The different types of wiring enclosures that are used (to include conduit, trunking and traywork systems)
15. The care, handling and application of ohmmeters, multimeters and other electrical measuring instruments
16. The procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance activities
17. Company policy on repair/replacement of components during the maintenance activities
18. The techniques used to dismantle/assemble integrated equipment (release of pressures/force, proofmarking to aid re-assembly, plugging exposed pipe/component openings, dealing with soldered joints, screwed, clamped and crimped connections)
19. Methods of removing and replacing cables and wires in wiring enclosures, without causing damage to existing cables
20. The use of IEE and other regulations when selecting wires and cables, and when carrying out tests on systems
21. Methods of attaching identification marks/labels to removed components or cables, to assist with re-assembly
22. Methods of checking that components are fit for purpose, and the need to replace ‘lifed’ items (such as motor brushes, seals and gaskets, and overload protection devices)
23. How to make adjustments to components/assemblies to ensure they function correctly
24. 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
25. The importance of making ‘off-load’ checks before proving the equipment with the electrical supply on
26. The generation of maintenance documentation and/or reports on completion of the maintenance activity
27. The equipment operating and control procedures to be applied during the maintenance activity
28. How to use lifting and handling equipment in the maintenance activity
29. The problems that can occur during the electrical maintenance activity, and how they can be overcome
30. The organisational procedure to be adopted for the safe disposal of waste of all types of materials
31. The extent of your own authority and whom you should report to when you have a problem you cannot resolve
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Maintaining electrical equipment within an engineered system

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<tr>
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<td>date</td>
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</tbody>
</table>

**Carry out all of the following during the maintenance activity:**

- Plan the maintenance activities to cause minimum disruption to normal working
- Use the correct issue of company and/or manufacturers’ drawings and maintenance documentation
- Adhere to risk assessment, COSHH and other relevant safety standards
- Ensure the safe isolation of equipment (such as electricity, mechanical, gas, air or fluids)
- Provide safe access and working arrangements for the maintenance area
- Carry out the maintenance activities using appropriate techniques and procedures
- Reconnect and return the system to service on completion of the maintenance activities
- Dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition

**Use appropriate dismantling and reassembly techniques to deal with two of the following:**

**Fluid power components:**

- Releasing stored pressure
- Disconnecting/removing hoses / pipes
- Chocking/supporting cylinders/rams/components
- Removing and replacing units/components (such as pumps, cylinders, valves, actuators)

**Mechanical components:**

- Draining and replenishing fluids
- Removing and refitting locking and retaining devices
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Maintaining electrical equipment within an engineered system

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<tbody>
<tr>
<td>removing minor mechanical units/sub-assemblies (such as guards, structures)</td>
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<tr>
<td>removing major mechanical units (such as gear boxes, pumps, work holding/transfer equipment)</td>
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<tr>
<td>proofmarking components to aid reassembly</td>
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<tr>
<td>setting, aligning and adjusting replaced units</td>
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**Process controller components:**

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<tr>
<td>reloading programs and making minor amendments</td>
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<tr>
<td>removing and replacing input/output interfacing</td>
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<tr>
<td>disconnecting/reconnecting wires/cables</td>
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<tr>
<td>removing and replacing program logic peripherals</td>
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**Carry out maintenance activities on six of the following types of electrical equipment:**

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<tbody>
<tr>
<td>single-phase power supplies</td>
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<tr>
<td>three-phase power supplies</td>
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<tr>
<td>direct current power supplies</td>
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<tr>
<td>motors and starters</td>
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<tr>
<td>switchgear and distribution panels</td>
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<tr>
<td>control systems and components</td>
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<td>electrical plant</td>
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<tr>
<td>wiring enclosures</td>
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<tr>
<td>luminaires</td>
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<tr>
<td>other specific electrical equipment</td>
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<tr>
<td><strong>Carry out all of the following maintenance activities, as applicable to the equipment being maintained:</strong></td>
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<tr>
<td>isolating and locking off equipment</td>
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<tr>
<td>disconnecting / reconnecting wires and cables</td>
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<tr>
<td>attaching suitable cable identification markers</td>
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<tr>
<td>checking components for serviceability</td>
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<tr>
<td>replacing damaged/defective components</td>
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<tr>
<td>removing and replacing damaged wires / cables</td>
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<tr>
<td>removing and replacing wiring enclosures</td>
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<tr>
<td>setting and adjusting replaced components</td>
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<tr>
<td>making ‘off-load’ checks before powering up</td>
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<tr>
<td>functionally testing completed system</td>
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<tr>
<td><strong>Replace a range of electrical components to include eight of the following:</strong></td>
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<tr>
<td>cables and connectors</td>
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<td>contactors</td>
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<tr>
<td>relay components</td>
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<td>transformers</td>
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<tr>
<td>overload protection devices</td>
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<tr>
<td>switches and sensors</td>
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<td>solenoids</td>
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<tr>
<td>capacitors</td>
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<tr>
<td>rectifiers</td>
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<td>encoders or resolvers</td>
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<td>invertors and servo controllers</td>
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<td>circuit boards</td>
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<tr>
<td>lighting fixtures</td>
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<td>batteries</td>
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<td>locking and retaining devices (such as cable ties, clips, proprietary fasteners)</td>
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</tbody>
</table>
## Unit 25
Maintaining electrical equipment within an engineered system

<table>
<thead>
<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ensure that maintenance activities comply with one or more of the following quality and accuracy standards:</strong></td>
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<tr>
<td>organisational guidelines and codes of practice</td>
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<tr>
<td>equipment manufacturer’s operation range</td>
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<tr>
<td>IEE wiring regulations</td>
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<tr>
<td>BS and ISO standards</td>
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<tr>
<td><strong>Complete all relevant paperwork from the following, and pass it to the appropriate people:</strong></td>
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<tr>
<td>job cards</td>
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<tr>
<td>maintenance log or report</td>
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<tr>
<td>permits to work/formal risk assessment</td>
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</tbody>
</table>

Knowledge and understanding reference:

Candidate: ________________________________ Date: ____________

Assessor: ________________________________ Date: ____________
Unit 26
Maintaining fluid power equipment within an engineered system

Unit summary
This unit identifies the competencies you need to carry out corrective maintenance activities on fluid power equipment within an engineered system, in accordance with approved procedures. You will be required to maintain a range of equipment, such as pumps, valves, actuators, sensors, compressors and other fluid power equipment, which are working in an integrated system involving two or more of the following interactive technologies: mechanical, electrical, or process controller.

You will be expected to isolate and disconnect items and components of the interactive technologies in order to gain access to and remove the fluid power units and components that require replacing or repair. This will involve dismantling and reassembling a variety of different types of assemblies and sub-assemblies which, in some instances, will need to be dismantled to component level.

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, tools or equipment used that you cannot personally resolve, or 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 work, and that all necessary job/task documentation is completed accurately and legibly. You will be expected to work with minimum 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 fluid power maintenance procedures. You will also know about the integrated technology assemblies and sub-assemblies, their properties, functions and associated defects, in adequate depth to provide a sound basis for carrying out the dismantling and reassembly process safely and effectively. You will understand the maintenance methods and procedures used, and their application within an engineered system, in sufficient depth to enable you to carry out the maintenance activities, correct faults, and ensure the maintained equipment functions to specification.

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.
Unit 26
Maintaining fluid power equipment within an engineered system

Performance statements:
You must:
a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Follow the relevant maintenance schedules to carry out the required work
c. Carry out the maintenance activities within the limits of your personal authority
d. Carry out the maintenance activities in the specified sequence and in an agreed timescale
e. Report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
f. Complete relevant maintenance records accurately and pass them on to the appropriate person
g. Dispose of waste materials in accordance with safe working practices and approved procedures

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:
1. Carry out all of the following during the maintenance activity:
   • plan the maintenance activities to cause minimum disruption to normal working
   • use the correct issue of company and/or manufacturers' drawings and maintenance documentation
   • adhere to risk assessment, COSHH and other relevant safety standards
   • ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
   • provide safe access and working arrangements for the maintenance area
   • carry out the maintenance activities using appropriate techniques and procedures
   • reconnect and return the system to service on completion of the maintenance activities
   • dispose of waste items in safe and environmentally acceptable manner, and leave the work area in a safe condition

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

   Mechanical components:
   • draining and replenishing fluids
   • removing and refitting locking and retaining devices
   • removing minor mechanical units/sub-assemblies (such as guards, structures)
   • removing major mechanical units (gear boxes, pumps, workholding/transfer equipment)
   • proofmarking components to aid re-assembly
   • setting, aligning and adjusting replaced units

   Electrical components:
   • isolating power supply
   • disconnecting and reconnecting wires/cables
   • removing and replacing major electrical components (such as motors, switch/control gear)
   • removing / replacing minor electrical components (such as relays, sensing devices, limit switches)
   • removing and replacing wiring enclosures (such as conduit, trunking and traywork)
Process controller components:
- de-activating and resetting program controller
- reloading programs and making minor amendments
- removing and replacing input/output interfacing
- disconnecting/re-connecting wires/cables
- removing and replacing program logic peripherals

3 Carry out maintenance activities on two of the following types of fluid power equipment:
- pneumatic
- hydraulic
- vacuum

4 Carry out all of the following maintenance activities, as applicable to the equipment being maintained:
- chocking/supporting cylinders/rams/component
- draining and removing fluids (as applicable)
- disconnecting/removing hoses and pipes
- proofmarking/labelling of removed components
- checking components for serviceability
- removing and replacing units/components (such as pumps, cylinders, valves, actuators)
- setting, aligning and adjusting replaced components
- making ‘off-load’ checks before re-pressurising system
- functional testing of the maintained system
- releasing stored pressure
- replacing damaged/defective components
- replacing all ‘lifed’ items (seals, filters, gaskets)
- tightening fastenings to the required torque

5 Carry out maintenance activities to component level on one of the following fluid power components:
- pumps
- valves
- cylinders
- actuators

6 Replace a range of fluid power components, to include seven of the following:
- pumps
- pistons
- spools
- valves
- actuators
- cylinders
- bearings
- reservoirs
- accumulators
- pressure intensifiers
- compressors
- receivers
- gaskets and seals
- pipework and hoses
- switches
- sensors
- lubricators/filters
- regulators
- other specific components
7 Ensure that maintenance activities comply with **one or more** of the following quality and accuracy standards:
- organisational guidelines and codes of practice
- equipment manufacturer’s operation range
- IEE wiring regulations
- BS and / or ISO standards

8 Complete **all** relevant paperwork from the following, and pass it to the appropriate people:
- job cards
- maintenance log or report
- permit to work/formal risk assessment
Unit 26
Maintaining fluid power equipment within an engineered system

Knowledge statements:
You must have knowledge and understanding of:
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. The isolation and lock-off procedure or permit-to-work procedure that applies to the system being worked on
3. The specific health and safety precautions to be applied during the maintenance activities, and their effects on others
4. How to recognise and deal with victims of electric shock (to include methods of safely removing the victim from the power source, isolating the power source, and methods of first aid resuscitation)
5. The importance of wearing protective clothing and other appropriate safety equipment during the maintenance activities, and where to obtain it
6. Hazards associated with carrying out maintenance activities on an integrated system (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 them
7. How to obtain and interpret drawings, charts, circuit and physical layouts, specifications, manufacturers’ manuals, history/maintenance reports, symbols used in fluid power, and other documents needed for the maintenance activities
8. The basic principles of how the system functions, its operation sequence, the working purpose of individual units/components, and how they interact
9. How to construct and apply ladder logic or sequential charts/tables
10. Dry and lubricated systems and their application
11. Selection of fluids for the system
12. How to determine pressure settings, and their effect on the system
13. The effects, and likely symptoms, of contamination in the system
14. The different types of pipework, fittings and manifolds, and their application
15. The identification and application of different types of valves (poppet, spool, piston, disc)
16. The identification and application of different types of sensors and actuators (rotary, linear, mechanical, electrical)
17. The identification and application of different types of cylinders (single acting, double acting)
18. The identification and application of different types of pumps (positive and non-positive displacement)
19. The application and fitting of static and dynamic seals
20. Company policy on repair/replacement of components, and the procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance activities
21. The sequence to be adopted for the dismantling and reassembling of the equipment, to both sub-assembly and individual component level
22. The techniques used to dismantle/re-assemble integrated equipment (release of pressures/force, proofmarking to aid assembly, plugging exposed pipe/component openings, dealing with soldered joints, screwed, clamped and crimped connections)
23. Methods of attaching identification marks/labels to removed components or cables, to assist with re-assembly
24. Methods of checking that components are fit for purpose, and the need to replace ‘lifed’ items (such as seals, gaskets, filters, pistons, spools and bearings)
25. How to make adjustments to components/assemblies, to ensure they function correctly
26. 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
27. The importance of making ‘off-load’ checks before applying full pressure
36. The generation of maintenance documentation and/or reports on completion of the maintenance activity
37. The manufacturer’s equipment operating and control procedures to be applied during the maintenance activity
38. How to use lifting and handling equipment in the maintenance activity
39. The problems that can occur during the maintenance activity, and how they can be overcome
40. The organisational procedure to be adopted for the safe disposal of waste of all types of materials
41. The extent of your own authority and whom you should report to when you have a problem that you cannot resolve
# Unit 26
## Maintaining fluid power equipment within an engineered system

<table>
<thead>
<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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<tbody>
<tr>
<td>evidence type</td>
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<td>date</td>
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**Carry out all of the following during the maintenance activity:**

- plan the maintenance activities to cause minimum disruption to normal working
- use the correct issue of company and/or manufacturers' drawings and maintenance documentation
- adhere to risk assessment, COSHH and other relevant safety standards
- ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
- provide safe access and working arrangements for the maintenance area
- carry out the maintenance activities using appropriate techniques and procedures
- reconnect and return the system to service on completion of the maintenance activities
- dispose of waste items in safe and environmentally acceptable manner, and leave the work area in a safe condition

**Use appropriate dismantling and reassembly techniques to deal with two of the following:**

**Mechanical components:**

- draining & replenishing fluids
- removing & refitting locking & retaining devices
- removing minor mechanical units/sub-assemblies (such as guards, structures)
- removing major mechanical units (gear boxes, pumps, workholding/transfer equipment)
- proofmarking components to aid reassembly
- setting, aligning and adjusting replaced units
Unit 26
Maintaining fluid power equipment within an engineered system

<table>
<thead>
<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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<tbody>
<tr>
<td><strong>Electrical components:</strong></td>
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<tr>
<td>isolating power supply</td>
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<tr>
<td>disconnecting and reconnecting wires/cables</td>
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<tr>
<td>removing and replacing major electrical components (such as motors, switch/control gear)</td>
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<tr>
<td>removing / replacing minor electrical components (such as relays, sensing devices, limit switches)</td>
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<tr>
<td>removing and replacing wiring enclosures (such as conduit, trunking and traywork)</td>
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<tr>
<td><strong>Process controller components:</strong></td>
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<tr>
<td>de-activating and resetting program controller</td>
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<tr>
<td>reloading programs and making minor amendments</td>
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<tr>
<td>removing and replacing input/output interfacing</td>
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<td>disconnecting/re-connecting wires/cables</td>
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<tr>
<td>removing and replacing program logic peripherals</td>
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<tr>
<td><strong>Carry out maintenance activities on two of the following types of fluid power equipment:</strong></td>
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<tr>
<td>pneumatic</td>
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<tr>
<td>hydraulic</td>
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<tr>
<td>vacuum</td>
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<tr>
<td><strong>Carry out all of the following maintenance activities, as applicable to the equipment being maintained:</strong></td>
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<tr>
<td>chocking/supporting cylinders/rams/component</td>
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<tr>
<td>draining and removing fluids (as applicable)</td>
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<tr>
<td>disconnecting/removing hoses and pipes</td>
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<tr>
<td>proofmarking/labelling of removed components</td>
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<tr>
<td>checking components for serviceability</td>
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# Unit 26
Maintaining fluid power equipment within an engineered system

<table>
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<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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</thead>
<tbody>
<tr>
<td>removing and replacing units/components (such as pumps, cylinders, valves, actuators)</td>
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<tr>
<td>setting, aligning and adjusting replaced components</td>
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<tr>
<td>making ‘off-load’ checks before re-pressurising system</td>
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<tr>
<td>functional testing of the maintained system</td>
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<tr>
<td>releasing stored pressure</td>
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<tr>
<td>replacing damaged/defective components</td>
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<tr>
<td>replacing all ‘lifed’ items (seals, filters, gaskets)</td>
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<td>tightening fastenings to the required torque</td>
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</table>

**Carry out maintenance activities to component level on one of the following fluid power components:**

- pumps
- valves
- cylinders
- actuators

**Replace a range of fluid power components, to include seven of the following:**

- pumps
- pistons
- spools
- valves
- actuators
- cylinders
- bearings
- reservoirs
- accumulators
- pressure intensifiers
- compressors
- receivers
- gaskets and seals
- pipework and hoses
- switches
### Unit 26
Maintaining fluid power equipment within an engineered system

<table>
<thead>
<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
</tr>
</thead>
<tbody>
<tr>
<td>sensors</td>
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<tr>
<td>lubricators/filters</td>
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<tr>
<td>regulators</td>
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<tr>
<td>other specific components</td>
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**Ensure that maintenance activities comply with one or more of the following quality and accuracy standards:**

- organisational guidelines and codes of practice
- equipment manufacturer’s operation range
- IEE wiring regulations
- BS and / or ISO standards

**Complete all relevant paperwork from the following, and pass it to the appropriate people:**

- job cards
- maintenance log or report
- permit to work/formal risk assessment

Knowledge and understanding reference:

---

Candidate: ___________________________  Date: ________________

Assessor: ___________________________  Date: ________________
Unit 27
Maintaining process controller equipment within an engineered system

Unit summary
This unit identifies the competencies you need to carry out corrective maintenance to process controller equipment within an engineered system, in accordance with approved procedures. 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), robots, etc) which are working in an integrated system involving two or more of the following interactive technologies: mechanical, electrical or fluid power.

This will involve dismantling, removing and replacing faulty peripheral components, process controller units, and components, down to board level on ‘shoebox’ or ‘rack’ type process controller systems. You will also need to be able to 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 are outside your permitted authority, to the relevant people. You will be expected to work with minimum 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 a good 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 the equipment operates to the required specification. You will also 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.
Unit 27
Maintaining process controller equipment within an engineered system

Performance statements:
You must:

a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Follow the relevant maintenance schedules to carry out the required work
c. Carry out the maintenance activities within the limits of your personal authority
d. Carry out the maintenance activities in the specified sequence and in an agreed time scale
e. Report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
f. Complete relevant maintenance records accurately and pass them on to the appropriate person
g. Dispose of waste materials in accordance with safe working practices and approved procedures

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:

1. Carry out all of the following during the maintenance activities:
   - plan the maintenance activities to cause minimum disruption to normal working
   - use the correct issue of company and/or manufacturers' drawings and maintenance documentation
   - adhere to risk assessment, COSHH and other relevant safety standards
   - ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
   - provide safe access and working arrangements for the maintenance area
   - carry out the maintenance activities using appropriate techniques and procedures
   - reconnect and return the system to service on completion of the maintenance activities
   - dispose of waste items in safe and environmentally acceptable manner, and leave the work area in a safe condition

2. Use appropriate dismantling and re-assembly techniques to deal with two of the following:
   Mechanical components
   - draining and replenishing of fluids
   - removing and refitting locking and retaining devices
   - removing minor mechanical units/sub-assemblies (such as guards, structures)
   - removing major mechanical units (such as gear boxes, pumps, workholding/transfer equipment)
   - proofmarking components to aid reassembly
   - setting, aligning and adjusting replaced units

   Electrical components
   - isolating the power supply
   - disconnecting and re-connecting wires/cables
   - removing and replacing major electrical components (such as motors, switch/control gear)
   - removing and replacing minor electrical components (such as relays, sensing devices, limit switches)
   - removing and replacing wiring enclosures (such as conduit, trunking and traywork)
Fluid power components
- releasing stored pressure
- disconnecting/removing hoses/pipes
- chocking/supporting cylinders/rams/components
- removing and replacing units/components (such as pumps, cylinders, valves, actuators)

3 Carry out maintenance activities on one of the following types of process controller equipment:
- fixed I/O
- rack mount
- modular

4 Carry out seven of the following program maintenance activities on the process controller system:
- select and use appropriate programming devices (such as terminals, handheld programmers and personal computers)
- use ladder logic, statement lists, or system flowcharts
- force contacts on and off
- edit, enter and remove contacts from lines of logic
- alter counter and timer settings
- use ‘on’ and ‘off-line’ programming
- carry out on-line monitoring of programs
- load, read and save programs
- produce back-ups of completed programs
- programme by computer based authoring (to include sub-routines)
- use single-step mode of operation

5 Carry out all of the following during the maintenance activities:
- take electrostatic precautions when handling sensitive components and circuit boards
- proofmark or label removed wires and components
- inspect components for serviceability
- use program full-run modes of operation
- change or add circuit boards
- replace power supplies
- replace peripherals (such as sensors, actuators, relays, switches)
- replace process controller units
- replace back-up batteries
- functionally test the system

6 Ensure maintenance activities comply with one or more of the following quality and accuracy standards:
- IEE wiring regulations
- BS and / or ISO standards
- organisational guidelines and codes of practice
- equipment manufacturer’s operation range

7 Complete all relevant paperwork from the following, and pass it to the appropriate people:
- job cards
- maintenance log or report
- permits to work/formal risk assessment
Unit 27
Maintaining process controller equipment within an engineered system

Knowledge statements:
You must have knowledge and understanding of:
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
42. The isolation and lock-off procedure or permit-to-work procedure that applies to the system being worked on
43. The isolation procedure which is specific to the process controller system being worked on
44. The specific health and safety precautions that need to be applied during the maintenance activities, and their effects on others
45. How to recognise and deal with victims of electric shock (to include methods of safely removing the victim from the power source, isolating the power source, and methods of first aid resuscitation)
46. The importance of wearing protective clothing and other appropriate safety equipment during the maintenance activities, and where this can be obtained
47. The procedures and precautions to be adopted to eliminate electrostatic discharge hazards
48. Hazards associated with carrying out maintenance activities on a process controlled integrated system (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 they can be minimised
49. 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
50. The basic principles of how the system functions, its operation sequence, the working purpose of individual units/components, and how they interact
51. The devices and systems for storing programmes
52. Procedures to be applied to storage, location and method of backing up programmes
53. The different types of interface cards, and their application
54. The procedures for the application of computer-based authoring software for design and development
55. The numbering system and codes used for identification inputs and outputs
56. How to search a programme within the process controller for specific elements
57. Programming techniques and codes used (interlocking, timers, counters, sub-routines etc)
58. 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
59. The procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance process
60. Company policy on repair/replacement of components during the maintenance activities
61. The techniques used to dismantle/assemble integrated equipment (release of pressures/force, proofmarking to aid re-assembly, plugging exposed pipe/component openings, dealing with soldered joints, screwed, clamped and crimped connections)
62. Methods of attaching identification marks/labels to removed components or cables to assist with re-assembly
63. Methods of checking that components are fit for purpose, and the need to replace items such as batteries, boards and other failed items
64. 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
65. The importance of making ‘off-load’ checks before proving the equipment with the electrical supply on
66. The generation of maintenance documentation and/or reports on completion of the maintenance activity
67. The equipment operating and control procedures to be applied during the maintenance activity
68. How to use lifting and handling equipment in the maintenance activity
69. The problems that can occur during the maintenance of the process controller system, and how they can be overcome
70. The organisational procedure to be adopted for the safe disposal of waste of all types of materials
71. The extent of your own authority and whom you should report to if you have a problem you cannot resolve
### Unit 27
Maintaining process controller equipment within an engineered system

<table>
<thead>
<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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<td>evidence type</td>
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<td>date</td>
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</table>

**Carry out all of the following during the maintenance activities:**

- plan the maintenance activities to cause minimum disruption to normal working
- use the correct issue of company and/or manufacturers’ drawings and maintenance documentation
- adhere to risk assessment, COSHH and other relevant safety standards
- ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
- provide safe access and working arrangements for the maintenance area
- carry out the maintenance activities using appropriate techniques and procedures
- reconnect and return the system to service on completion of the maintenance activities
- dispose of waste items in safe and environmentally acceptable manner, and leave the work area in a safe condition
## Unit 27
Maintaining process controller equipment within an engineered system

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<th>evidence record sheet</th>
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<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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Use appropriate dismantling and reassembly techniques to deal with two of the following:

- Mechanical components
- draining and replenishing of fluids
- removing and refitting locking and retaining devices
- removing minor mechanical units/sub-assemblies (such as guards, structures)
- removing major mechanical units (such as gear boxes, pumps, workholding/transfer equipment)
- proofmarking components to aid reassembly
- setting, aligning and adjusting replaced units

Electrical components

- isolating the power supply
- disconnecting and re-connecting wires/cables
- removing and replacing major electrical components (such as motors, switch/control gear)
- removing and replacing minor electrical components (such as relays, sensing devices, limit switches)
- removing and replacing wiring enclosures (such as conduit, trunking and traywork)

Fluid power components

- releasing stored pressure
- disconnecting/removing hoses / pipes chocking/supporting cylinders/rams/components
- removing and replacing units/components (such as pumps, cylinders, valves, actuators)
## Unit 27
Maintaining process controller equipment within an engineered system

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<th>Additional performance evidence (if required)</th>
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<tbody>
<tr>
<td><strong>Carry out maintenance activities on one of the following types of process controller equipment:</strong></td>
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<td>fixed I/O</td>
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<td>rack mount</td>
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<tr>
<td>modular</td>
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<td><strong>Carry out seven of the following program maintenance activities on the process controller system:</strong></td>
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<td>select and use appropriate programming devices (such as terminals, handheld programmers and personal computers)</td>
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<td>use ladder logic, statement lists, or system flowcharts</td>
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<td>force contacts on and off</td>
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<tr>
<td>edit, enter and remove contacts from lines of logic</td>
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<td>alter counter and timer settings</td>
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<td>use ‘on’ and ‘off-line’ programming</td>
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<td>carry out on-line monitoring of programs</td>
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<td>load, read and save programs</td>
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<td>produce back-ups of completed programs</td>
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<tr>
<td>programme by computer based authoring (to include sub-routines)</td>
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<td>use single-step mode of operation</td>
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<td><strong>Carry out all of the following during the maintenance activities:</strong></td>
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<td>take electrostatic precautions when handling sensitive components and circuit boards</td>
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<td>proofmark or label removed wires and components</td>
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<td>inspect components for serviceability</td>
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<td>use program full-run modes of operation</td>
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<td>change or add circuit boards</td>
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<td>replace power supplies</td>
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<td>replace peripherals (such as sensors, actuators, relays, switches)</td>
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<td>replace process controller units</td>
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<td>replace back-up batteries</td>
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<tr>
<td>functionally test the system</td>
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</table>

Ensure maintenance activities comply with one or more of the following quality and accuracy standards:

- IEE wiring regulations
- BS and/or ISO standards
- Organisational guidelines and codes of practice
- Equipment manufacturer’s operation range

Complete all relevant paperwork from the following, and pass it to the appropriate people:

- Job cards
- Maintenance log or report
- Permits to work/formal risk assessment

Knowledge and understanding reference:

Candidate: ___________________________________________  Date: __________________
Assessor: ___________________________________________  Date: __________________
Unit 28
Carrying out planned maintenance on engineered systems

Unit summary
This unit identifies the competencies you need to carry out planned maintenance activities on engineered systems, in accordance with approved procedures. You will be required to carry out the maintenance activities on engineered systems involving at least two of the following interactive technologies: mechanical, electrical, fluid power or process controller. You will need to organise and carry out the maintenance activities to minimise down time, and ensure that the maintained system performs at optimal level and functions to the required specification.

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, tools or equipment used that you cannot personally resolve, or 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 work, and that all necessary job/task documentation is completed accurately and legibly. You will be expected to work with minimum 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 planned maintenance procedures within an engineered system. You will know about the integrated technologies within the system, how the system functions, and potential problems or defects that may occur. You will understand the process of developing planned maintenance, and its application, and will know about the maintenance criteria, in adequate depth to provide a sound basis for carrying out the activities safely and effectively, and for ensuring the system is maintained to the required specification. In addition, you will be expected to report where the outcome of the maintenance activity identifies the need for further investigation or maintenance work.

You will understand the safety precautions required when carrying out the maintenance activities, especially those for isolating the equipment and taking the necessary safeguards to protect yourself and others in the workplace. You will be required to demonstrate safe working practices throughout.
Unit 28
Carrying out planned maintenance on engineered systems

Performance statements:
You must:

a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Follow the relevant maintenance schedules to carry out the required work
c. Carry out the maintenance activities within the limits of your personal authority
d. Carry out the maintenance activities in the specified sequence and in an agreed timescale
e. Report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
f. Complete relevant maintenance records accurately and pass them on to the appropriate person
g. Dispose of waste materials in accordance with safe working practices and approved procedures

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:

1. Carry out all of the following during the maintenance activities:
   - plan the maintenance activities to cause minimum disruption to normal working
   - use the correct issue of company and/or manufacturers’ drawings and maintenance documentation
   - adhere to risk assessment, COSHH and other relevant safety standards
   - ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
   - provide safe access and working arrangements for the maintenance area
   - carry out the maintenance activities using appropriate techniques and procedures
   - reconnect and return the system to service on completion of the maintenance activities
   - dispose of waste items in safe and environmentally acceptable manner, and leave the work area in a safe condition

2. Carry out planned maintenance activities on engineered systems, involving two or more of the following:
   - interactive technologies, to sub-assembly/component level:
   - mechanical
   - electrical
   - fluid power
   - process controller

3. Follow planned maintenance activities based on one of the following types of maintenance schedule:
   - condition based maintenance
   - scheduled maintenance
   - total preventative maintenance (TPM)
4 Carry out ten of the following planned maintenance activities:
   • visual examination and testing of the system against the maintenance schedule
   • checking operation of all gauges and sensors
   • monitoring component condition/deterioration
   • making sensory checks (such as sight, sound, smell, touch)
   • replacing ‘lifed’ consumables (such as filters, fluids)
   • carrying out system self-analysis checks
   • removing excessive dirt and grime
   • checking condition of belts, bearings, seals
   • making routine adjustments
   • carrying out leak checks on all connections
   • testing and reviewing system operation
   • recording the results of the maintenance activity and reporting any defects found

5 Ensure the maintained equipment/system meets all of the following quality and accuracy standards:
   • equipment operates within acceptable limits for successful continuous operation to meet output specification
   • any potential defects are identified and reported for future action
   • all relevant documentation is completed accurately and legibly

6 Complete all relevant paperwork and pass it to the appropriate people:
   • job cards
   • maintenance log or report
   • permit to work/formal
   • risk assessment
Unit 28
Carrying out planned maintenance on engineered systems

Knowledge statements:
You must have a knowledge and understanding of:
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. The isolation and lock-off procedure or permit-to-work procedure that applies to the system being maintained
3. The specific health and safety precautions to be applied during the maintenance activities, and their effects on others
4. How to recognise and deal with victims of electric shock (to include methods of safely removing the victim from the power source, isolating the power source, and methods of first aid resuscitation)
5. The importance of wearing protective clothing and other appropriate safety equipment during the maintenance activities, and where it may be obtained
6. Hazards associated with carrying out maintenance activities on an integrated system (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 them
7. How to obtain and interpret drawings, charts, specifications, manufacturers’ manuals, history/maintenance reports and other documents needed for the maintenance activities
8. The various planned maintenance schedules that are generally used (such as condition based maintenance, scheduled maintenance, and total preventative maintenance (TPM))
9. The basic principles of how the system functions, its operation sequence, the working purpose of individual units/components, and how they interact
10. The equipment operating and control procedures, and how to apply them in order to carry out the planned maintenance activities
11. The testing methods and procedures to be used to check that the system conforms to acceptable limits
12. How to make sensory checks by sight, sound, smell, touch
13. The procedure for obtaining consumables and ‘lifed’ items that will require replacing during the maintenance activity
14. Company policy on repair/replacement of components during the maintenance activities
15. Methods of checking that components are fit for purpose, and the need to replace ‘lifed’ items such as filters, seals, gaskets, belts, chains and bearings
16. How to make adjustments to components and assemblies to ensure they function correctly
17. The generation of maintenance documentation and/or reports on completion of the maintenance activity
18. The problems that can occur during the planned maintenance activity, and how they can be overcome
19. The organisational procedure to be adopted for the safe disposal of waste of all types of materials
20. The extent of your own authority and whom you should report to when you have a problem you cannot resolve
<table>
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<th>evidence record sheet</th>
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<td><strong>Carry out all of the following during the maintenance activities:</strong></td>
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<tr>
<td>plan the maintenance activities to cause minimum disruption to normal working</td>
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<td>use the correct issue of company and/or manufacturers’ drawings and maintenance documentation</td>
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<td>adhere to risk assessment, COSHH and other relevant safety standards</td>
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<td>ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)</td>
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<td>provide safe access and working arrangements for the maintenance area</td>
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<td>carry out the maintenance activities using appropriate techniques and procedures</td>
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<td>reconnect and return the system to service on completion of the maintenance activities</td>
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<td>dispose of waste items in safe and environmentally acceptable manner, and leave the work area in a safe condition</td>
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<td><strong>Carry out planned maintenance activities on engineered systems, involving two or more of the following</strong></td>
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<tr>
<td>interactive technologies, to sub-assembly/component level:</td>
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<td>mechanical</td>
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<td>fluid power</td>
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<td>process controller</td>
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Unit 28
Carrying out planned maintenance on engineered systems

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<tr>
<td><strong>Follow planned maintenance activities based on one of the following types of maintenance schedule:</strong></td>
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<td>condition based maintenance</td>
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<td>scheduled maintenance</td>
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<td>total preventative maintenance (TPM)</td>
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<td><strong>Carry out ten of the following planned maintenance activities:</strong></td>
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<tr>
<td>visual examination and testing of the system against the maintenance schedule</td>
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<tr>
<td>checking operation of all gauges and sensors</td>
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<tr>
<td>monitoring component condition/deterioration</td>
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<td>making sensory checks (such as sight, sound, smell, touch)</td>
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<td>replacing ‘lifed’ consumables (such as filters, fluids)</td>
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<td>carrying out system self-analysis checks</td>
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<td>removing excessive dirt and grime</td>
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<td>checking condition of belts, bearings, seals</td>
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<td>making routine adjustments</td>
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<td>carrying out leak checks on all connections</td>
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<tr>
<td>testing and reviewing system operation</td>
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<td>recording the results of the maintenance activity and reporting any defects found</td>
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<td><strong>Ensure the maintained equipment/system meets all of the following quality and accuracy standards:</strong></td>
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<td>equipment operates within acceptable limits for successful continuous operation to meet output specification</td>
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<td>any potential defects are identified and reported for future action</td>
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<td>all relevant documentation is completed accurately and legibly</td>
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# Unit 28
Carrying out planned maintenance on engineered systems

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**Complete all relevant paperwork and pass it to the appropriate people:**

- job cards
- maintenance log or report
- permit to work/formal
- risk assessment

Knowledge and understanding reference:

Candidate: ___________________________ Date: ______________

Assessor: ___________________________ Date: ______________
Unit 29
Reading and extracting information from service drawings and specifications

Unit summary
This unit identifies the competencies you need in order to read and extract information from drawings and specifications relating to factory/building services. In this unit, you will be required to make effective use of text, numeric and graphical information, by interpreting and using technical information extracted from engineering services drawings, specifications, technical data sheets and maintenance manuals, in accordance with approved procedures. You will be required to extract the necessary information from the various drawings and related documents, in order to establish and carry out the maintenance requirements, and to make valid decisions about the quality and performance of the equipment being maintained.

Your responsibilities will require you to comply with organisational policy and procedures for the care and control of the drawings and related specifications. You will be expected to use the drawings and specifications in order to obtain relevant information about the factory services. You will be expected to report any problems with the use and interpretation of the drawings and specifications that you cannot personally resolve, or are outside your permitted authority, to the relevant people. You will be expected to work with minimum 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 the different types of drawings and documents used within a services maintenance environment, and will provide an informed approach to applying instructions and procedures. You will be able to read and interpret the drawings and documents used, and will know about the symbols, notations, conventions, and abbreviations used, in adequate depth to provide a sound basis for carrying out the maintenance activities to the required specification.
Unit 29
Reading and extracting information from service drawings and specifications

Performance statements:
You must:
a. Use the approved source to obtain the required drawings and specifications
b. Correctly interpret the drawings and specifications
c. Identify, extract and interpret the required information
d. Use the information obtained to ensure that work output meets the specification
e. Deal promptly and effectively with any problems within your control and report those which cannot
   be solved
f. Report any inaccuracies or discrepancies in drawings and specifications

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational
Standard.

You must:
1 Use approved sources to obtain the necessary drawings and related specifications, and carry out
   all of the following:
   • check the currency and validity of the drawings and documents used
   • exercise care and control over the documents at all times
   • correctly extract all necessary data in order to carry out the required tasks
   • seek out additional information where there are gaps or deficiencies in the information
     obtained
   • report any problems found with the drawings/specifications
   • make valid decisions based on the data extracted from the documents
   • return all drawings and related documents to the approved location on completion of the work

2 Use information extracted from three of the following services drawings and related
documentation, to include:
   • approved sketches
   • technical illustrations
   • software based documentation
   • gas supply, distribution and installation
   • fuel oil supply, distribution and installation
   • routing diagrams (such as piping, cables)
   • steam supply, distribution and installation general assembly drawings
   • general layout drawings (identifying such things as service plant, intake locations, sub-stations,
     boiler rooms, compressed air supply, buildings)
   • operation and maintenance manuals
   • manufacturer/supplier/contractor data
   • electrical supply, distribution and installation
   • water supply, distribution and installation
   • compressed air supply, distribution and installation
   • layout diagrams (such as schematic, block, physical, system)
3 Use information extracted from related documentation, to include two from the following:
- works instructions
- maintenance log/reports
- fault diagnosis guides
- test schedules national, international and organisational standards
- health and safety standards relating to activity (such as CSHH)
- environmental requirements
- organisational standards

4 Extract information that includes three of the following:
- utility supply details (such as electricity, water, gas; comprising size, nature of supply, metering and equipment details)
- service distribution arrangements, including plant and equipment specifications
- locations of services, including standby and emergency backup systems
- maintenance schedules for services equipment
- electrical data and fluid data (relating to such things as steam, water, compressed air, oil)
- protective arrangements and equipment (such as containment, pressure relief valves, environmental controls, warning and evacuation systems and equipment)

Knowledge statements:
You must have knowledge and understanding of:
1. The sources of the drawings and specifications that you use in your work activities
2. How drawings and documents are obtained, and how to check that they are current and valid
3. How to use other sources of information to support the drawings (such as organisational standards, national and international standards, health and safety documentation)
4. The procedures for reporting discrepancies in the drawings or documents, and for reporting lost or damaged drawings/documents
5. Care and control procedures for the drawings and documents, and the importance of returning the drawings and documents to the designated location on completion of the work activities
6. The basic drawing conventions, colour coding of services, symbols and notations used, and why there needs to be different types of drawings
7. The types of drawings used and how they interrelate (such as general layout drawings; piping and cable route diagrams; flow, block, schematic and system diagrams)
8. Imperial and metric systems of measurement; dimensions and tolerances; scales and reference points
9. The meaning of the different symbols, notations and abbreviations found on the drawings used for services (such as electricity, water, gas, fuel oil, compressed air, steam, pressure and flow characteristics)
10. How damage and contaminants on drawings can lead to delays in carrying out work
11. The extent of your own responsibility, when to act on your own initiative to find, clarify and evaluate information, and whom you should report to if you have problems that you cannot resolve
## Unit 29
Reading and extracting information from service drawings and specifications

<table>
<thead>
<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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</table>

**Use approved sources to obtain the necessary drawings and related specifications, and carry out all of the following:**

- check the currency and validity of the drawings and documents used
- exercise care and control over the documents at all times
- correctly extract all necessary data in order to carry out the required tasks
- seek out additional information where there are gaps or deficiencies in the information obtained
- report any problems found with the drawings/specifications
- make valid decisions based on the data extracted from the documents
- return all drawings and related documents to the approved location on completion of the work

**Use information extracted from three of the following services drawings and related documentation, to include:**

- approved sketches
- technical illustrations
- software based documentation
- gas supply, distribution and installation
- fuel oil supply, distribution and installation
- routing diagrams (such as piping, cables)
- steam supply, distribution and installation general assembly drawings
**Unit 29**
Reading and extracting information from service drawings and specifications

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<td>general layout drawings (identifying such things as service plant, intake locations, sub-stations, boiler rooms, compressed air supply, buildings)</td>
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<td>operation and maintenance manuals</td>
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<td>manufacturer/supplier/contractor data</td>
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<td>electrical supply, distribution and installation</td>
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<td>water supply, distribution and installation</td>
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<td>compressed air supply, distribution and installation</td>
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<td>layout diagrams (such as schematic, block, physical, system)</td>
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**Use information extracted from related documentation, to include two from the following:**

- works instructions
- maintenance log/reports
- fault diagnosis guides
- test schedules
- national, international and organisational standards
- health and safety standards relating to activity (such as COSHH)
- environmental requirements
- organisational standards

**Extract information that includes three of the following:**

- utility supply details (such as electricity, water, gas; comprising size, nature of supply, metering and equipment details)
- service distribution arrangements, including plant and equipment specifications
- locations of services, including standby and emergency backup systems
<table>
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<td>electrical data and fluid data (relating to such things as steam, water, compressed air, oil)</td>
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<td>protective arrangements and equipment (such as containment, pressure relief valves, environmental controls, warning and evacuation systems and equipment)</td>
</tr>
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</table>

Knowledge and understanding reference:

Candidate: ___________________________ Date: __________________

Assessor: ___________________________ Date: __________________
Unit 30
Carrying out fault diagnosis on services and systems

Unit summary
This unit identifies the competencies you need to carry out fault diagnosis on services, and service equipment and systems, in accordance with approved procedures. You will be required to diagnose faults on a range of service equipment and systems, such as fresh and foul water, environmental control, emergency power generation, heating and ventilation, gas distribution, process control, instrumentation control, and refrigeration, at sub-assembly and/or component level, as applicable to the equipment. You will be expected to use a variety of fault diagnosis methods and techniques, and to utilise a number of diagnostic aids and equipment. From the evidence gained, you will be expected to identify the fault and its probable cause, and to suggest action to remedy the problem.

Your responsibilities will require you to comply with organisational policy and procedures for the fault diagnostic activities undertaken, and to report any problems with these activities, or the tools and equipment used that you cannot personally resolve, or are outside your permitted authority, to the relevant people. You will be expected to work with minimum 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 fault diagnosis procedures on service equipment and systems. You will understand the various fault diagnosis methods and techniques used, and their application. You will know how to apply and interpret information obtained from diagnostic aids and equipment, in adequate depth to provide a sound basis for carrying out the activities and identifying faults or conditions that are outside the required specification.

You will understand the safety precautions required when carrying out the fault diagnosis activities, especially those for isolating the equipment. 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.
Unit 30
Carrying out fault diagnosis on services and systems

Performance statements:
You must:
a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Review and use all relevant information on the symptoms and problems associated with the products or assets
c. Investigate and establish the most likely causes of the faults
d. Select, use and apply diagnostic techniques, tools and aids to locate faults
e. Complete the fault diagnosis within the agreed time and inform the appropriate people when this cannot be achieved
f. Determine the implications of the fault for other work and for safety considerations
g. Use the evidence gained to draw valid conclusions about the nature and probable cause of the fault
h. Record details on the extent and location of the faults in an appropriate format

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:
1  Carry out all of the following during the fault diagnostic activities:
   • plan the fault diagnosis so as to minimise disruption to normal working
   • use the correct issue of company and/or manufacturers’ drawings and maintenance documentation
   • adhere to risk assessment, COSHH and other relevant safety standards
   • ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
   • provide safe access and working arrangements for the maintenance area
   • carry out the fault diagnostic activities using approved procedures
   • collect equipment fault diagnosis evidence from live and isolated systems
   • disconnect or isolate components or parts of the system when appropriate to confirm diagnosis
   • identify the fault and determine appropriate corrective action
   • dispose of waste items in safe and environmentally acceptable manner, and leave the work area in a safe condition

2  Carry out fault diagnosis on two of the following types of services equipment, to sub-assembly or component level as applicable:
   • fresh water
   • foul water
   • compressed air
   • refrigeration
   • environmental control
   • emergency power generation
   • gas distribution
   • instrumentation and control
   • heating and ventilating
   • air conditioning and ventilating
   • process control
3 Collect evidence regarding the fault from **four** of the following sources:
   - the person or operator who reported the fault
   - monitoring equipment or gauges
   - recording devices sensory input (such as sight, sound, smell, touch)
   - plant or machinery records/history
   - condition of the end product

4 Use a range of fault diagnostic techniques, to include:
   - half-split technique
   - emergent problem sequence
   - six point technique
   - function testing
   - injection and sampling
   - input/output technique
   - unit substitution

5 Use a variety of diagnostic aids and equipment, to include **two** of the following:
   - manufacturer's manual
   - algorithms
   - probability charts/reports
   - equipment self-diagnostics
   - circuit diagrams/specifications
   - logic diagrams
   - flow charts
   - fault analysis charts (such as fault trees)
   - troubleshooting guides

6 Use **two** of the following types of test equipment to help in the fault diagnosis:
   - mechanical measuring equipment (such as measuring instruments, dial test indicators, torque instruments)
   - electrical/electronic measuring instruments (such as multimeters, logic probes, temperature meters)
   - fluid power test equipment (such as test rigs, flow meters, pressure gauges)

7 Find faults that have resulted in **two** of the following breakdown categories:
   - intermittent problem
   - partial failure or reduced performance/out-of-specification product
   - complete breakdowns

8 Provide a record of the outcome of the fault diagnosis, using **one** of the following:
   - step-by-step analytical report
   - preventative maintenance log/report
   - corrective action report
   - company-specific reporting procedure
Knowledge statements:
You must have knowledge and understanding of:
1. The health and safety requirements of the area in which you are carrying out the fault diagnosis activities, and the responsibility they place on you
2. The specific safety precautions to be taken when carrying out the fault diagnosis of the particular service system
3. The isolation and lock-off procedures or permit-to-work procedure that applies
4. The importance of wearing protective clothing and other appropriate safety equipment during the fault diagnosis process, the type of equipment to be used, and where to obtain it
5. Hazards associated with carrying out fault diagnosis on service equipment and systems (such as handling fluids, stored pressure/force, electrical contact, process controller interface, using faulty or damaged tools and equipment, using practices and procedures that do not follow laid-down procedures), and how they can be minimised
6. How to recognise and deal with victims of electric shock (to include methods of safely removing the victim from the power source, isolating the power source, and methods of first aid resuscitation)
7. Where to obtain, and how to interpret, drawings, service and circuit diagrams, specifications, manufacturers’ manuals and other documents needed in the fault diagnosis activities
8. The basic principles of how the system functions, and the working purpose of the various units within it
9. 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)
10. 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)
11. How to evaluate sensory information (by sight, sound, smell, touch)
12. The procedures to be followed to investigate faults, and how to deal with intermittent conditions
13. How to use the various aids and reports available for fault diagnosis
14. The 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 it is calibrated or configured correctly for the intended use, and that it is free from damage and defects
15. The application of specific fault finding methods and techniques best suited to the problem
16. How to analyse and evaluate possible characteristics and causes of specific faults/problems
17. How to relate previous reports/records of similar fault conditions
18. 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
19. How to prepare a report which complies with the company policy on fault diagnosis
20. The extent of your own responsibility and whom you should report to if you have problems that you cannot resolve
## Unit 30
Carrying out fault diagnosis on services and systems

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**Carry out all of the following during the fault diagnostic activities:**

- plan the fault diagnosis so as to minimise disruption to normal working
- use the correct issue of company and/or manufacturers' drawings and maintenance documentation
- adhere to risk assessment, COSHH and other relevant safety standards
- ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
- provide safe access and working arrangements for the maintenance area
- carry out the fault diagnostic activities using approved procedures
- collect equipment fault diagnosis evidence from live and isolated systems
- disconnect or isolate components or parts of the system when appropriate to confirm diagnosis
- identify the fault and determine appropriate corrective action
- dispose of waste items in safe and environmentally acceptable manner, and leave the work area in a safe condition
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Carrying out fault diagnosis on services and systems

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<tr>
<td><strong>Carry out fault diagnosis on two of the following types of services equipment, to sub-assembly or component level as applicable:</strong></td>
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<td>fresh water</td>
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<td>foul water</td>
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<td>compressed air</td>
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<td>refrigeration</td>
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<td>environmental control</td>
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<td>emergency power generation</td>
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<td>gas distribution</td>
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<td>instrumentation and control</td>
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<td>heating and ventilating</td>
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<td>air conditioning and ventilating</td>
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<td>process control</td>
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<td><strong>Collect evidence regarding the fault from four of the following sources:</strong></td>
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<td>the person or operator who reported the fault</td>
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<td>monitoring equipment or gauges</td>
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<td>condition of the end product</td>
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<td><strong>Use a range of fault diagnostic techniques, to include: half-split technique Plus one more from the following:</strong></td>
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<td>emergent problem sequence</td>
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<td>six point technique</td>
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<td>function testing</td>
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<td>injection and sampling</td>
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<td>input/output technique</td>
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<td>unit substitution</td>
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<td><strong>Use a variety of diagnostic aids and equipment, to include two of the following:</strong></td>
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<td>manufacturer's manual</td>
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<td>algorithms</td>
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<td>probability charts/reports</td>
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<td>equipment self-diagnostics</td>
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<td>circuit diagrams/specifications</td>
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<td>logic diagrams</td>
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<td>flow charts</td>
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<td>fault analysis charts (such as fault trees)</td>
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<tr>
<td>troubleshooting guides</td>
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### Unit 30
Carrying out fault diagnosis on services and systems

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

- Mechanical measuring equipment (such as measuring instruments, dial test indicators, torque instruments)
- Electrical/electronic measuring instruments (such as multimeters, logic probes, temperature meters)
- Fluid power test equipment (such as test rigs, flow meters, pressure gauges)

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

- Intermittent problem
- Partial failure or reduced performance/out-of-specification product
- Complete breakdowns

**Provide a record of the outcome of the fault diagnosis, using one of the following:**

- Step-by-step analytical report
- Preventative maintenance log/report
- Corrective action report
- Company-specific reporting procedure

Knowledge and understanding reference:

**Candidate:** ______________________________  **Date:** __________________

**Assessor:** ______________________________  **Date:** __________________
Unit 31
Maintaining fresh water distribution systems and equipment

Unit summary
This unit identifies the competencies you need to carry out corrective maintenance activities on water distribution systems and equipment, in accordance with approved procedures. You will be required to maintain a range of fresh water systems, such as mains cold water [potable (drinkable)], hot water supplies, cold down service and non-mains supplies (river, well). This will involve dismantling, removing and replacing faulty or damaged components, including pumps, valves, couplings, traps, motors, pipework, cylinders, tanks, heaters filters, gaskets/seals, faucets and other ancillary equipment. You will be expected to apply a range of dismantling and assembly methods and techniques, such as marking/labelling of components to aid the reassembly, dismantling components requiring pressure techniques, torque loading and setting, and aligning and adjusting components.

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 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 minimum 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 maintenance procedures on water distribution equipment. You will understand the dismantling and reassembly methods and procedures, and their application. You will know how the equipment functions, 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/system functions to the required specification. You will also have sufficient depth of knowledge of these components to ensure 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 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.
Unit 31
Maintaining fresh water distribution systems and equipment

Performance statements:
You must:
  a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
  b. Follow the relevant maintenance schedules to carry out the required work
  c. Carry out the maintenance activities within the limits of your personal authority
  d. Carry out the maintenance activities in the specified sequence and in an agreed time scale
  e. Report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
  f. Complete relevant maintenance records accurately and pass them on to the appropriate person
  g. Dispose of waste materials in accordance with safe working practices and approved procedures

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:
1  Carry out all of the following during the maintenance activity:
   • plan the maintenance activities to cause minimum disruption to normal working
   • use the correct issue of company and/or manufacturers' drawings and maintenance documentation
   • adhere to risk assessment, COSHH and other relevant safety standards
   • ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
   • provide safe access and working arrangements for the maintenance area
   • carry out the maintenance activities using appropriate techniques and procedures
   • re-connect and return the system to service on completion of the maintenance activities
   • dispose of waste items in safe and environmentally acceptable manner, and leave the work area in a safe condition

2  Carry out maintenance activities on two of the following types of water systems:
   • mains cold water (potable)
   • hot water supplies
   • cold down service
   • non-mains supplies
Unit 31
Maintaining fresh water distribution systems and equipment

3 Carry out all of the following maintenance techniques, as appropriate to the equipment being maintained:
- dismantling equipment to unit/sub-assembly level
- dismantling units to component level
- marking/labelling of components
- checking components for serviceability
- replacing ‘lifed’ items (such as filters, seals, washers)
- replacing damaged/defective components
- setting, aligning and adjusting replaced components
- tightening fasteners to the required torque
- making checks before reconnecting supply
- functionally testing the completed system

4 Maintain and/or replace a range of water distribution equipment, to include 15 of the following:
- pumps
- motors
- heaters
- valves
- couplings/connectors
- wet and dry risers
- asbestos pipe
- pump chambers
- copper pipe
- plastic pipe
- lead pipe
- clay pipe
- iron pipe
- filters
- cylinders
- tanks
- gaskets and seals
- gauges/indicators
- manifolds
- traps
- dosing plant
- sensors
- switches
- faucets
- control devices
- electrical wiring
- electrical connectors
- ancillary equipment (such as sinks, toilets, showers)

5 Maintain water distribution systems, to comply with one of the following quality and accuracy standards:
- organisational guidelines and codes of practice
- equipment manufacturer’s operation range
- IEE wiring regulations
- BS and/or ISO standards
Complete all relevant paperwork, from the following, and pass it to the appropriate people:

- job cards
- permits to work/formal risk assessment
- maintenance log or report
Unit 31
Maintaining fresh water distribution systems and equipment

Knowledge statements:
You must have knowledge and understanding of:
1. The health and safety requirements of the area in which the maintenance activity is to take place
2. The isolation and lock-off procedures or permit-to-work procedure that applies
3. The specific health and safety precautions to be applied during the maintenance procedure, and their effects on others (to include The Water Regulations Advisory Scheme (WRAS), The Prevention and Control of Legionellosis, and Safe Working in Confined Spaces 1997)
4. Hazards associated with carrying out maintenance activities on water distribution equipment and systems, and how they can be minimised
5. The importance of wearing protective clothing and other appropriate safety equipment during the maintenance process
6. How to obtain and interpret drawings, specifications, manufacturers’ manuals and other documents needed in the maintenance process
7. The procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance
8. Company policy on repair/replacement of components during maintenance process
9. The sequence to be adopted for the dismantling/reassembly of various types of assemblies
10. The methods and techniques used to dismantle/assemble mechanical equipment (release of pressures/force, proof marking, extraction, pressing, alignment)
11. Methods of checking components are fit for purpose, and how to identify defects and wear characteristics
12. How to make adjustments to components/assemblies to ensure they function correctly
13. The basic principles of how the equipment functions, its operation sequence, the working purpose of individual units/components and how they interact
14. The types and applications of the different types of pipework systems (such as copper, plastic, lead, iron)
15. The applications of the different types of pipework systems (such as copper, plastic, lead, iron)
16. The equipment and tools used to bend, form and thread pipework
17. The types of contaminants in water systems, and the problems they can cause
18. The different methods used to treat water supplies to meet user needs
19. The applications of the different pipework and equipment cleaning procedures (rod, water jet, solvents)
20. Methods of checking removed components are fit for purpose, and the need to replace ‘lifed’ items (such as seals, gaskets, washers)
21. How to make adjustments to components to ensure they function correctly
22. How to check tools and equipment are free from damage or defects, and are in a safe and usable condition
23. The generation of maintenance documentation and/or reports following the maintenance activity
24. The equipment operating and control procedures to be applied during the maintenance activity
25. How to use lifting and handling equipment correctly and safely in the maintenance activity
26. The problems associated with the maintenance activity, and how they can be overcome
27. The organisational procedure to be adopted for the safe disposal of waste of all types of materials
28. The extent of your own authority and whom you should report to if you have problems you cannot resolve
### Unit 31
Maintaining fresh water distribution systems and equipment

<table>
<thead>
<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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<td>evidence type</td>
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**Carry out all of the following during the maintenance activity:**

- plan the maintenance activities to cause minimum disruption to normal working
- use the correct issue of company and/or manufacturers’ drawings and maintenance documentation
- adhere to risk assessment, COSHH and other relevant safety standards
- ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
- provide safe access and working arrangements for the maintenance area
- carry out the maintenance activities using appropriate techniques and procedures
- re-connect and return the system to service on completion of the maintenance activities
- dispose of waste items in safe and environmentally acceptable manner, and leave the work area in a safe condition

**Carry out maintenance activities on two of the following types of water systems:**

- mains cold water (potable)
- hot water supplies
- cold down service
- non-mains supplies
## Unit 31
Maintaining fresh water distribution systems and equipment

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<th>evidence record sheet</th>
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<th>additional performance evidence (if required)</th>
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<td><strong>Carry out all of the following maintenance techniques, as appropriate to the equipment being maintained:</strong></td>
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<td>dismantling equipment to unit/subassemblies level</td>
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<td>dismantling units to component level</td>
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<td>marking/labelling of components</td>
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<td>checking components for serviceability</td>
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<td>replacing ‘life’ items (such as filters, seals, washers)</td>
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<td>replacing damaged/defective components</td>
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<td>setting, aligning and adjusting replaced components</td>
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<td>tightening fasteners to the required torque</td>
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<td>making checks before reconnecting supply</td>
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<td>functionally testing the completed system</td>
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<td><strong>Maintain and/or replace a range of water distribution equipment, to include 15 of the following:</strong></td>
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<td>sensors</td>
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**Unit 31**  
**Maintaining fresh water distribution systems and equipment**

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<td>ancillary equipment (such as sinks, toilets, showers)</td>
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**Maintain water distribution systems, to comply with one of the following quality and accuracy standards:**

- organisational guidelines and codes of practice
- equipment manufacturer’s operation range
- IEE wiring regulations
- BS and/or ISO standards

**Complete all relevant paperwork, from the following, and pass it to the appropriate people:**

- job cards
- permits to work/formal risk assessment
- maintenance log or report

**Knowledge and understanding reference:**

| Candidate: ______________________________ | Date: __________________ |
| Assessor: ______________________________ | Date: __________________ |
Unit 32
Maintaining waste/foul water distribution systems and equipment

Unit summary
This unit identifies the competencies you need to carry out corrective maintenance activities on waste/foul water distribution systems and equipment, in accordance with approved procedures. You will be required to maintain distribution systems such as foul, storm and waste/effluent water systems. This will involve dismantling, removing and replacing faulty or damaged components, including pumps, valves, couplings, traps, motors, pipework, cylinders, tanks, heaters, filters, gaskets/seals, faucets and other ancillary equipment. You will be expected to apply a range of dismantling and assembly methods and techniques, such as marking/labelling of components to aid the reassembly, dismantling components requiring pressure techniques, torque loading and setting, and aligning and adjusting components.

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 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 minimum 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 maintenance procedures on waste/foul water distribution equipment. You will understand the dismantling and reassembly methods and procedures, and their application. You will know how the equipment functions, 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. You will also have sufficient knowledge of these components to ensure 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 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.
Unit 32
Maintaining waste/foul water distribution systems and equipment

Performance statements:
You must:
a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Follow the relevant maintenance schedules to carry out the required work
c. Carry out the maintenance activities within the limits of your personal authority
d. Carry out the maintenance activities in the specified sequence and in an agreed time scale
e. Report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
f. Complete relevant maintenance records accurately and pass them on to the appropriate person
g. Dispose of waste materials in accordance with safe working practices and approved procedures

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:
1. Carry out all of the following during the maintenance activity:
   - plan the maintenance activities to cause minimum disruption to normal working
   - use the correct issue of company and/or manufacturers' drawings and maintenance documentation
   - adhere to risk assessment, COSHH and other relevant safety standards
   - ensure the safe isolation of equipment (such as mechanical, electricity, or fluids)
   - provide safe access and working arrangements for the maintenance area
   - carry out the maintenance activities using appropriate techniques and procedures
   - re-connect and return the system to service on completion of the maintenance activities
   - dispose of waste items in safe and environmentally acceptable manner, and leave the work area in a safe condition

2. Carry out maintenance activities on two of the following types of water systems:
   - waste/effluent
   - storm water
   - foul water

3. Carry out all of the following maintenance techniques, as appropriate to the equipment being maintained:
   - tightening fastenings to the required torque
   - setting, aligning and adjusting replaced components
   - marking/labelling of components
   - dismantling equipment to unit/sub-assembly level
   - replacing all 'lifed' items (such as seals, gaskets)
   - dismantling units to component level
   - checking components for serviceability
   - making checks before re-connecting system
   - functionally testing completed system
   - replacing damaged/defective components
4 Maintain and/or replace a range of water distribution equipment/components, to include **12** of the following:
- pumps
- motors
- valves
- couplings/connectors
- pump chambers
- macerators
- interceptors
- plastic pipe
- lead pipe
- clay pipe
- iron pipe
- asbestos
- pipe tanks
- manifolds
- traps
- filters
- sensors
- switches
- gauges/indicators
- gaskets and seals
- faucets
- control devices
- electrical wiring
- electrical connectors
- dosing plant
- ancillary equipment (such as sinks, toilets, showers)

5 Maintain waste water distribution systems in compliance with **one** of the following quality and accuracy standards:
- organisational guidelines and codes of practice
- equipment manufacturer’s operation range
- IEE wiring regulations
- BS and/or ISO standards

6 Complete **all** relevant paperwork from the following, and pass it to the appropriate people:
- job cards
- permits to work/formal risk assessment
- maintenance log or report
Unit 32
Maintaining waste/foul water distribution systems and equipment

Knowledge statements:
You must have knowledge and understanding of:
1. The health and safety requirements of the area in which the maintenance activity is to take place
2. The isolation and lock-off procedures or permit-to-work procedure that applies
3. The specific health and safety precautions to be applied during the maintenance procedure, and their effects on others (to include The Water Regulations Advisory Scheme (WRAS), The Prevention and Control of Legionellosis, and Safe working in Confined Spaces 1997)
4. Hazards associated with carrying out maintenance on waste water distribution systems, and how these hazards can be minimised
5. The importance of wearing protective clothing and other appropriate safety equipment during the maintenance process
6. How to obtain and interpret drawings, specifications, manufacturers’ manuals and other documents needed in the maintenance process
7. The procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance activities
8. Company policy on repair/replacement of components during the maintenance process
9. The sequence to be adopted for the dismantling/re-assembly of various types of assemblies
10. The methods and techniques used to dismantle/assemble mechanical equipment (release of pressures/force, component identification, extraction, pressing, alignment)
11. Methods of checking that components are fit for purpose, how to identify defects and wear characteristics, and the need to replace ‘lifed’ items (such as seals, washers and gaskets)
12. How to make adjustments to components/assemblies to ensure they function correctly
13. The basic principles of how the equipment functions, its operation sequence, the working purpose of individual units/components and how they interact
14. The applications of the different types of pipework systems (iron, clay, plastic, lead, asbestos)
15. The applications of the different types of couplings and their fittings (bends, branches, reduction pieces)
16. The different methods used to treat water supplies to meet user needs
17. The applications of the different pipework and equipment cleaning procedures (rod, water jet, solvents)
18. How to check that tools and equipment are free from damage or defects, and are in a safe and usable condition
19. The generation of maintenance documentation and/or reports following the maintenance activity
20. The equipment operating and control procedures to be applied during the maintenance activity
21. How to use lifting and handling equipment correctly and safely in the maintenance activity
22. The problems associated with the maintenance activity, and how they can be overcome
23. The organisational procedure to be adopted for the safe disposal of waste of all types of materials
24. The extent of your own authority and whom you should report to if you have problems that you cannot resolve
## Unit 32
Maintaining waste/foul water distribution systems and equipment

<table>
<thead>
<tr>
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**Carry out all of the following during the maintenance activity:**

- plan the maintenance activities to cause minimum disruption to normal working
- use the correct issue of company and/or manufacturers' drawings and maintenance documentation
- adhere to risk assessment, COSHH and other relevant safety standards
- ensure the safe isolation of equipment (such as mechanical, electricity, or fluids)
- provide safe access and working arrangements for the maintenance area
- carry out the maintenance activities using appropriate techniques and procedures
- re-connect and return the system to service on completion of the maintenance activities
- dispose of waste items in safe and environmentally acceptable manner, and leave the work area in a safe condition

**Carry out maintenance activities on two of the following types of water systems:**

- waste/effluent
- storm water
- foul water
**Unit 32**  
Maintaining waste/foul water distribution systems and equipment

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<td>setting, aligning and adjusting replaced components</td>
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<td>dismantling equipment to unit/subassembly level</td>
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<td>replacing all ‘lifed’ items (such as seals, gaskets)</td>
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<td>dismantling units to component level</td>
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<td>checking components for serviceability</td>
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<td>making checks before re-connecting system</td>
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<td>functionally testing completed system</td>
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<td>replacing damaged/defective components</td>
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<td><strong>Maintain and/or replace a range of water distribution equipment/components, to include 12 of the following:</strong></td>
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<td>electrical connectors</td>
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<td>ancillary equipment (such as sinks, toilets, showers)</td>
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**Maintain waste water distribution systems in compliance with one of the following quality and accuracy standards:**
- organisational guidelines and codes of practice
- equipment manufacturer's operation range
- IEE wiring regulations
- BS and/or ISO standards

**Complete all relevant paperwork from the following, and pass it to the appropriate people:**
- job cards
- permits to work/formal risk assessment
- maintenance log or report

Knowledge and understanding reference:

Candidate: _______________________________________________  Date: ___________________

Assessor: ________________________________________________   Date: ___________________
Unit 33
Maintaining workplace environmental control systems

Unit summary
This unit identifies the competencies you need to carry out corrective maintenance activities on workplace environmental control systems, such as heating and ventilation, air conditioning and ventilation, chillers, lighting, lifts, building/room access, fire systems and CCTV systems, in accordance with approved procedures. This will involve dismantling, removing and maintaining faulty or damaged components, such as sensors, switches, thermostats, meters, thermocouples, transformers, timers, interlocks, electrical components and wiring, electronic boards and components, controller units, computer systems, peripheral devices and environmental monitoring and targeting software. You will be expected to apply a range of dismantling and assembly methods and techniques, to include marking/labelling of components to aid the reassembly, dismantling components by unplugging, desoldering, removal of screwed, clamped and crimped connections, and aligning and adjusting components.

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 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 minimum 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 maintenance procedures to workplace environmental control systems and equipment. You will understand the dismantling and reassembly methods and procedures used, and their application. You will know how the equipment functions, 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. You will also have sufficient knowledge of these components to ensure they are fit for purpose and meet the specifications, thus providing a sound basis for carrying out re-assembly.

You will understand the safety precautions required when carrying out the maintenance activities, especially those for isolating the equipment. 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.
Unit 33
Maintaining workplace environmental control systems

Performance statements:
You must:

a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Follow the relevant maintenance schedules to carry out the required work
c. Carry out the maintenance activities within the limits of your personal authority
d. Carry out the maintenance activities in the specified sequence and in an agreed time scale
e. Report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
f. Complete relevant maintenance records accurately and pass them on to the appropriate person
g. Dispose of waste materials in accordance with safe working practices and approved procedures

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:

1. Carry out all of the following during the maintenance activity:
   - plan the maintenance activities to cause minimum disruption to normal working
   - use the correct issue of company and/or manufacturers’ drawings and maintenance documentation
   - adhere to risk assessment, COSHH and other relevant safety standards
   - ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
   - provide safe access and working arrangements for the maintenance area
   - carry out the maintenance activities using appropriate techniques and procedures
   - re-connect and return the system to service on completion of the maintenance activities
   - dispose of waste items in safe and environmentally acceptable manner, and leave the work area in a safe condition

2. Carry out maintenance activities on three of the following types of equipment associated with workplace environmental control systems:
   - heating and ventilation
   - air conditioning and ventilation
   - intruder/alarm systems lighting
   - CCTV
   - chillers
   - lift control
   - fire systems
   - building/room access
   - other specific system
3 Carry out **all** of the following maintenance techniques, as appropriate to the equipment being maintained:
- testing system for leaks
- dismantling equipment to unit/sub-assembly level
- setting, aligning and adjusting replaced components
- checking components for serviceability
- replacing all ‘lifed’ items (such as batteries, lamps)
- replacing damaged/defective components
- marking/labelling of components
- tightening fasteners to the required torque
- making ‘off-line’ checks before starting up
- functionally testing the completed system
- dismantling units to component level

4 Maintain and/or replace a range of environmental control equipment components, to include **12** of the following:
- relays
- inverters
- actuators
- valves
- sensors
- switches
- thermostats
- dampers
- meter
- motor starters
- vents/diffusers
- electrical cables
- network cables
- contactors
- printers
- solenoids
- circuit boards
- safety systems
- fixed resistors
- thermistors
- integrated circuits
- thermocouples
- batteries
- transformers
- BMS controller units
- BMS remote PC
- BMS terminal (PC, server)
- uninterrupted power supplies
- timers
- interlocks
- modems
- overload protection devices
- PC peripheral devices
- monitoring/targeting software
5  Maintain workplace environmental control equipment/systems in compliance with one of the following quality and accuracy standards:
   • organisational guidelines and codes of practice
   • equipment manufacturer’s operation range
   • IEE wiring regulations
   • BS and/or ISO standards

6  Complete all relevant paperwork from the following, and pass it to the appropriate people:
   • job cards
   • permits to work/formal risk assessment
   • maintenance log or report

Knowledge statements:
You must have knowledge and understanding of:
1. The health and safety requirements of the area in which the maintenance activity is to take place
2. The isolation and lock-off procedures or permit-to-work procedure that applies to the equipment being maintained
3. The specific health and safety precautions to be applied during the maintenance procedure, and their effects on others
4. Hazards associated with carrying out maintenance activities on workplace environmental equipment/systems (such as stored pressure/force, live electrical connections, using damaged or badly maintained tools and equipment, not following laid-down maintenance procedures), and how they can be minimised
5. The importance of wearing protective clothing and other appropriate safety equipment during the maintenance process
6. How to obtain and interpret drawings, specifications, manufacturers’ manuals and other documents needed in the maintenance process
7. The procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance activities
8. Company policy on repair/replacement of components during maintenance process
9. The sequence to be adopted for the dismantling/reassembly of various types of assemblies
10. The methods and techniques used to dismantle/assemble workplace environmental control equipment (such as unplugging, de-soldering removal of screwed, clamped and crimped connections)
11. Methods of checking that components are fit for purpose, how to identify defects and wear characteristics, and the need to replace ‘lifed’ items (such as batteries, lamps, seals and gaskets)
12. How to make adjustments to components/assemblies to ensure they function correctly
13. The basic principles of how the equipment functions, its operation sequence, the working purpose of individual units/components and how they interact
14. Methods of removing and replacing components and units without damaging the system and infrastructure
15. 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 their intended purpose
16. The generation of maintenance documentation and/or reports following the maintenance activity
17. The equipment operating and control procedures to be applied during the maintenance activity
18. How to use lifting and handling equipment correctly and safely in the maintenance activity
19. The problems associated with the maintenance activity, and how they can be overcome
20. The organisational procedure to be adopted for the safe disposal of waste of all types of materials
21. The extent of your own authority and whom you should report to if you have problems that you cannot resolve
### Unit 33
Maintaining workplace environmental control systems

<table>
<thead>
<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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<td>evidence type</td>
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**Carry out all of the following during the maintenance activity:**

- plan the maintenance activities to cause minimum disruption to normal working
- use the correct issue of company and/or manufacturers’ drawings and maintenance documentation
- adhere to risk assessment, COSHH and other relevant safety standards
- ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
- provide safe access and working arrangements for the maintenance area
- carry out the maintenance activities using appropriate techniques and procedures
- re-connect and return the system to service on completion of the maintenance activities
- dispose of waste items in safe and environmentally acceptable manner, and leave the work area in a safe condition

**Carry out maintenance activities on three of the following types of equipment associated with workplace**

- environmental control systems:
- heating and ventilation
- air conditioning and ventilation
- intruder/alarm systems
- lighting
- CCTV
- chillers
- lift control
- fire systems
- building/room access
- other specific system
## Unit 33
Maintaining workplace environmental control systems

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<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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<tbody>
<tr>
<td><strong>Carry out all of the following maintenance techniques, as appropriate to the equipment being maintained:</strong></td>
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<td>testing system for leaks</td>
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<td>dismantling equipment to unit/subassembly level</td>
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<td>setting, aligning and adjusting replaced components</td>
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<td>checking components for serviceability</td>
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<td>replacing damaged/defective components</td>
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<td>marking/labelling of components</td>
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<td>tightening fasteners to the required torque</td>
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<td>making ‘off-line’ checks before starting up</td>
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<td>functionally testing the completed system</td>
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<td>dismantling units to component level</td>
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<tr>
<td><strong>Maintain and/or replace a range of environmental control equipment components, to include 12 of the following:</strong></td>
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<td>vents/diffusers</td>
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<td>electrical cables</td>
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<td>network cables</td>
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<td>contactors</td>
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<td>solenoids</td>
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<td>safety systems</td>
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<td>fixed resistors</td>
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## Unit 33
Maintaining workplace environmental control systems

<table>
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<td>thermistors</td>
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<td>integrated circuits</td>
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<td>thermocouples</td>
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<td>batteries</td>
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<td>transformers</td>
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<td>BMS controller units</td>
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<td>BMS remote PC</td>
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<td>BMS terminal (PC, server)</td>
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<td>uninterrupted power supplies</td>
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<td>timers</td>
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<td>interlocks</td>
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<td>overload protection devices</td>
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<td>PC peripheral devices</td>
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<td>monitoring/targeting software</td>
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**Maintain workplace environmental control equipment/systems in compliance with one of the following quality and accuracy standards:**
- organisational guidelines and codes of practice
- equipment manufacturer's operation range
- IEE wiring regulations
- BS and/or ISO standards

**Complete all relevant paperwork from the following, and pass it to the appropriate people:**
- job cards
- permits to work/formal risk assessment
- maintenance log or report

Knowledge and understanding reference:

Candidate: _______________________________________________  Date: ___________________

Assessor: ________________________________________________   Date: ___________________
Unit 34
Maintaining emergency power generation equipment

Unit summary
This unit identifies the competencies you need to carry out corrective maintenance activities on emergency power generation equipment, in accordance with approved procedures. This will include the engine/primary power source, the generator, the electrical load connection, and the appropriate control equipment. The maintenance activity will involve dismantling, removing and maintaining faulty or damaged sub-assemblies and components, such as engine components, generator, fans, pumps, valves, couplings, ducting, heaters, filters and control gear, and equipment such as speed governors, voltage regulation, safety control devices, fire protection and shutdown systems, measurement display and recording systems, control panels, electrical components and wiring.

You will be required to apply a range of dismantling and assembly methods and techniques, to include marking/labelling of components to aid the assembly, aligning/adjusting of components, and dismantling components by mechanically dismantling, unplugging, de-soldering, and removal of screwed, clamped and crimped connections.

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 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 minimum 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 maintenance procedures to emergency power generation systems and equipment. You will understand the dismantling and reassembly methods and procedures used, and their application. You will know how the equipment functions, 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. You will also have sufficient knowledge of these components to ensure 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 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.
Unit 34
Maintaining emergency power generation equipment

Performance statements:
You must:
a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Follow the relevant maintenance schedules to carry out the required work
c. Carry out the maintenance activities within the limits of your personal authority
d. Carry out the maintenance activities in the specified sequence and in an agreed time scale
e. Report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
f. Complete relevant maintenance records accurately and pass them on to the appropriate person
g. Dispose of waste materials in accordance with safe working practices and approved procedures

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:
1. Carry out **all** of the following during the maintenance activity:
   - plan the maintenance activities to cause minimum disruption to normal working
   - use the correct issue of company and/or manufacturers' drawings and maintenance documentation
   - adhere to risk assessment, COSHH and other relevant safety standards
   - ensure the safe isolation of equipment (such as mechanical, electricity, gas, air, fuel oil, fluids)
   - provide safe access and working arrangements for the maintenance area (barriers, signage)
   - carry out the maintenance activities using appropriate techniques and procedures
   - re-connect and return the system to service on completion of the maintenance activities
   - dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition

2. Carry out maintenance activities on **six** of the following types of emergency generation equipment:
   - turbine alternator sets
   - piston engine alternator sets
   - generators
   - governors
   - control gear
   - voltage regulators
   - batteries and chargers
   - mechanical protection equipment
   - electrical protection equipment
3 Carry out all of the following maintenance techniques, as appropriate to the equipment being maintained:
- testing the system for leaks
- tightening fasteners to the required torque
- dismantling units to component level
- marking/labelling of components
- checking components for serviceability
- replacing damaged/defective components
- setting, aligning and adjusting replaced components
- dismantling equipment to sub-assembly level
- checking correct operation of all safety devices
- making ‘off-load’ checks before starting up
- replenishing oil, coolant and grease
- replacing all ‘lifed’ items (such as batteries, lamps)
- functionally testing the completed system

4 Maintain and/or replace a range of emergency power generation equipment components, to include 12 of the following:
- engine components (valves, shell bearings)
- turbine components
- bearings and seals
- clutches and brakes
- drive mechanisms (chains, pulleys and belts)
- transmission items (shafts, couplings)
- fuel supply components (pumps, injectors, pipes)
- ignition (plugs, heaters, burners)
- cooling equipment (radiators, pumps, hoses)
- lubrication components (pumps, filters, pipes)
- exhaust systems
- speed governing components
- control panel components (breakers, contactors)
- annunciators/alarms
- temperature control components (thermostat, thermocouples, thermistors)
- electronic components (circuit boards, timers, transducers)
- voltage regulators
- relays and solenoids
- sensors
- switches and switch gear
- electrical cables
- overload protection devices
- safety devices
- pressure relief valves
- meters/gauges (temperature, pressure, speed)
- test systems (manual, automatic)
- noise reduction/attenuation

5 Maintain emergency power generation equipment /systems in compliance with one or more of the following quality and accuracy standards:
- organisational guidelines and codes of practice
- equipment manufacturer’s guidelines
- IEE wiring regulations
- BS and/or ISO standards
Complete all relevant documentation from the following, and pass it to the appropriate people:

- job cards
- permits to work/formal risk assessment
- electronic recording
- maintenance log or report
Unit 34
Maintaining emergency power generation equipment

Knowledge statements:
You must have knowledge and understanding of:
1. The health and safety requirements of the area in which the maintenance activity is to take place
2. The isolation and lock-off procedures or permit-to-work procedure that applies to the equipment being maintained
3. The specific health and safety precautions to be applied during the maintenance procedure, and their effects on others
4. Hazards associated with carrying out maintenance activities on emergency power generation equipment/systems (such as moving machinery, hot components, stored pressure/force, live electrical connections, handling oils and coolants, using damaged or badly maintained tools and equipment, not following laid-down maintenance procedures), and how they can be minimised
5. The importance of wearing the correct personal and environmental protection equipment and other appropriate safety equipment during the maintenance process
6. How to obtain and interpret drawings, specifications, manufacturers’ manuals and other documents needed in the maintenance process
7. The procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance activities
8. Company policy on repair/replacement of components during the maintenance process
9. The basic principles of how the equipment functions, its operation sequence, the working purpose of individual units/components and how they interact (to include principles of power generator sets, the function of the stator, rotor and excitation system, principles of AC power generation, electrical losses, synchronizing and loading, output voltage control)
10. Generator and prime mover tripping and protection devices
11. Generator and bus terminal connections
12. Why electrical earthing and bonding is critical and why it must be both mechanically and electrically secure
13. The sequence to be adopted for the dismantling/reassembly of various types of assemblies
14. The methods and techniques used to dismantle/assemble emergency power generation equipment (such as removing bolted components and assemblies, removing components requiring pressure, unplugging, de-soldering, removal of screwed, clamped and crimped connections)
15. Methods of checking components are fit for purpose, how to identify defects and wear characteristics, and the need to replace ‘lifed’ items (such as batteries, lamps, seals and gaskets)
16. How to make adjustments to components/assemblies to ensure they function correctly
17. Methods of removing and replacing components and units without damaging the system and infrastructure
18. The use of electrical measuring equipment (such as multimeters and resistance testers)
19. Methods of testing equipment and systems for leaks, and the tools and equipment that can be used
20. Types and application of coolants and antifreeze agents; quantities used; and methods of flushing and filling the system
21. 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 their intended purpose
22. The generation of maintenance documentation and/or reports following the maintenance activity
23. The equipment operating and control procedures to be applied during the maintenance activity
24. How to use lifting and handling equipment correctly and safely in the maintenance activity
25. The problems associated with the maintenance activity, and how they can be overcome
26. The organisational procedure to be adopted for the safe disposal of waste of all types of materials
27. The extent of your own authority and whom you should report to if you have problems that you cannot resolve
## Unit 34
Maintaining emergency power generation equipment

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**Perform the following during the maintenance activity:**
- Plan the maintenance activities to cause minimum disruption to normal working.
- Use the correct issue of company and/or manufacturers’ drawings and maintenance documentation.
- Adhere to risk assessment, COSHH and other relevant safety standards.
- Ensure the safe isolation of equipment (such as mechanical, electricity, gas, air, fuel oil, fluids).
- Provide safe access and working arrangements for the maintenance area (barriers, signage).
- Carry out the maintenance activities using appropriate techniques and procedures.
- Re-connect and return the system to service on completion of the maintenance activities.
- Dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition.

**Perform maintenance activities on six of the following types of emergency generation equipment:**
- Turbine alternator sets
- Piston engine alternator sets
- Generators
- Governors
- Control gear
- Voltage regulators
- Batteries and chargers
- Mechanical protection equipment
- Electrical protection equipment
### Unit 34
Maintaining emergency power generation equipment

<table>
<thead>
<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Carry out all of the following maintenance techniques, as appropriate to the equipment being maintained:</strong></td>
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<tr>
<td>testing the system for leaks</td>
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<tr>
<td>tightening fasteners to the required torque</td>
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<tr>
<td>dismantling units to component level</td>
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<tr>
<td>marking/labelling of components</td>
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<tr>
<td>checking components for serviceability</td>
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<tr>
<td>replacing damaged/defective components</td>
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<tr>
<td>setting, aligning and adjusting replaced components</td>
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<tr>
<td>dismantling equipment to subassembly level</td>
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<tr>
<td>checking correct operation of all safety devices</td>
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<tr>
<td>making ‘off-load’ checks before starting up</td>
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<tr>
<td>replenishing oil, coolant and grease</td>
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<tr>
<td>replacing all ‘lifed’ items (such as batteries, lamps)</td>
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<tr>
<td>functionally testing the completed system</td>
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</tbody>
</table>

**Maintain and/or replace a range of emergency power generation equipment components, to include 12 of the following:**

- engine components (valves, shell bearings)
- turbine components
- bearings and seals
- clutches and brakes
- drive mechanisms (chains, pulleys and belts)
- transmission items (shafts, couplings)
- fuel supply components (pumps, injectors, pipes)
- ignition (plugs, heaters, burners)
# Unit 34
Maintaining emergency power generation equipment

<table>
<thead>
<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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<tbody>
<tr>
<td>cooling equipment (radiators, pumps, hoses)</td>
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<tr>
<td>lubrication components (pumps, filters, pipes)</td>
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<td>exhaust systems</td>
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<tr>
<td>speed governing components</td>
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<td>control panel components (breakers, contactors)</td>
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<td>temperature control components (thermostat, thermocouples, thermistors)</td>
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<td>electronic components (circuit boards, timers, transducers)</td>
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<td>annunciators/alarms</td>
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<tr>
<td>voltage regulators</td>
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<tr>
<td>relays and solenoids</td>
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<td>sensors</td>
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<tr>
<td>switches and switch gear</td>
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<tr>
<td>electrical cables</td>
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<tr>
<td>overload protection devices</td>
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<tr>
<td>safety devices</td>
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<tr>
<td>pressure relief valves</td>
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<tr>
<td>meters/gauges (temperature, pressure, speed)</td>
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<tr>
<td>test systems (manual, automatic)</td>
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<tr>
<td>noise reduction/attenuation</td>
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</table>

**Maintain emergency power generation equipment /systems in compliance with one or more of the following quality and accuracy standards:**

- organisational guidelines and codes of practice
- equipment manufacturer's guidelines
- IEE wiring regulations
- BS and/or ISO standards
### Unit 34
Maintaining emergency power generation equipment

<table>
<thead>
<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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</thead>
<tbody>
<tr>
<td><strong>Complete all relevant documentation from the following, and pass it to the appropriate people:</strong></td>
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<tr>
<td>job cards</td>
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<tr>
<td>permits to work/formal risk assessment</td>
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<tr>
<td>electronic recording</td>
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<tr>
<td>maintenance log or report</td>
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</tbody>
</table>

Knowledge and understanding reference:

Candidate: ____________________________ Date: ____________________

Assessor: ____________________________ Date: ____________________
This unit identifies the competencies you need to carry out corrective maintenance activities on heating and ventilation systems, in accordance with approved procedures. You will be required to maintain heating and ventilation systems, which will include one of the following primary heating sources: gaseous, liquid, solid fuel, electricity and renewable energy. This will involve dismantling, removing and replacing faulty or damaged components, including motors, fans, pumps, valves, couplings, ducting and trunking, heaters, filters, and control devices such as thermostats and switches. You will be expected to apply a range of dismantling and assembly methods and techniques, such as proof marking/labelling of components to aid the reassembly, dismantling components requiring pressure techniques, torque loading, and setting, aligning and adjusting components.

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 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 minimum 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 maintenance procedures on heating and ventilation equipment. You will understand the dismantling and reassembly methods and procedures, and their application. You will know how the equipment functions, 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. You will also have sufficient knowledge of these components to ensure 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 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.
Unit 35
Maintaining heating and ventilation systems

Performance statements:
You must:

a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Follow the relevant maintenance schedules to carry out the required work
c. Carry out the maintenance activities within the limits of your personal authority
d. Carry out the maintenance activities in the specified sequence and in an agreed time scale
e. Report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
f. Complete relevant maintenance records accurately and pass them on to the appropriate person
g. Dispose of waste materials in accordance with safe working practices and approved procedures

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:
1 Carry out all of the following during the maintenance activity:
   • plan the maintenance activities to cause minimum disruption to normal working
   • use the correct issue of company and/or manufacturers' drawings and maintenance documentation
   • adhere to risk assessment, COSHH and other relevant safety standards
   • ensure the safe isolation of equipment (such as mechanical, electricity, gas, or fluids)
   • provide safe access and working arrangements for the maintenance area
   • carry out the maintenance activities using appropriate techniques and procedures
   • re-connect and return the system to service on completion of the maintenance activities
   • dispose of waste items in safe and environmentally acceptable manner, and leave the work area in a safe condition

2 Carry out maintenance activities on one of the following types of primary energy heat source systems:
   • liquid
   • gaseous
   • solid fuel
   • renewable energy
   • electrical

3 Carry out all of the following maintenance techniques, as appropriate to the equipment being maintained:
   • setting, aligning and adjusting replaced components
   • dismantling equipment to unit/sub-assembly level
   • dismantling units to component level
   • proof marking/labelling of components
   • checking components for serviceability
   • replacing all ‘lifed’ items (seals, bearings, gaskets)
   • testing the system for leaks
   • tightening fastenings to the required torque
   • making ‘off-line’ checks before starting up
   • lubricating components
   • functionally testing the completed system
   • replacing damaged/defective components

4 Maintain and/or replace a range of heating/ventilation components, to include 15 of the following:
• boiler
• heat exchanger
• motors
• fans
• blowers
• pumps
• calorifiers
• storage devices
• ductwork
• dampers
• vents/diffuser
• valves
• strainers/filters
• pipework
• couplings
• heater batteries
• manifolds/flanges
• gaskets and seals
• gauges/indicators
• sensors
• switches
• condenser
• control devices
• safety devices
• electrical components
• supplementary heaters
• silencers
• insulation
• local heating system (such as radiators, in line duct heaters, skirting heating, fan coil, convectors, storage pipe heaters and air handling units)

5 Maintain heating and ventilation systems in compliance with **one or more** of the following quality and accuracy standards:
• organisational guidelines and codes of practice
• equipment manufacturer’s operation range
• IEE wiring regulations
• BS and/or ISO standards

6 Complete **all** relevant paperwork from the following, and pass it to the appropriate people:
• job cards
• permits to work/formal risk assessment
• maintenance log or report
Unit 35
Maintaining heating and ventilation systems

Knowledge statements:
You must have knowledge and understanding of:
1. The health and safety requirements of the area in which the maintenance activity is to take place
2. The isolation and lock-off procedures or permit-to-work procedure that applies
3. The specific health and safety precautions to be applied during the maintenance procedure, and their effects on others
4. Hazards associated with carrying out maintenance activities on heating and ventilation equipment (stored pressure/force, hot surfaces, misuse of tools, using damaged or badly maintained tools and equipment, not following laid-down maintenance procedures), and how to minimise them
5. The importance of wearing protective clothing and other appropriate safety equipment during the maintenance process
6. How to obtain and interpret drawings, specifications, manufacturers’ manuals and other documents needed in the maintenance process
7. The procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance activities
8. Company policy on repair/replacement of components during the maintenance process
9. The sequence to be adopted for the dismantling/reassembly of various types of assemblies
10. The methods and techniques used to dismantle/assemble heating and ventilation equipment (release of pressures/force, proof marking, extraction, pressing, alignment)
11. Methods of checking that components are fit for purpose, how to identify defects and wear characteristics, and the need to replace ‘lifed’ items (such as seals and gaskets)
12. How to make adjustments to components/assemblies to ensure they function correctly
13. The basic principles of how the equipment functions, its operation sequence, the working purpose of individual units/components and how they interact
14. The correct operating ranges, including temperature and pressure of secondary heating sources (air and water)
15. The advantages and disadvantages of the application of different local heating systems (such as radiators, in line duct heaters, skirting heating, fan coil, convectors, storage pipe heaters and air handling units)
16. The typical building design temperatures, such as for offices, factories (light and heavy work) warehouses and canteens
17. How to make adjustments to components to ensure they function correctly
18. 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 their intended purpose
19. The generation of maintenance documentation and/or reports following the maintenance activity
20. The equipment operating and control procedures to be applied during the maintenance activity
21. How to use lifting and handling equipment correctly and safely in the maintenance activity
22. The problems associated with the maintenance activity, and how they can be overcome
23. The organisational procedure to be adopted for the safe disposal of waste of all types of materials
24. The extent of your own authority and whom you should report to if you have problems that you cannot resolve
### Unit 35
Maintaining heating and ventilation systems

<table>
<thead>
<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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<table>
<thead>
<tr>
<th>evidence type</th>
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<tbody>
<tr>
<td>date</td>
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</table>

**Carry out all of the following during the maintenance activity:**

- plan the maintenance activities to cause minimum disruption to normal working
- use the correct issue of company and/or manufacturers’ drawings and maintenance documentation
- adhere to risk assessment, COSHH and other relevant safety standards
- ensure the safe isolation of equipment (such as mechanical, electricity, gas, or fluids)
- provide safe access and working arrangements for the maintenance area
- carry out the maintenance activities using appropriate techniques and procedures
- re-connect and return the system to service on completion of the maintenance activities
- dispose of waste items in safe and environmentally acceptable manner, and leave the work area in a safe condition

**Carry out maintenance activities on one of the following types of primary energy heat source systems:**

- liquid
- gaseous
- solid fuel
- renewable energy
- electrical
**Unit 35**  
Maintaining heating and ventilation systems

<table>
<thead>
<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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<tbody>
<tr>
<td>Carry out all of the following maintenance techniques, as appropriate to the equipment being maintained:</td>
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<tr>
<td>setting, aligning and adjusting replaced components</td>
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<tr>
<td>dismantling equipment to unit/subassembly level</td>
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<tr>
<td>dismantling units to component level</td>
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<tr>
<td>proof marking/labelling of components</td>
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<tr>
<td>checking components for serviceability</td>
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<tr>
<td>replacing all ‘lifed’ items (seals, bearings, gaskets)</td>
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<tr>
<td>testing the system for leaks</td>
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<tr>
<td>tightening fastenings to the required torque</td>
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<tr>
<td>making ‘off-line’ checks before starting up</td>
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<tr>
<td>lubricating components</td>
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<tr>
<td>functionally testing the completed system</td>
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<tr>
<td>replacing damaged/defective components</td>
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</table>

**Maintain and/or replace a range of heating/ventilation components, to include 15 of the following:**

- boiler
- heat exchanger
- motors
- fans
- blowers
- pumps
- calorifiers
- storage devices
- ductwork
- dampers
- vents/diffuser
- valves
- strainers/filters
- pipework
- couplings
- heater batteries
- manifolds/flanges
- gaskets and seals
- gauges/indicators
Unit 35
Maintaining heating and ventilation systems

<table>
<thead>
<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
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<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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<tbody>
<tr>
<td>sensors</td>
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<tr>
<td>switches</td>
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<tr>
<td>condenser</td>
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<tr>
<td>control devices</td>
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<td>safety devices</td>
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<td>electrical components</td>
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<td>supplementary heaters</td>
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<td>silencers</td>
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<tr>
<td>insulation</td>
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<tr>
<td>local heating system (such as radiators, in line duct heaters, skirting heating, fan coil, convectors, storage pipe heaters and air handling units)</td>
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Maintain heating and ventilation systems in compliance with one or more of the following quality and accuracy standards:

- organisational guidelines and codes of practice
- equipment manufacturer's operation range
- IEE wiring regulations
- BS and/or ISO standards

Complete all relevant paperwork from the following, and pass it to the appropriate people:

- job cards
- permits to work/formal risk assessment
- maintenance log or report

Knowledge and understanding reference:

Candidate: ___________________________  Date: ________________

Assessor: ___________________________  Date: ________________
Unit 36
Maintaining air conditioning and ventilation systems

Unit summary
This unit identifies the competencies you need to carry out corrective maintenance activities on air conditioning and ventilation systems, in accordance with approved procedures. You will be required to maintain a range of air conditioning equipment and ventilation systems, which will include air generation, distribution and control systems. This will involve dismantling, removing and replacing faulty or damaged components, including motors, fans, pumps, valves, couplings, ducting and trunking, heaters, filters, and control devices such as thermostats and switches. You will be expected to apply a range of dismantling and assembly methods and techniques, such as proof marking/labelling of components to aid the reassembly, dismantling components requiring pressure techniques, torque loading, and setting, aligning and adjusting components.

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 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 minimum 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 maintenance procedures on air conditioning and ventilation equipment. You will understand the dismantling and reassembly methods and procedures, and their application. You will know how the equipment functions, 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. You will also have sufficient knowledge of these components to ensure 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 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.
Unit 36
Maintaining air conditioning and ventilation systems

Performance statements:
You must:
1. Work safely at all times, complying with health and safety and other relevant regulations 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 time scale
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 records accurately and pass them on to the appropriate person
7. Dispose of waste materials in accordance with safe working practices and approved procedures

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:
1. Carry out all the following activities during the maintenance activity:
   - plan the maintenance activities to cause minimum disruption to normal working
   - use the correct issue of company and/or manufacturers' drawings and maintenance documentation
   - adhere to risk assessment, COSHH and other relevant safety standards
   - ensure the safe isolation of equipment (such as mechanical, electricity, heating, chilling and air sources)
   - provide safe access and working arrangements for the maintenance area
   - carry out the maintenance activities using appropriate techniques and procedures
   - re-connect and return the system to service on completion of the maintenance activities
   - dispose of waste items in safe and environmentally acceptable manner, and leave the work area in a safe condition
2. Carry out maintenance activities on all of the following types of equipment:
   - remote air conditioning generation
   - local air conditioning distribution
   - air conditioning control
3. Carry out all of the following maintenance techniques, as appropriate to the equipment being maintained:
   - testing the system for leaks
   - dismantling equipment to unit/sub-assembly level
   - setting, aligning and adjusting replaced components
   - checking components for serviceability
   - replacing all 'lifed' items (such as batteries, lamps)
   - replacing damaged/defective components
   - marking/labelling of components
   - tightening fasteners to the required torque
   - making 'off-line' checks before starting up
   - functionally testing the completed system
   - dismantling units to component level
4 Maintain and/or replace a range of air conditioning components to include 15 of the following:
- motors
- chiller batteries
- pumps
- humidifiers
- chilled beams
- condensers
- evaporators
- ducting/trunking
- dampers
- vents/diffusers
- valves
- filters
- pipework
- couplings
- manifolds/flanges
- silencers/attenuators
- gaskets and sealants
- gauges/indicators
- sensors
- switches
- thermostats
- insulation
- electrical connectors
- electrical components
- wiring safety devices
- local air conditioning system
- battery heaters (generation/local controlled)
- fans (supply and extraction)

5 Maintain air conditioning and ventilation systems in compliance with one or more of the following quality and accuracy standards:
- organisational guidelines and codes of practice
- equipment manufacturer’s operation range
- IEE wiring regulations
- BS and/or ISO standards

6 Complete all relevant paperwork from the following, and pass it to the appropriate people:
- job cards
- permits to work/formal risk assessment
- maintenance log or report
Knowledge statements:
You must have knowledge and understanding of:
1. The health and safety requirements of the area in which the maintenance activity is to take place
2. The isolation and lock-off procedures or permit-to-work procedure that applies
3. The specific health and safety precautions to be applied during the maintenance process, and their effects on others (including The Prevention and Control of Legionellosis, and Safe Working in Confined Spaces 1997)
4. Hazards associated with carrying out maintenance activities on air conditioning equipment (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 they can be minimised
5. The importance of wearing protective clothing and other appropriate safety equipment during the maintenance process
6. How to obtain and interpret drawings, specifications, manufacturers’ manuals and other documents needed in the maintenance process
7. The procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance
8. Company policy on the repair/replacement of components during the maintenance process
9. The sequence to be adopted for the dismantling/reassembly of various types of assemblies
10. The methods and techniques used to dismantle/assemble air conditioning equipment (release of pressures/force, proof marking, extraction, pressing, alignment)
11. Methods of checking components are fit for purpose, how to identify defects and wear characteristics, and the need to replace ‘lifed’ items (such as seals and gaskets)
12. How to make adjustments to components/assemblies to ensure that they function correctly
13. The basic principles of how the equipment functions, its operation sequence, the working purpose of individual units/components and how they interact
14. The correct operating ranges, including temperature and pressure of secondary heating sources (air and water)
15. Basic applications of different local heating systems (such as radiators, in line duct heaters, skirting heating, fan coil, convectors, storage pipe heaters and air handling units)
16. The typical building design temperatures, such as for offices, factories (light and heavy work) warehouses and canteens
17. The uses of measuring equipment, such as micrometers, verniers and other measuring devices
18. How to make adjustments to components to ensure they function correctly
19. 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 their intended purpose
20. The generation of maintenance documentation and/or reports following the maintenance activity
21. The equipment operating and control procedures to be applied during the maintenance activity
22. How to use lifting and handling equipment correctly and safely in the maintenance activity
23. The problems associated with the maintenance activity, and how they can be overcome
24. The organisational procedure to be adopted for the safe disposal of waste of all types of materials
25. The extent of your own authority and whom you should report to if you have problems that you cannot resolve
### Unit 36
Maintaining air conditioning and ventilation systems

<table>
<thead>
<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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<td>evidence type</td>
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**Carry out all the following activities during the maintenance activity:**

- plan the maintenance activities to cause minimum disruption to normal working
- use the correct issue of company and/or manufacturers’ drawings and maintenance documentation
- adhere to risk assessment, COSHH and other relevant safety standards
- ensure the safe isolation of equipment (such as mechanical, electricity, heating, chilling and air sources)
- provide safe access and working arrangements for the maintenance area
- carry out the maintenance activities using appropriate techniques and procedures
- re-connect and return the system to service on completion of the maintenance activities
- dispose of waste items in safe and environmentally acceptable manner, and leave the work area in a safe condition

**Carry out maintenance activities on all of the following types of equipment:**

- remote air conditioning generation
- local air conditioning distribution
- air conditioning control
### Unit 36
Maintaining air conditioning and ventilation systems

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<td><strong>Carry out all of the following maintenance techniques, as appropriate to the equipment being maintained:</strong></td>
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<td>testing the system for leaks</td>
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<td>dismantling equipment to unit/subassembly level</td>
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<tr>
<td>setting, aligning and adjusting replaced components</td>
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<td>checking components for serviceability</td>
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<td>replacing all ‘lifed’ items (such as batteries, lamps)</td>
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<td>replacing damaged/defective components</td>
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<td>marking/labelling of components</td>
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<td>tightening fasteners to the required torque</td>
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<td>making ‘off-line’ checks before starting up</td>
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<td>functionally testing the completed system</td>
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<td>dismantling units to component level</td>
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<td><strong>Maintain and/or replace a range of air conditioning components to include 15 of the following:</strong></td>
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<td>motors</td>
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<td>chiller batteries</td>
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<td>pumps</td>
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<td>humidifiers</td>
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<td>chilled beams</td>
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<td>condensers</td>
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<td>evaporators</td>
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<td>ducting/trunking</td>
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<td>dampers</td>
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<td>vents/diffusers</td>
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<td>valves</td>
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<td>filters</td>
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<td>pipework</td>
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<td>couplings</td>
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<td>manifolds/flanges</td>
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<td>silencers/attenuators</td>
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<td>gaskets and sealants</td>
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<td>gauges/indicators</td>
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## Unit 36
Maintaining air conditioning and ventilation systems

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<td>sensors</td>
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<td>switches</td>
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<td>thermostats</td>
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<td>insulation</td>
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<td>electrical connectors</td>
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<td>electrical components</td>
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<td>wiring safety devices</td>
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<tr>
<td>local air conditioning system</td>
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<tr>
<td>battery heaters (generation/local controlled)</td>
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<tr>
<td>fans (supply and extraction)</td>
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**Maintain air conditioning and ventilation systems in compliance with one or more of the following quality and accuracy standards:**

- organisational guidelines and codes of practice
- equipment manufacturer’s operation range
- IEE wiring regulations
- BS and/or ISO standards

**Complete all relevant paperwork from the following, and pass it to the appropriate people:**

- job cards
- permits to work/formal risk assessment
- maintenance log or report

Knowledge and understanding reference:

Candidate: _______________________________________________ Date: ___________________

Assessor: ________________________________________________ Date: ___________________
Unit 37
Maintaining gas distribution systems and equipment

Unit summary
This unit identifies the competencies you need to carry out corrective maintenance activities on gas distribution systems and equipment, in accordance with approved procedures. You will be required to maintain a range of gas distribution systems, which will include mains, cylinder and tanked gases. This will involve dismantling, removing and replacing faulty or damaged components, including valves, couplings, motors, regulators, boosters, manifolds, storage devices, sensors, gaskets and seals, filters, gauges and indicators, electrical wiring, safety devices, pipework and hoses. You will be expected to apply a range of dismantling and assembly methods and techniques, such as labelling of components to aid the assembly, dismantling components requiring pressure techniques, torque loading, and setting, aligning and adjusting components.

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 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 minimum 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 gas distribution maintenance procedures. You will understand the dismantling and reassembly methods and procedures used, and their application. You will know how the equipment functions, 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. You will also have sufficient knowledge of these components to ensure 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 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.
Unit 37
Maintaining gas distribution systems and equipment

Performance statements:
You must:

a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Follow the relevant maintenance schedules to carry out the required work
c. Carry out the maintenance activities within the limits of your personal authority
d. Carry out the maintenance activities in the specified sequence and in an agreed time scale
e. Report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
f. Complete relevant maintenance records accurately and pass them on to the appropriate person
g. Dispose of waste materials in accordance with safe working practices and approved procedures

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:
1. Carry out all the following activities during the maintenance activity:
   • plan maintenance activities to cause minimum disruption to normal working
   • use the correct issue of company and/or manufacturers’ drawings and maintenance documentation
   • adhere to risk assessment, COSHH and other relevant safety standards
   • ensure the safe isolation of equipment (such as mechanical, electricity, gas)
   • provide safe access and working arrangements for the maintenance area
   • carry out the maintenance activities using appropriate techniques and procedures
   • re-connect and return the system to service on completion of the maintenance activities
   • functionally test and adjust equipment to specification
   • dispose of waste items in safe and environmentally acceptable manner
   • leave the work area in a safe condition

2. Carry out maintenance activities on two of the following types of gas distribution systems:
   • mains
   • cylinders
   • tanks
   • other

3. Carry out all of the following maintenance techniques, as appropriate to the equipment being maintained:
   • testing the system for leaks
   • dismantling equipment to unit/sub-assembly level
   • setting, aligning and adjusting replaced components
   • checking components for serviceability
   • replacing all ‘lifed’ items (such as batteries, lamps)
   • replacing damaged/defective components
   • marking/labelling of components
   • tightening fasteners to the required torque
   • making ‘off-line’ checks before starting up
   • functionally testing the completed system
   • dismantling units to component level
4 Maintain and/or replace a range of gas distribution components, to include 12 of the following:
   • motors
   • valves
   • rigid pipe
   • flexible pipe/hoses
   • gaskets and seals
   • boosters
   • regulators
   • couplings
   • manifolds
   • storage devices
   • sensors
   • meters
   • gauges/indicators
   • filters
   • supporting devices
   • electrical wiring
   • switches
   • equipotential bonding
   • safety devices

5 Maintain gas distribution systems in compliance with one or more of the following quality and accuracy standards:
   • organisational guidelines and codes of practice
   • equipment manufacturer’s operation range
   • IEE wiring regulations
   • BS and/or ISO standards

6 Complete all relevant paperwork from the following, and pass it to the appropriate people:
   • job cards
   • permits to work/formal risk assessment
   • maintenance log or report
Unit 37
Maintaining gas distribution systems and equipment

Knowledge statements:
You must have knowledge and understanding of:
1. The health and safety requirements of the area in which the maintenance activity is to take place
2. The isolation and lock-off procedures or permit-to-work procedure that applies to the gas system being maintained
3. The specific health and safety precautions to be applied during the maintenance procedure, and their effects on others
4. Hazards associated with carrying out maintenance activities on gas systems (such as fire, explosion, respiratory problems, stored pressure, misuse of tools, using damaged or badly maintained tools and equipment, not following laid-down maintenance procedures), and how they can be minimised
5. The importance of wearing protective clothing and other appropriate safety equipment during the maintenance process
6. How to obtain and interpret drawings, specifications, manufacturers’ manuals and other documents needed in the maintenance process
7. The procedure for updating drawings and other documentation on gas distribution systems
8. The procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance activities
9. The importance of following the correct procedures for purging and decommissioning components
10. Company policy on the repair/replacement of components during the maintenance process
11. The sequence to be adopted for the dismantling/reassembly of various types of gas assemblies
12. Methods of checking components are fit for purpose, how to identify defects and wear characteristics, and the need to replace ‘lifed’ items (such as seals and gaskets)
13. How to make adjustments to components/assemblies to ensure they function correctly
14. The basic principles of how the equipment functions, its operation sequence, the working purpose of individual units/components and how they interact
15. The methods used to label and identify different pipework systems (including colour coding and warning signs)
16. The different types and applications of measuring and monitoring equipment used
17. How to check tools and equipment are free from damage or defects, are in a safe and usable condition, and are configured correctly for their intended purpose
18. The generation of maintenance documentation and/or reports following the maintenance activity
19. The equipment operating and control procedures to be applied during the maintenance activity
20. How to use lifting and handling equipment correctly and safely in the maintenance activity
21. The problems associated with the maintenance activity, and how they can be overcome
22. The organisational procedure to be adopted for the safe disposal of waste of all types of materials
23. The extent of your own authority and whom you should report to if you have problems that you cannot resolve
### Unit 37
Maintaining gas distribution systems and equipment

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Carry out all the following activities during the maintenance activity:

- plan maintenance activities to cause minimum disruption to normal working
- use the correct issue of company and/or manufacturers’ drawings and maintenance documentation
- adhere to risk assessment, COSHH and other relevant safety standards
- ensure the safe isolation of equipment (such as mechanical, electricity, gas)
- provide safe access and working arrangements for the maintenance area
- carry out the maintenance activities using appropriate techniques and procedures
- re-connect and return the system to service on completion of the maintenance activities
- functionally test and adjust equipment to specification
- dispose of waste items in safe and environmentally acceptable manner
- leave the work area in a safe condition

**Carry out maintenance activities on two of the following types of gas distribution systems:**
- mains
- cylinders
- tanks
- other
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Maintaining gas distribution systems and equipment

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<td>dismantling equipment to unit/subassembly level</td>
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<td>replacing damaged/defective components</td>
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<td>dismantling units to component level</td>
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<td><strong>Maintain and/or replace a range of gas distribution components, to include 12 of the following:</strong></td>
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<td>valves</td>
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<td>rigid pipe</td>
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<td>flexible pipe/hoses</td>
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<td>gaskets and seals</td>
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<td>boosters</td>
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<td>regulators</td>
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Maintaining gas distribution systems and equipment

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**Maintain gas distribution systems in compliance with one or more of the following quality and accuracy standards:**

- organisational guidelines and codes of practice
- equipment manufacturer’s operation range
- IEE wiring regulations
- BS and/or ISO standards

**Complete all relevant paperwork from the following, and pass it to the appropriate people:**

- job cards
- permits to work/formal risk assessment
- maintenance log or report

**Knowledge and understanding reference:**

Candidate: ___________________________  Date: ________________

Assessor: ___________________________  Date: ________________
Unit 38
Maintaining compressed air systems and equipment

Unit summary
This unit identifies the competencies you need to carry out corrective maintenance activities on compressed air systems and equipment, in accordance with approved procedures. You will be required to maintain a range of compressed air equipment, which will include compressed air generation, distribution and control systems. This will involve dismantling, removing and replacing faulty or damaged components, including pumps, valves, couplings, receivers, driers, motors, regulators, compressor components, sensors, pipework and hoses, filters, electrical wiring, gaskets and seals. You will be expected to apply a range of dismantling and assembly methods and techniques, such as proof marking/labelling of components to aid the assembly, dismantling components requiring pressure techniques, torque loading, and setting, aligning and adjusting components.

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 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 minimum 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 maintenance procedures on compressed air equipment. You will understand the dismantling and reassembly methods and procedures used, and their application. You will know how the equipment functions, 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. You will also have sufficient knowledge of these components to ensure 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 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.
Unit 38
Maintaining compressed air systems and equipment

Performance statements:
You must:
a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Follow the relevant maintenance schedules to carry out the required work
c. Carry out the maintenance activities within the limits of your personal authority
d. Carry out the maintenance activities in the specified sequence and in an agreed time scale
e. Report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
f. Complete relevant maintenance records accurately and pass them on to the appropriate person
g. Dispose of waste materials in accordance with safe working practices and approved procedures

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:
1. Carry out all the following during the maintenance activity:
   - plan the maintenance activities to cause minimum disruption to normal working
   - use the correct issue of company and/or manufacturers' drawings and maintenance documentation
   - adhere to risk assessment, COSHH and other relevant safety standards
   - ensure the safe isolation of equipment (such as mechanical, electricity, air or fluids)
   - provide safe access and working arrangements for the maintenance area
   - carry out the maintenance activities using appropriate techniques and procedures
   - re-connect and return the system to service on completion of the maintenance activities
   - dispose of waste items in safe and environmentally acceptable manner, and leave the work area in a safe condition

2. Carry out maintenance activities on all of the following types of equipment:
   - compressed air generation
   - compressed air distribution
   - compressed air control

3. Carry out all of the following maintenance techniques, as appropriate to the equipment:
   - testing the system for leaks
   - dismantling equipment to unit/sub-assembly level
   - setting, aligning and adjusting replaced components
   - checking components for serviceability
   - replacing all ‘lifed’ items (such as batteries, lamps)
   - replacing damaged/defective components
   - marking/labelling of components
   - tightening fasteners to the required torque
   - making ‘off-line’ checks before starting up
   - functionally testing the completed system
   - dismantling units to component level
4 Maintain and/or replace a range of compressed air equipment and components, to include 15 of the following:
- pumps
- receivers
- driers
- motors
- pistons
- valves
- reservoirs
- couplings
- rigid pipe
- vanes
- filters
- regulators
- compressors
- silencers
- manifolds
- sensors
- lubricators
- separation units
- flexible pipe/hoses
- gauges/indicators
- gaskets and sealants
- control equipment
- electrical connectors
- monitoring equipment
- switches
- electrical wiring
- safety devices

5 Maintain compressed air systems equipment which complies with one or more of the following quality and accuracy standards:
- organisational guidelines and codes of practice
- equipment manufacturer’s operation range
- IEE wiring regulations
- BS and/or ISO standards

6 Complete all relevant paperwork from the following, and pass it to the appropriate people:
- job cards
- permits to work/formal risk assessment
- maintenance log or report
Knowledge statements:
You must have knowledge and understanding of:
1. The health and safety requirements of the area in which the maintenance activity is to take place
2. The isolation and lock-off procedures or permit-to-work procedure that applies to the compressed air equipment/system being worked on
3. The specific health and safety precautions to be applied during the maintenance procedure, and their effects on others
4. Hazards associated with carrying out maintenance activities on compressed air equipment (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 they can be minimised
5. The importance of wearing protective clothing and other appropriate safety equipment during the maintenance process
6. How to obtain and interpret drawings, specifications, manufacturers’ manuals and other documents needed in the maintenance process
7. The procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance activities
8. Company policy on the repair/replacement of components during the maintenance process
9. The sequence to be adopted for the dismantling/reassembly of various types of assemblies used on compressed air equipment
10. The methods and techniques used to dismantle/assemble compressed air equipment (release of pressures/force, proof marking, extraction, pressing, alignment)
11. Methods of checking components are fit for purpose, how to identify defects and wear characteristics, and the need to replace ‘lifed’ items (such as seals and gaskets)
12. How to make adjustments to components/assemblies to ensure they function correctly
13. The basic principles of how the equipment functions, its operation sequence, the working purpose of individual units/components and how they interact
14. The use of measuring equipment (such as micrometers, verniers, and other measuring devices)
15. How to check tools and equipment are free from damage or defects, are in a safe and usable condition, and are configured correctly for their intended purpose
16. The generation of maintenance documentation and/or reports following the maintenance activity
17. The equipment operating and control procedures to be applied during the maintenance activity
18. How to use lifting and handling equipment correctly and safely in the maintenance activity
19. The problems associated with the maintenance activity, and how they can be overcome
20. The organisational procedure to be adopted for the safe disposal of waste of all types of materials
21. The extent of your own authority and whom you should report to if you have problems that you cannot resolve
## Unit 38
Maintaining compressed air systems and equipment

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<tr>
<th>evidence record sheet</th>
<th>evidence type</th>
<th>date</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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**Carry out all the following during the maintenance activity:**

- plan the maintenance activities to cause minimum disruption to normal working
- use the correct issue of company and/or manufacturers’ drawings and maintenance documentation
- adhere to risk assessment, COSHH and other relevant safety standards
- ensure the safe isolation of equipment (such as mechanical, electricity, air or fluids)
- provide safe access and working arrangements for the maintenance area
- carry out the maintenance activities using appropriate techniques and procedures
- re-connect and return the system to service on completion of the maintenance activities
- dispose of waste items in safe and environmentally acceptable manner, and leave the work area in a safe condition

**Carry out maintenance activities on all of the following types of equipment:**

- compressed air generation
- compressed air distribution
- compressed air control

**Carry out all of the following maintenance techniques, as appropriate to the equipment:**

- testing the system for leaks
- dismantling equipment to unit/subassembly level
- setting, aligning and adjusting replaced components
- checking components for serviceability
- replacing all ‘lifed’ items (such as batteries, lamps)
## Unit 38
Maintaining compressed air systems and equipment

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<tbody>
<tr>
<td>replacing damaged/defective components</td>
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<td>marking/labelling of components</td>
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<td>tightening fasteners to the required torque</td>
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<tr>
<td>making ‘off-line’ checks before starting up</td>
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<tr>
<td>functionally testing the completed system</td>
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<tr>
<td>dismantling units to component level</td>
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</table>

Maintain and/or replace a range of compressed air equipment and components, to include 15 of the following:

- pumps
- receivers
- driers
- motors
- pistons
- valves
- reservoirs
- couplings
- rigid pipe
- vanes
- filters
- regulators
- compressors
- silencers
- manifolds
- sensors
- lubricators
- separation units
- flexible pipe/hoses
- gauges/indicators
- gaskets and sealants
- control equipment
- electrical connectors
- monitoring equipment
- switches
- electrical wiring
- safety devices
**Unit 38**  
Maintaining compressed air systems and equipment

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**Maintain compressed air systems equipment which complies with one or more of the following quality and accuracy standards:**

- organisational guidelines and codes of practice
- equipment manufacturer's operation range
- IEE wiring regulations
- BS and/or ISO standards

**Complete all relevant paperwork from the following, and pass it to the appropriate people:**

- job cards
- permits to work/formal risk assessment
- maintenance log or report

**Knowledge and understanding reference:**

Candidate: _______________________________________________  Date: ___________________  
Assessor: ________________________________________________  Date: ___________________
Unit 39
Maintaining process control systems

Unit summary
This unit identifies the competencies you need to carry out corrective maintenance activities to process controller equipment, in accordance with approved procedures. You will be required to maintain a range of process controller equipment, such as fixed I/O, rack mount and modular systems. This will involve dismantling, removing and replacing faulty peripheral components, process controller units and components, down to unit and board level. You will also need to be able to 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 are outside your permitted authority, to the relevant people. You will be expected to work with minimum 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 a good understanding of your work, and will provide an informed approach to applying maintenance procedures to process controller systems. 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 the equipment operates to the required specification. You will also know about the interaction of the other associated integrated technologies, and will 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. 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 statements:

You must:

a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Follow the relevant maintenance schedules to carry out the required work
c. Carry out the maintenance activities within the limits of your personal authority
d. Carry out the maintenance activities in the specified sequence and in an agreed time scale
e. Report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
f. Complete relevant maintenance records accurately and pass them on to the appropriate person
g. Dispose of waste materials in accordance with safe working practices and approved procedures

Scope of the unit:

The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:

1. Carry out all of the following during the maintenance activities:
   - plan the maintenance activities to cause minimum disruption to normal working
   - use the correct issue of company and/or manufacturers’ drawings and maintenance documentation
   - adhere to risk assessment, COSHH and other relevant safety standards
   - ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
   - provide safe access and working arrangements for the maintenance area
   - carry out the maintenance activities using appropriate techniques and procedures
   - re-connect and return the system to service on completion of the maintenance activities
   - dispose of waste items in safe and environmentally acceptable manner, and leave the work area in a safe condition

2. Carry out maintenance activities on one of the following types of process controller equipment:
   - fixed IO
   - modular
   - rack mount

3. Carry out seven of the following program maintenance activities on the process controller system:
   - select and use appropriate programming devices (such as terminals, hand-held programmers and personal computers)
   - programme by computer-based authoring (to include subroutines)
   - use ladder logic, statement lists, or system flowcharts
   - produce back-ups of completed programs
   - edit, enter and remove contacts from lines of logic
   - carry out on-line monitoring of programs
   - use ‘on’ and ‘off-line’ programming
   - use single-step mode of operation
   - load, read and save programs
   - alter counter and timer settings
   - force contacts on and off
4 Carry out all of the following during the maintenance activities:
   • take electrostatic precautions when handling components and circuit boards
   • proofmarking or labelling of removed wires and components
   • replace peripherals (such as sensors, actuators, relays, switches)
   • inspect components for serviceability
   • use program full-run modes of operation
   • replace back-up batteries
   • functionally test the system
   • change or add circuit boards
   • replace power supplies
   • replace process controller units

5 Maintain process controller equipment in compliance with one or more of the following quality and accuracy standards:
   • IEE wiring regulations
   • BS and ISO standards
   • organisational guidelines and codes of practice
   • equipment manufacturer’s operation range

6 Complete all relevant paperwork from the following, and pass it to the appropriate people:
   • job cards
   • maintenance log or report
   • permits to work/formal risk assessment
Unit 39
Maintaining process control systems

Knowledge statements:
You must have knowledge and understanding of:
1. The health and safety requirements of the area in which the maintenance 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 process controller system being worked on
3. The specific health and safety precautions to be applied during the maintenance activity, and their effects on others
4. How to recognise and deal with victims of electric shock (to include methods of safely removing the victim from the power source, isolating the power source, and methods of first aid resuscitation)
5. The importance of wearing protective clothing and other appropriate safety equipment during the maintenance activities, and where this can be obtained
6. The procedures and precautions to be adopted to eliminate electrostatic discharge
7. Hazards associated with carrying out maintenance activities on process control systems (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 they can be minimised
8. How to obtain and interpret drawings, charts, specifications, manufacturers’ manuals, history/maintenance reports, symbols used on process controller documents and other documents needed in the maintenance process
9. The basic principles of how the system functions, its operation sequence, the working purpose of individual units/components and how they interact
10. The devices and systems for storing programmes
11. Procedures to be applied to the storage, location and method of backing up programmes
12. The different types of interface cards and their application
13. The procedures and application of ‘design and development’ computer-based authoring software
14. The numbering system and codes used for identification of inputs and outputs
15. How to search the user programme within the process controller for specific elements
16. Programming techniques and codes used (interlocking, timers, counters, subroutines, etc)
17. 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
18. The procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance process
19. Company policy on the repair/replacement of components during the maintenance process
20. The techniques used to dismantle/assemble integrated equipment (release of pressures/force, proofmarking to aid assembly, plugging exposed pipe/component openings, dealing with soldered joints, screwed, clamped and crimped connections)
21. Methods of attaching identification marks/labels to removed components or cables, to assist with reassembly
22. Methods of checking that components are fit for purpose, and the need to replace batteries, boards and other failed items
23. 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 their intended purpose
24. The importance of making ‘off-load’ checks before proving the equipment with the electrical supply on
25. The generation of maintenance documentation and/or reports following the maintenance activity
26. The equipment operating and control procedures to be applied during the maintenance activity
27. How to use lifting and handling equipment correctly and safely in the maintenance activity
28. The problems that can occur during the maintenance of the process controller system, and how they can be overcome
29. The organisational procedure to be adopted for the safe disposal of waste of all types of materials
30. The extent of your own authority and whom you should report to if you have problems that you cannot resolve
# Unit 39
Maintaining process control systems

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**Carry out all of the following during the maintenance activities:**

- Plan the maintenance activities to cause minimum disruption to normal working
- Use the correct issue of company and/or manufacturers’ drawings and maintenance documentation
- Adhere to risk assessment, COSHH and other relevant safety standards
- Ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
- Provide safe access and working arrangements for the maintenance area
- Carry out the maintenance activities using appropriate techniques and procedures
- Re-connect and return the system to service on completion of the maintenance activities
- Dispose of waste items in safe and environmentally acceptable manner, and leave the work area in a safe condition

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

- Fixed IO
- Modular
- Rack mount
**Unit 39**  
Maintaining process control systems

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<td><strong>Carry out seven of the following program maintenance activities on the process controller system:</strong></td>
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<tr>
<td>select and use appropriate programming devices (such as terminals, hand-held programmers and personal computers)</td>
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<tr>
<td>programme by computer-based authoring (to include subroutines)</td>
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<td>use ladder logic, statement lists, or system flowcharts</td>
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<td>produce back-ups of completed programs</td>
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<td>edit, enter and remove contacts from lines of logic</td>
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<td>carry out on-line monitoring of programs</td>
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<td>use ‘on’ and ‘off-line’ programming</td>
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<tr>
<td>use single-step mode of operation</td>
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<td>load, read and save programs</td>
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<td>alter counter and timer settings</td>
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<td>force contacts on and off</td>
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<td><strong>Carry out all of the following during the maintenance activities:</strong></td>
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<tr>
<td>take electrostatic precautions when handling components and circuit boards</td>
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<td>proofmarking or labelling of removed wires and components</td>
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<td>replace peripherals (such as sensors, actuators, relays, switches)</td>
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<td>inspect components for serviceability</td>
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<td>use program full-run modes of operation</td>
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<td>replace back-up batteries</td>
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<td>functionally test the system</td>
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<tr>
<td>change or add circuit boards</td>
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<td>replace power supplies</td>
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<tr>
<td>replace process controller units</td>
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## Unit 39
Maintaining process control systems

<table>
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### Maintain process controller equipment in compliance with one or more of the following quality and accuracy standards:

- IEE wiring regulations
- BS and ISO standards
- Organisational guidelines and codes of practice
- Equipment manufacturer’s operation range

### Complete all relevant paperwork from the following, and pass it to the appropriate people:

- Job cards
- Maintenance log or report
- Permits to work/formal risk assessment

Knowledge and understanding reference:

Candidate: ___________________________  Date: ______________

Assessor: ___________________________  Date: ______________
**Unit 40**

Maintaining instrumentation and control systems

**Unit summary**

This unit identifies the competencies you need to carry out corrective maintenance activities to instrumentation and control equipment, in accordance with approved procedures. You will be required to maintain a range of instrumentation and control equipment, such as pressure, flow, level and temperature instruments, fiscal monitoring equipment, fire and gas detection and alarm systems, industrial weighing systems, speed measurement and control systems, vibration monitoring equipment, nucleonics and radiation measurement, analysers recorders and indicators, telemetry systems and emergency shutdown systems. This will involve dismantling, removing and replacing a range of instruments and faulty peripheral components, down to unit and board/component level, as appropriate.

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, instrument system, tools or equipment used, that you cannot personally resolve, or are outside your permitted authority, to the relevant people. You will be expected to work with minimum 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 a good understanding of your work, and will provide an informed approach to applying maintenance procedures on instrumentation and control equipment and systems. You will understand the maintenance methods and procedures used, and their application, and will know about the various instrumentation 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 the equipment operates to the required specification. You will also know about the interaction of the other associated integrated technologies, and will have sufficient knowledge to carry out the dismantling and reassembly of the instrumentation system safely and effectively.

You will understand the safety precautions required when carrying out the maintenance activities, especially those for isolating the equipment. 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.
Unit 40
Maintaining instrumentation and control systems

Performance statements:
You must:

a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Follow the relevant maintenance schedules to carry out the required work
c. Carry out the maintenance activities within the limits of your personal authority
d. Carry out the maintenance activities in the specified sequence and in an agreed time scale
e. Report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
f. Complete relevant maintenance records accurately and pass them on to the appropriate person
g. Dispose of waste materials in accordance with safe working practices and approved procedures

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:
1. Carry out all of the following during the maintenance activities:
   • plan the maintenance activities to cause minimum disruption to the process/system operation
   • use the correct issue of company and/or manufacturers' drawings and maintenance documentation
   • adhere to risk assessment, COSHH and other relevant safety standards
   • ensure the insertion of any relevant system trip defeats (such as fire extinguishant, emergency shutdown)
   • ensure the safe isolation of instruments (such as process, electricity, hydraulic, pneumatic, mechanical)
   • carry out appropriate de-contamination procedures (such as toxic, corrosive, inflammable, explosive)
   • provide safe access and working arrangements for the maintenance area
   • carry out the maintenance activities using appropriate techniques and procedures
   • dispose of waste items in safe and environmentally acceptable manner, and leave the work area in a safe condition

2. Carry out maintenance activities on four of the following types of instrumentation and control equipment:
   • pressure
   • flow
   • level
   • temperature
   • weight
   • fiscal metering
   • fire detection and alarm
   • gas detection and alarm
   • emergency shutdown
   • speed measurement
   • speed control
   • vibration monitoring
   • nuclonics and radiation
   • analysers
   • recorders and indicators
   • telemetry systems
3 Carry out all of the following maintenance techniques, as appropriate to the equipment being maintained:
- replacing peripherals (such as sensors, actuators, relays, switches)
- proof marking/labelling of removed wires or components
- taking electrostatic precautions when handling components and circuit boards
- setting, aligning and adjusting replaced instruments
- replacing ‘lifed’ items (such as seals, bearings, gaskets)
- disconnecting electrical/pneumatic supply
- disconnecting signal transmission
- removing instruments from the system
- replacing mechanical components
- disconnecting process pipework
- replacing electrical components
- replacing complete instruments
- replacing back-up batteries
- tightening fastenings to the required torque

4 Use four of the following types of instrumentation test and calibration equipment:
- signal sources
- standard test gauges
- analogue and digital meters
- digital pressure indicators
- calibrated flow meters
- special purpose test equipment
- pressure sources
- comparators
- manometers
- current injection devices
- calibrated weights
- logic probes
- temperature baths
- workshop potentiometers
- dead weight testers
- insulation testers

5 Return instruments and systems to service, to include carrying out all of the following:
- connecting up process impulse pipework
- connecting up electrical/pneumatic supply
- connecting up signal transmission (electrical, electronic, pneumatic, mechanical)
- confirming that signal measurement and transmission are satisfactory
- final re-commisioning of the system and removal of any trip defeats

6 Maintain process controller equipment in compliance with one or more of the following quality and accuracy standards:
- IEE wiring regulations
- BS and ISO standards
  - organisational guidelines and codes of practice
- equipment manufacturer’s operation range

7 Complete all relevant paperwork from the following, and pass it to the appropriate people:
- job cards
- maintenance log or report
- permits to work/formal risk assessment
Unit 40
Maintaining instrumentation and control systems

Knowledge statements:
You must have knowledge and understanding of:
1. The health and safety requirements of the area in which the maintenance 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 system and instruments being worked on, and how to check that any stored energy in pipework and instruments has been released
3. The specific health and safety precautions that need to be applied during the maintenance process, and their effects on others
4. How to recognise and deal with victims of electric shock (to include methods of safely removing the victim from the power source, isolating the power source, and methods of first aid resuscitation)
5. The importance of wearing protective clothing and other appropriate safety equipment during the maintenance activities, and where this can be obtained
6. The procedures and precautions to be adopted to eliminate electrostatic discharge
7. Hazards associated with carrying out maintenance activities on instrumentation and control systems (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 they can be minimised
8. How to obtain and interpret drawings, charts, specifications, manufacturers’ manuals, history/maintenance reports, symbols used on instrumentation and control documents, and other documents needed in the maintenance process
9. The basic principles of operation of the instrumentation being maintained, how the system functions, its operation sequence, the working purpose of individual units/components and how they interact
10. The reasons for making sure control systems are isolated or put into manual control, and appropriate trip locks or keys are inserted, before removing any sensors or instruments from the system
11. The identification and selection of instrument sensors (including how to identify their markings, calibration information, component values, operating parameters and working range)
12. Methods of checking and calibrating instruments, and the type and range of equipment that can be used
13. The correct way of fitting instruments to avoid faulty readings (caused by head correction, poor flow past sensor, blockages, incorrect wiring, poor insulation or incorrect materials)
14. The correct and tidy installation and connection of external wiring and components, to avoid electronic interference or mechanical damage
15. How to carry out visual checks of the instruments (checking for leaks, security of joints and physical damage)
16. The procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance process
17. Company policy on the repair/replacement of components during the maintenance process
18. The techniques used to dismantle/assemble integrated equipment (release of pressures/force, proofmarking to aid assembly, plugging exposed pipe/component openings, dealing with soldered joints, screwed, clamped and crimped connections)
19. Methods of attaching identification marks/labels to removed components or cables, to assist with reassembly
20. Methods of checking that components are fit for purpose, and the need to replace batteries, boards and other failed items
21. 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 their intended purpose
22. The generation of maintenance documentation and/or reports following the maintenance activity
23. The equipment operating and control procedures to be applied during the maintenance activity
24. The problems that can occur during the maintenance of the instrumentation and control system, and how they can be overcome
25. The organisational procedure to be adopted for the safe disposal of waste of all types of materials
26. The extent of your own authority and whom you should report to if you have problems that you cannot resolve
## Unit 40
Maintaining instrumentation and control systems

<table>
<thead>
<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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**Carry out all of the following during the maintenance activities:**

- plan the maintenance activities to cause minimum disruption to the process/system operation
- use the correct issue of company and/or manufacturers’ drawings and maintenance documentation
- adhere to risk assessment, COSHH and other relevant safety standards
- ensure the insertion of any relevant system trip defeats (such as fire extinguishant, emergency shutdown)
- ensure the safe isolation of instruments (such as process, electricity, hydraulic, pneumatic, mechanical)
- carry out appropriate de-contamination procedures (such as toxic, corrosive, inflammable, explosive)
- provide safe access and working arrangements for the maintenance area
- carry out the maintenance activities using appropriate techniques and procedures
- dispose of waste items in safe and environmentally acceptable manner, and leave the work area in a safe condition

**Carry out maintenance activities on four of the following types of instrumentation and control equipment:**

- pressure
- flow
- level
- temperature
- weight
- fiscal metering
- fire detection and alarm
- gas detection and alarm
### Unit 40
Maintaining instrumentation and control systems

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**Carry out all of the following maintenance techniques, as appropriate to the equipment being maintained:**

- replacing peripherals (such as sensors, actuators, relays, switches)
- proof marking/labelling of removed wires or components
- taking electrostatic precautions when handling components and circuit boards
- setting, aligning and adjusting replaced instruments
- replacing ‘lifed’ items (such as seals, bearings, gaskets)
- disconnecting electrical/pneumatic supply
- disconnecting signal transmission
- removing instruments from the system
- replacing mechanical components
- disconnecting process pipework
- replacing electrical components
- replacing complete instruments
- replacing back-up batteries
- tightening fastenings to the required torque
## Unit 40
Maintaining instrumentation and control systems

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Use four of the following types of instrumentation test and calibration equipment:

- signal sources
- standard test gauges
- analogue and digital meters
- digital pressure indicators
- calibrated flow meters
- special purpose test equipment
- pressure sources
- comparators
- manometers
- current injection devices
- calibrated weights
- logic probes
- temperature baths
- workshop potentiometers
- dead weight testers
- insulation testers

Return instruments and systems to service, to include carrying out all of the following:

- connecting up process impulse pipework
- connecting up electrical/pneumatic supply
- connecting up signal transmission (electrical, electronic, pneumatic, mechanical)
- confirming that signal measurement and transmission are satisfactory
- final re-commissioning of the system and removal of any trip defeats

Maintain process controller equipment in compliance with one or more of the following quality and accuracy standards:

- IEE wiring regulations
- BS and ISO standards
- organisational guidelines and codes of practice
- equipment manufacturer’s operation range
## Unit 40
Maintaining instrumentation and control systems

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<td>permits to work/formal risk assessment</td>
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Knowledge and understanding reference:

Candidate: ___________________________  Date: ________________

Assessor: _______________________________  Date: ________________
Unit 41
Maintaining industrial refrigeration equipment

Unit summary
This unit identifies the competencies you need to carry out corrective maintenance activities on industrial refrigeration equipment, in accordance with approved procedures. This will involve dismantling, removing and maintaining faulty or damaged components, such as motors, compressors, evaporative condensers, evaporators, safety control devices, valves, refrigerant metering devices, sensors, switches, thermostats, meters, thermocouples, timers, interlocks, electrical components and wiring, electronic boards and components, controller units, computer systems and peripheral devices.

You will be expected to apply a range of dismantling and assembly methods and techniques, to include marking/labelling of components to aid the assembly, dismantling components by unplugging, desoldering removal of screwed, clamped and crimped connections, and aligning and adjusting components. You will also be expected to purge the system with the designated gases, to charge the system with the specified refrigerant and lubricant, and to bring the system back on line following the recognised and safe procedures.

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 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 minimum 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 maintenance procedures on refrigeration systems and equipment. You will understand the dismantling and reassembly methods and procedures used, and their application. You will know how the equipment functions, 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. You will also have sufficient knowledge of these components to ensure 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, charging and purging the equipment. 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.
Unit 41
Maintaining industrial refrigeration equipment

Performance statements:
You must:

a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Follow the relevant maintenance schedules to carry out the required work
c. Carry out the maintenance activities within the limits of your personal authority
d. Carry out the maintenance activities in the specified sequence and in an agreed time scale
e. Report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
f. Complete relevant maintenance records accurately and pass them on to the appropriate person
g. Dispose of waste materials in accordance with safe working practices and approved procedures

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:
1. Carry out all of the following during the maintenance activity:
   - plan the maintenance activities to cause minimum disruption to normal working
   - use the correct issue of company and/or manufacturers' drawings and maintenance documentation
   - adhere to risk assessment, COSHH and other relevant safety standards
   - ensure the safe isolation of equipment (such as mechanical, electricity, refrigerants)
   - provide safe access and working arrangements for the maintenance area
   - carry out the maintenance activities using appropriate techniques and procedures
   - re-connect and return the system to service on completion of the maintenance activities
   - dispose of waste items in safe and environmentally acceptable manner, and leave the work area in a safe condition

2. Carry out maintenance activities on two of the following types of refrigeration equipment:
   - compression types using air cooled condensers
   - compression types using water cooled condensers
   - compression types using secondary refrigerants
   - air conditioning cooling plant

3. Carry out all of the following maintenance techniques, as appropriate to the equipment being maintained:
   - testing the system for leaks
   - dismantling equipment to unit/sub-assembly level
   - dismantling units to component level
   - marking/labelling of components
   - checking components for serviceability
   - replacing 'lifed' items (such as lamps, seals, gaskets)
   - replacing damaged/defective components
   - setting, aligning and adjusting replaced components
   - checking correct operation of all safety devices
   - checking operation of all valves
   - tightening fasteners to the required torque
   - functionally testing the completed system
Maintain and/or replace a range of refrigeration equipment components, to include 10 of the following:
- motors
- evaporative condensers
- evaporators
- compressors
- relays
- sensors
- switches
- thermostats
- thermocouples
- vents/diffusers
- electrical cables
- overload protection devices
- circuit boards
- safety devices
- electronic components
- pressure relief valves
- gauges (temperature, humidity, pressure)
- transformers
- uninterrupted power supplies
- interlocks
- modems
- printers
- PC peripheral devices
- monitoring software

Carry out charging/evacuation procedures on refrigeration equipment to include five of the following, as applicable to the equipment being maintained:
- purging equipment of all air (such as dry nitrogen)
- using flushing lines and equipment
- liquid charging of a system
- vapour charging of a system
- adding refrigeration lubricants
- pumping down a system
- setting pressure cut-outs
- setting expansion valves
- setting thermostats and controls

Carry out pressure leak testing of the completed system, using two of the following methods:
- bubble testing
- halide torch
- treated papers
- sulphur candles
- electronic instruments
- automatic detection
- other suitable method

Maintain refrigeration equipment/systems in compliance with one or more of the following quality and accuracy standards:
- organisational guidelines and codes of practice
- equipment manufacturer’s operation range
- IEE wiring regulations
- BS and/or ISO standards
Complete all relevant paperwork from the following, and pass it to the appropriate people:
• job cards
• permits to work/formal risk assessment
• maintenance log or report
Unit 41
Maintaining industrial refrigeration equipment

Knowledge statements:
You must have knowledge and understanding of:
1. The health and safety requirements of the area in which the maintenance activity is to take place
2. The isolation and lock-off procedures or permit-to-work procedure that applies to the refrigeration equipment being maintained
3. The specific health and safety precautions to be applied during the maintenance procedure, and their effects on others
4. Hazards associated with carrying out maintenance activities on refrigeration equipment/systems (such as stored pressure/force, lack of good ventilation, live electrical connections, handling liquid or vapour refrigerants, using damaged or badly maintained tools and equipment, not following laid-down maintenance procedures), and how they can be minimised
5. Handling and storing of gas cylinders and equipment; the safe handling, storing and disposal of refrigerants; methods of determining contents in cylinders to allow complete charging
6. The importance of wearing protective clothing and other appropriate safety equipment during the maintenance process
7. How to obtain and interpret drawings, specifications, manufacturers’ manuals and other documents needed in the maintenance process
8. The procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance activities
9. Company policy on the repair/replacement of components during the maintenance process
10. The sequence to be adopted for the dismantling/reassembly of various types of assemblies
11. The methods and techniques used to dismantle/assemble refrigeration equipment (unplugging, de-soldering removal of screwed, clamped and crimped connections, removing bolted components and assemblies)
12. Methods of checking that components are fit for purpose, how to identify defects and wear characteristics, and the need to replace 'lifed' items (such as batteries, lamps, seals and gaskets)
13. How to make adjustments to components/assemblies to ensure they function correctly
14. The basic principles of how compression type refrigeration systems function, their operation sequence, the working purpose of individual units/components and how they interact
15. Types of compressor, condenser, expansion valves and evaporators, and methods of stopping compressor prime movers
16. The system operating pressures and temperatures, and the relationship between refrigerant gas pressures and temperatures
17. Methods of removing and replacing components and units without damaging the system and infrastructure
18. Methods of testing equipment and systems for leaks (such as liquid bubble testing, treated paper, halide torch, sulphur candles, electronic instruments or automatic detection equipment), and the tools and equipment that can be used
19. Types and application of primary and secondary refrigerants, and methods of purging and charging the system using liquid and vapour refrigerants
20. The use of vacuum pumps, pressure gauges, compound gauges, flow gauges and indicators
21. 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 their intended purpose
22. The generation of maintenance documentation and/or reports following the maintenance activity
23. The equipment operating and control procedures to be applied during the maintenance activity
24. How to use lifting and handling equipment correctly and safely in the maintenance activity
25. The problems associated with the maintenance activity, and how they can be overcome
26. The organisational procedure to be adopted for the safe disposal of waste of all types of materials
27. The extent of your own authority and whom you should report to if you have problems that you cannot resolve
## Unit 41
Maintaining industrial refrigeration equipment

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<th>evidence record sheet</th>
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**Carry out all of the following during the maintenance activity:**

- plan the maintenance activities to cause minimum disruption to normal working
- use the correct issue of company and/or manufacturers’ drawings and maintenance documentation
- adhere to risk assessment, COSHH and other relevant safety standards
- ensure the safe isolation of equipment (such as mechanical, electricity, refrigerants)
- provide safe access and working arrangements for the maintenance area
- carry out the maintenance activities using appropriate techniques and procedures
- re-connect and return the system to service on completion of the maintenance activities
- dispose of waste items in safe and environmentally acceptable manner, and leave the work area in a safe condition

**Carry out maintenance activities on two of the following types of refrigeration equipment:**

- compression types using air cooled condensers
- compression types using water cooled condensers
- compression types using secondary refrigerants
- air conditioning cooling plant

**Carry out all of the following maintenance techniques, as appropriate to the equipment being maintained:**

- testing the system for leaks
- dismantling equipment to unit/subassembly level
## Unit 41
Maintaining industrial refrigeration equipment

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<td>replacing damaged/defective components</td>
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<td>setting, aligning and adjusting replaced components</td>
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<td>functionally testing the completed system</td>
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**Maintain and/or replace a range of refrigeration equipment components, to include 10 of the following:**

- motors
- evaporative condensers
- evaporators
- compressors
- relays
- sensors
- switches
- thermostats
- thermocouples
- vents/diffusers
- electrical cables
- overload protection devices
- circuit boards
- safety devices
- electronic components
- pressure relief valves
- gauges (temperature, humidity, pressure)
- transformers
# Unit 41
Maintaining industrial refrigeration equipment

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**Carry out charging/evacuation procedures on refrigeration equipment to include five of the following, as applicable**

- to the equipment being maintained:
  - purging equipment of all air (such as dry nitrogen)
  - using flushing lines and equipment
  - liquid charging of a system
  - vapour charging of a system
  - adding refrigeration lubricants
  - pumping down a system
  - setting pressure cut-outs
  - setting expansion valves
  - setting thermostats and controls

**Carry out pressure leak testing of the completed system, using two of the following methods:**

- bubble testing
- halide torch
- treated papers
- sulphur candles
- electronic instruments
- automatic detection
- other suitable method

**Maintain refrigeration equipment/systems in compliance with one or more of the following quality and accuracy standards:**

- organisational guidelines and codes of practice
- equipment manufacturer’s operation range
- IEE wiring regulations
- BS and/or ISO standards
### Unit 41
Maintaining industrial refrigeration equipment

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Knowledge and understanding reference:

Candidate: _____________________________________________ Date: ________________

Assessor: ______________________________________________ Date: ________________
Unit 42
Maintaining environmental control equipment

Unit summary
This unit identifies the competencies required to carry out maintenance on fixed and portable environmental control equipment, in accordance with approved procedures, and to demonstrate an appropriate level of skill and knowledge of the function and operation of a wide range of equipment, which includes: solid and liquid particle separation, gas scrubbers, clean-up equipment, noise and vibration absorbers, and their control equipment.

You need to demonstrate your ability to overhaul the plant, or to remove and repair, or replace faulty subassemblies and components, including fans, pumps, valves, couplings, ducting, heaters, filters and control equipment. You will need to re-assemble and carry out appropriate test procedures, which may include the use of special purpose tooling and equipment. To help the re-assembly you will, when dismantling equipment, be required to use a logical approach to component identification (proof marking/labelling), and to their assembly criteria.

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 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 minimum 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 maintenance procedures to environmental control systems and equipment. You will understand the dismantling and reassembly methods and procedures, and their application. You will know how the equipment functions, 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. You will also have sufficient knowledge of these components to ensure 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 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.
Unit 42
Maintaining environmental control equipment

Performance statements:
You must:

a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Follow the relevant maintenance schedules to carry out the required work
c. Carry out the maintenance activities within the limits of your personal authority
d. Carry out the maintenance activities in the specified sequence and in an agreed time scale
e. Report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
f. Complete relevant maintenance records accurately and pass them on to the appropriate person
g. Dispose of waste materials in accordance with safe working practices and approved procedures

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:
1. Carry out all of the following during the maintenance activities:
   - plan the maintenance work so as to cause minimum disruption to normal working
   - use the correct issue of company and equipment suppliers' drawings and maintenance documentation
   - adhere to hazard and risk assessment, COSHH and other relevant safety documents
   - ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
   - ensure the provision of adequate safety barriers and signage about the work area
   - carry out the maintenance activities using appropriate techniques and procedures
   - return the equipment in a safe and serviceable condition
   - dispose of waste items in a safe and environmentally acceptable manner

2. Carry out maintenance activities on three or more of the following types of pollution control equipment:
   - air pollution control equipment (such as decarbonisation (\(\text{CO}_2\) reduction), denitrification, deodorising desulphurisation, dust collectors, smoke filters, scrubbers, and removal of refrigerant gases)
   - effluent treatment equipment (such as aerobic and anaerobic biochemical treatment, filter screens and presses, liquid separators, waste oil treatment, sewage treatment, industrial waste water treatment)
   - noise and vibration equipment (such as vibration prevention and isolation, noise attenuation and acoustic enclosures)
   - waste and used product handling, storing and recycling equipment (such as appliance recycling, battery recycling, incinerators, ash handling, heat recovery, shredders and crushers, conveyors and sorters, compaction)
3 Carry out all of the following maintenance techniques as appropriate to the equipment being maintained:
   - checking components for serviceability
   - dismantling assemblies to component level
   - functionally testing the completed system
   - making ‘off-line’ checks before starting up
   - marking/labelling of components
   - replacing all ‘lifed’ items
   - replacing damaged/defective components
   - replenishing oils and greases
   - setting, aligning and adjusting replaced components
   - tightening fasteners to the required torque

4 Maintain a range of mechanical environmental control equipment to include 10 of the following:
   - actuators
   - bearings
   - belt drives
   - burners
   - chains and sprockets
   - containment booms
   - conveyor belts
   - couplings
   - dampers
   - enclosures and guards
   - exhaust systems
   - fasteners
   - filters (individual)
   - flow measurement
   - gauges
   - geared drives
   - levers and links
   - lubrication systems
   - mechanical isolators
   - mechanical overloads
   - noise attenuation
   - pipework
   - pollution samplers
   - pulleys and belts
   - pumps
   - safety devices
   - seals and gaskets
   - sorting screens
   - spill kits
   - storage tanks
   - test systems
   - valves
5 Maintain a range of electrical environmental control equipment to include 10 of the following:

- annunciator systems
- BMS interfaces
- combustion control
- contactors
- circuit boards
- control systems
- electrical infrastructure
- electrical isolators
- electrical trips
- flow measurement
- infra-red monitoring
- interlocks
- inverters
- level floats and indicators
- meters
- motor starters
- pollution samplers
- radar monitors
- relays
- resistors
- safety devices
- switchgear
- sensors solenoids
- switches
- test systems
- thermostics
- thermocouples
- thermostats
- timers
- transducers
- transformers
- IEE regulations
- The Factories Act
- Gas Safety Regulations
- The Noise at Work Regulations
- Electricity at Work Regulations
- HS(G)37 Local Exhaust Ventilation

6 Maintain environmental control equipment in compliance with the appropriate regulations or guidelines, which will include one or more of the following:

- equipment manufacturer’s guidelines
- HSE EH0 Occupational Exposure Limits
- ISO 14000 Environmental Management
- HSC Control of Legionella Bacteria in Water Systems
- organisational (company) guidelines and codes of practice
- The Workplace (Health, Safety and Welfare) Regulations
- PPG2 Environmental agency Pollution Prevention Guidelines

7 Complete all necessary verbal, written or computer communication requirements, to include:

- job cards
- electronic recording
- permits to work
- maintenance log reporting
- hazard and risk assessments
Knowledge statements:
You must have knowledge and understanding of:
1. The health and safety requirements of the area in which the maintenance activity is to take place
2. Safe working practices, isolation procedures and permit-to-work systems
3. The specific health and safety precautions to be applied during the maintenance procedure, and their effects on others
4. The specific regulations relating to the environmental control equipment being maintained
5. Hazards associated with carrying out general maintenance activities (including the use of lubricants, cleaning materials, power tools, the use and misuse of hand tools, and the consequences of not following laid-down, good practice, maintenance procedures), and how they can be minimised
6. The importance of using the correct personal and workplace-safety protection equipment
7. How to obtain and interpret drawings, specifications, manufacturers’ manuals and other documents needed in the maintenance process
8. The procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance activities
9. Company policy on the repair/replacement of components during the maintenance process
10. The sequence to be adopted for the dismantling/re-assembly of various types of assemblies
11. The methods and techniques used to dismantle/assemble mechanical equipment (release of pressures/force, proof marking, extraction, pressing, alignment)
12. Methods of checking that components are fit for purpose, and how to identify defects and wear characteristics
13. How to make adjustments to components/assemblies to ensure that they function correctly
14. The basic principles of how the equipment functions, its operation sequence, the working purpose of individual units/components and how they interact
15. Associated hazardous substances, their measurements and exposure limits
16. How to carry out biological monitoring
17. How to carry out hazard and risk assessment
18. The procedures for carrying out noise and vibration measurement
19. The prevention and reduction systems for noise and vibration
20. Methods of checking that removed components are fit for purpose, and the need to replace ‘lifed’ items (such as seals and gaskets)
21. The uses of measuring equipment (such as tapes, rules and other measuring devices)
22. How to make adjustments to components to ensure they function correctly
23. 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 their intended purpose
24. The generation of maintenance documentation and/or reports following the maintenance activity
25. The equipment operating and control procedures to be applied during the maintenance activity
26. How to use lifting and handling equipment correctly and safely in the maintenance activity
27. The problems associated with the maintenance activity, and how they can be overcome
28. The organisational procedure to be adopted for the safe disposal of waste of all types of materials
29. The extent of your own authority and whom you should report to if you have problems that you cannot resolve
### Unit 42
Maintaining environmental control equipment

<table>
<thead>
<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
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**Carry out all of the following during the maintenance activities:**

- plan the maintenance work so as to cause minimum disruption to normal working
- use the correct issue of company and equipment suppliers’ drawings and maintenance documentation
- adhere to hazard and risk assessment, COSHH and other relevant safety documents
- ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
- ensure the provision of adequate safety barriers and signage about the work area
- carry out the maintenance activities using appropriate techniques and procedures
- return the equipment in a safe and serviceable condition
- dispose of waste items in a safe and environmentally acceptable manner

**Carry out maintenance activities on three or more of the following types of pollution control equipment:**

- air pollution control equipment (such as decarbonisation (CO2 reduction), denitrification, deodorising desulphurisation, dust collectors, smoke filters, scrubbers, and removal of refrigerant gases)
- effluent treatment equipment (such as aerobic and anaerobic biochemical treatment, filter screens and presses, liquid separators, waste oil treatment, sewage treatment, industrial waste water treatment)
## Unit 42
Maintaining environmental control equipment

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<tr>
<td>noise and vibration equipment (such as vibration prevention and isolation, noise attenuation and acoustic enclosures)</td>
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<td>waste and used product handling, storing and recycling equipment (such as appliance recycling, battery recycling, incinerators, ash handling, heat recovery, shredders and crushers, conveyors and sorters, compaction)</td>
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**Carry out all of the following maintenance techniques as appropriate to the equipment being maintained:**

- checking components for serviceability
- dismantling assemblies to component level
- functionally testing the completed system
- making ‘off-line’ checks before starting up
- marking/labelling of components
- replacing all ‘lifed’ items
- replacing damaged/defective components
- replenishing oils and greases
- setting, aligning and adjusting replaced components
- tightening fasteners to the required torque
## Unit 42
### Maintaining environmental control equipment

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Unit 42
Maintaining environmental control equipment

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Unit 42
Maintaining environmental control equipment

Complete all necessary verbal, written or computer communication requirements, to include:
job cards
electronic recording
permits to work
maintenance log reporting
hazard and risk assessments

Knowledge and understanding reference:

Candidate: ___________________________ Date: ________________
Assessor: ___________________________ Date: ________________
Unit 43
Carrying out planned maintenance on services systems and equipment

Unit summary
This unit identifies the competencies you need to carry out planned maintenance activities on services systems and equipment, such as water distribution, waste water, environmental control, refrigeration, heating and ventilation, air conditioning and ventilation, gas distribution, compressed air, process control, and instrumentation and control. You will need to organise and carry out the maintenance activities to minimise down time, and to ensure that the maintained system performs at optimal level and functions to the required specification.

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, tools or equipment used that you cannot personally resolve, or 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 minimum 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 planned maintenance procedures on services systems and equipment. You will know how the system functions and the potential problems or defects that may occur. You will understand the process of developing planned maintenance, and its application, and will know about the maintenance criteria in adequate depth to provide a sound basis for carrying out the activities safely and effectively, and ensuring the system is maintained to the required specification. You will be expected to report where the outcome identifies the need for further investigation or maintenance work.

You will understand the safety precautions required when carrying out the maintenance activities, especially those for isolating the equipment. 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.
Unit 43
Carrying out planned maintenance on services systems and equipment

Performance statements:
You must:

a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Follow the relevant maintenance schedules to carry out the required work
c. Carry out the maintenance activities within the limits of your personal authority
d. Carry out the maintenance activities in the specified sequence and in an agreed time scale
e. Report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
f. Complete relevant maintenance records accurately and pass them on to the appropriate person
g. Dispose of waste materials in accordance with safe working practices and approved procedures

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:

1 Carry out all of the following during the maintenance activities:
   • plan the maintenance activities to cause minimum disruption to normal working
   • use the correct issue of company and/or manufacturers' drawings and maintenance documentation
   • adhere to risk assessment, COSHH and other relevant safety standards
   • ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
   • provide safe access and working arrangements for the maintenance area
   • carry out the maintenance activities using appropriate techniques and procedures
   • re-connect and return the system to service on completion of the maintenance activities
   • dispose of waste items in safe and environmentally acceptable manner, and leave the work area in a safe condition

2 Carry out planned maintenance activities on services systems and equipment, on two or more of the following, to sub-assembly/component level:
   • fresh water distribution
   • waste water
   • environmental control
   • process control
   • gas distribution
   • refrigeration
   • compressed air
   • emergency power generation
   • heating and ventilation
   • air conditioning and ventilation
   • instrumentation and control

3 Follow planned maintenance activities based on one of the following types of maintenance schedule:
   • condition based maintenance
   • scheduled maintenance
   • total preventative maintenance (TPM)
4  Carry out 10 of the following planned maintenance activities:
   • visual examination and testing of the system against the maintenance schedule
   • checking the operation of all gauges and sensors
   • monitoring component condition/deterioration
   • making sensory checks (such as sight, sound, smell, touch)
   • replacing 'lifed' consumables (such as filters, fluids)
   • carrying out system self-analysis checks
   • removing excessive dirt and grime
   • checking the condition of belts, bearings, seals, cables
   • making routine adjustments
   • carrying out checks on all connections
   • testing and reviewing the system operation
   • recording the results of the maintenance and reporting any defects found

5  Ensure the maintained equipment/system meets all of the following quality and accuracy standards:
   • organisational guidelines and codes of practice
   • equipment manufacturer’s operation range
   • IEE wiring regulations
   • BS and/or ISO standards

6  Complete all relevant paperwork from the following, and pass it to the appropriate people:
   • job cards
   • maintenance log or report
   • permit to work/formal risk assessment
Knowledge statements:
You must have a knowledge and understanding of:
1. The health and safety requirements of the area in which the maintenance 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 system being maintained
3. The specific health and safety precautions to be applied during the maintenance procedure, and their effects on others
4. How to recognise and deal with victims of electric shock (to include methods of safely removing the victim from the power source, isolating the power source, and methods of first aid resuscitation)
5. The importance of wearing protective clothing and other appropriate safety equipment during the maintenance activities, and where it may be obtained
6. Hazards associated with carrying out maintenance activities on service systems (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 they can be minimised
7. How to obtain and interpret drawings, charts, specifications, manufactures manuals, history/maintenance reports and other documents needed in the maintenance process
8. A basic understanding of the various planned maintenance schedules that are generally used (such as condition based maintenance, scheduled maintenance, and total preventative maintenance (TPM))
9. The basic principles of how the system functions, its operation sequence, the working purpose of individual units/components and how they interact
10. The equipment operating and control procedures, and how to apply them along with the planned maintenance procedures
11. The testing methods and procedures to be used to check that the system conforms within acceptable limits
12. How to make sensory checks (by sight, sound, smell, touch)
13. The procedure for obtaining consumables and ‘lifed’ items that will require replacing during the maintenance activity
14. Company policy on the repair/replacement of components during the maintenance process
15. Methods of checking components are fit for purpose, and the need to replace ‘lifed’ items (such as filters, seals, gaskets, belts, chains and bearings)
16. How to make adjustments to components and assemblies to ensure that they function correctly
17. The generation of maintenance documentation and/or reports following the maintenance activity
18. The problems that can occur during the planned maintenance activity, and how they can be overcome
19. The organisational procedure to be adopted for the safe disposal of waste of all types of materials
20. The extent of your own authority and whom you should report to if you have problems that you cannot resolve
## Unit 43
Carrying out planned maintenance on services systems and equipment

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**Carry out all of the following during the maintenance activities:**

- plan the maintenance activities to cause minimum disruption to normal working
- use the correct issue of company and/or manufacturers’ drawings and maintenance documentation
- adhere to risk assessment, COSHH and other relevant safety standards
- ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
- provide safe access and working arrangements for the maintenance area
- carry out the maintenance activities using appropriate techniques and procedures
- re-connect and return the system to service on completion of the maintenance activities
- dispose of waste items in safe and environmentally acceptable manner, and leave the work area in a safe condition

**Carry out planned maintenance activities on services systems and equipment, on two or more of the following, to sub-assembly/component level:**

- fresh water distribution
- waste water
- environmental control
- process control
- gas distribution
- refrigeration
- compressed air
- emergency power generation
- heating and ventilation
- air conditioning and ventilation
- instrumentation and control
**Unit 43**  
Carrying out planned maintenance on services systems and equipment

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**Follow planned maintenance activities based on one of the following types of maintenance schedule:**

- condition based maintenance
- scheduled maintenance
- total preventative maintenance (TPM)

**Carry out 10 of the following planned maintenance activities:**

- visual examination and testing of the system against the maintenance schedule
- checking the operation of all gauges and sensors
- monitoring component condition/deterioration
- making sensory checks (such as sight, sound, smell, touch)
- replacing ‘lifed’ consumables (such as filters, fluids)
- carrying out system self-analysis checks
- removing excessive dirt and grime
- checking the condition of belts, bearings, seals, cables
- making routine adjustments
- carrying out checks on all connections
- testing and reviewing the system operation
- recording the results of the maintenance and reporting any defects found

**Ensure the maintained equipment/system meets all of the following quality and accuracy standards:**

- organisational guidelines and codes of practice
- equipment manufacturer’s operation range
- IEE wiring regulations
- BS and/or ISO standards
Unit 43
Carrying out planned maintenance on services systems and equipment

<table>
<thead>
<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete all relevant paperwork from the following, and pass it to the appropriate people:</td>
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<td>job cards</td>
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<td>maintenance log or report</td>
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<tr>
<td>permit to work/formal risk assessment</td>
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<td>Knowledge and understanding reference:</td>
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Candidate: _____________________________________________ Date: ____________________
Assessor: _____________________________________________ Date: ____________________
Unit 44
Carrying out fault diagnosis on lifts

Unit summary
This unit identifies the competencies you need to carry out fault diagnosis on lifts, in accordance with approved procedures. You will be required to diagnose faults on a lift involving two or more of the following interactive technologies: mechanical, electrical, fluid power or electronics, both at assembly and sub-assembly/component level. You will be expected to use a variety of fault diagnosis methods and techniques, and to utilise a number of diagnostic aids and equipment. From the evidence gained you will be expected to identify the fault and its probable cause, and to suggest action to remedy the problem.

Your responsibilities will require you to comply with organisational policy and procedures for the fault diagnostic activities undertaken, and to report any problems with these activities, or the tools and equipment used that you cannot personally resolve, or are outside your permitted authority, to the relevant people. You will be expected to work with minimum 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 fault diagnosis procedures on lift equipment. You will understand the various fault diagnosis methods and techniques used, and their application. You will know how to apply and interpret information obtained from diagnostic aids and equipment, in adequate depth to provide a sound basis for carrying out the activities, identifying faults or conditions that are outside the acceptable specification. You will know about the interaction of the other associated integrated technologies, and will have adequate knowledge to carry out fault diagnosis of the lift installation effectively.

You will understand the safety precautions required when carrying out the fault diagnosis activities, especially those for isolating the equipment. 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.
Unit 44
Carrying out fault diagnosis on lifts

Performance statements:

You must:

a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Review and use all relevant information on the symptoms and problems associated with the products or assets
c. Investigate and establish the most likely causes of the faults
d. Select, use and apply diagnostic techniques, tools and aids to locate faults
e. Complete the fault diagnosis within the agreed time and inform the appropriate people when this cannot be achieved
f. Determine the implications of the fault for other work and for safety considerations
g. Use the evidence gained to draw valid conclusions about the nature and probable cause of the fault
h. Record details on the extent and location of the faults in an appropriate format

Scope of the unit:

The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:

1. Carry out all of the following during the fault diagnostic activities:
   - plan the fault diagnosis to cause minimum disruption to normal working
   - use the correct issue of company and/or manufacturers’ drawings and maintenance documentation
   - adhere to risk assessment, COSHH and other relevant safety standards
   - ensure the safe isolation of the equipment (such as mechanical, electricity, or fluids)
   - provide safe access and working arrangements for the maintenance area
   - carry out the fault diagnostic activities using approved techniques and procedures
   - identify the fault and determine appropriate corrective action
   - dispose of waste items in safe and environmentally acceptable manner, and leave the work area in a safe condition

2. Carry out fault diagnosis on three of the following types of lift equipment:
   - mechanical
   - fluid power
   - electrical
   - electronic

3. Collect evidence regarding the fault from four of the following sources:
   - the person who reported the fault
   - monitoring equipment
   - recording devices
   - sensory input (such as sight, sound, smell, touch)
   - lift equipment records/history
   • operation of the equipment
4 Use a range of fault diagnostic techniques to include:
   • half-split technique

   Plus one more from the following:
   • emergent problem sequence
   • six point technique
   • unit substitution
   • function testing
   • injection and sampling
   • input/output technique

5 Use a variety of diagnostic aids and equipment to include two of the following:
   • manufacturer's manual
   • algorithms
   • probability charts/reports
   • equipment self-diagnostics
   • circuit diagrams/specifications
   • logic diagrams
   • flow charts
   • fault analysis charts (such as fault trees)
   • troubleshooting guides

6 Use two of the following types of test equipment to help in the fault diagnosis:
   • mechanical measuring equipment (such as measuring instruments, dial test indicators, torque instruments)
   • electrical/electronic measuring instruments (such as multimeters, logic probes)
   • fluid power test equipment (such as test rigs, flow meters, pressure gauges)

7 Find faults that have resulted in two of the following breakdown categories:
   • intermittent problem
   • partial failure/out-of-specification operation
   • complete breakdowns

8 Provide a record of the outcome of the fault diagnosis using one of the following:
   • step-by-step analytical report
   • preventative maintenance log/report
   • corrective action report
   • company-specific reporting procedure
Knowledge statements:
You must have knowledge and understanding of:

1. The health and safety requirements of the area in which you are carrying out the fault diagnosis activities.
2. The specific safety precautions to be taken when carrying out the fault diagnosis of lift equipment.
3. The isolation and lock-off procedures or permit-to-work procedure that applies.
4. The importance of wearing protective clothing and other appropriate safety equipment during the fault diagnosis process; the type of equipment to be used, and where to obtain it.
5. Hazards associated with carrying out fault diagnosis on lifts (e.g., handling oils/greases, stored pressure/force, electrical contact, process controller interface, using faulty or damaged tools and equipment, using practices/procedures that do not follow laid-down procedures), and how they can be minimised.
6. How to recognise and deal with victims of electric shock (to include methods of safely removing the victim from the power source, isolating the power source, and methods of first aid resuscitation).
7. Where to obtain, and how to interpret, drawings, circuit diagrams, specifications, manufacturers’ manuals and other documents needed in the fault diagnosis activities.
8. 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).
9. How to evaluate the various types of information available for fault diagnosis (such as user reports, monitoring equipment, sensory inputs, machinery history records, and operation of the lift).
10. How to evaluate sensory information from sight, sound, smell, touch.
11. The procedures to be followed to investigate faults, and how to deal with intermittent conditions.
12. How to use the various aids and reports available for fault diagnosis.
13. The type 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 it is calibrated or configured correctly for the intended use and is free from damage and defects.
14. The application of specific fault finding methods and techniques best suited to the problem.
15. How to analyse and evaluate possible characteristics and causes of specific faults/problems.
16. How to relate previous reports/records of similar fault conditions.
17. How to evaluate the likely risk of running the equipment with the displayed fault, and the effects the fault could have on the overall operation.
18. How to prepare a report which complies with the company policy on fault diagnosis.
19. The extent of your own responsibility and whom you should report to if you have problems that you cannot resolve.
## Carrying out fault diagnosis on lifts

**Evidence Record Sheet**

<table>
<thead>
<tr>
<th>Evidence Type</th>
<th>Performance Evidence 1</th>
<th>Performance Evidence 2</th>
<th>Performance Evidence 3</th>
<th>Additional Performance Evidence (if required)</th>
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<td>Date</td>
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</table>

**Carry out all of the following during the fault diagnostic activities:**

- Plan the fault diagnosis to cause minimum disruption to normal working
- Use the correct issue of company and/or manufacturers’ drawings and maintenance documentation
- Adhere to risk assessment, COSHH and other relevant safety standards
- Ensure the safe isolation of the equipment (such as mechanical, electricity, or fluids)
- Provide safe access and working arrangements for the maintenance area
- Carry out the fault diagnostic activities using approved techniques and procedures
- Identify the fault and determine appropriate corrective action
- Dispose of waste items in safe and environmentally acceptable manner, and leave the work area in a safe condition

**Carry out fault diagnosis on three of the following types of lift equipment:**

- Mechanical
- Fluid power
- Electrical
- Electronic

**Collect evidence regarding the fault from four of the following sources:**

- The person who reported the fault
- Monitoring equipment
- Recording devices
- Sensory input (such as sight, sound, smell, touch)
- Lift equipment records/history
- Operation of the equipment
**Unit 44**  
Carrying out fault diagnosis on lifts

<table>
<thead>
<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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Use a range of fault diagnostic techniques to include:

- half-split technique
- Plus one more from the following:
  - emergent problem sequence
  - six point technique
  - unit substitution
  - function testing
  - injection and sampling
  - input/output technique

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

- manufacturer's manual
- algorithms
- probability charts/reports
- equipment self-diagnostics
- circuit diagrams/specifications
- logic diagrams
- flow charts
- fault analysis charts (such as fault trees)
- troubleshooting guides

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

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

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

- intermittent problem
- partial failure/out-of-specification operation
- complete breakdowns
# Unit 44
Carrying out fault diagnosis on lifts

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<thead>
<tr>
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<th>additional performance evidence (if required)</th>
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<tbody>
<tr>
<td><strong>Provide a record of the outcome of the fault diagnosis using one of the following:</strong></td>
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<tr>
<td>step-by-step analytical report</td>
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<tr>
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<td>corrective action report</td>
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<tr>
<td>company-specific reporting procedure</td>
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</tbody>
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Knowledge and understanding reference:

Candidate: _______________________________  Date: ________________

Assessor: _______________________________  Date: ________________
Unit 45
Inspecting and servicing lift equipment

Unit summary
This unit identifies the competencies you need to carry out routine inspection and servicing of lift installations, in accordance with approved procedures. You will be required to carry out routine inspection, adjustment, and lubrication of lift installations, including minor repair work, the routine replacement of components, and servicing of lift equipment for traction and hydraulic lifts. This servicing will be carried out to ensure that the lift performs at optimal level and functions to specification, and that down time is minimised.

Your responsibilities will require you to comply with organisational policy and procedures for the inspection and servicing activities undertaken, and to report any problems with the servicing activities, or the tools and equipment used that you cannot personally resolve, or are outside your permitted authority, to the relevant people. You must ensure that all tools, equipment, and materials used in the servicing 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 minimum 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 planned servicing procedures on lift equipment. You will understand the process of developing planned servicing, and its application, and will know about the servicing criteria, in adequate depth to provide a sound basis for carrying out the activities to the required specification. You will also be expected to report where the outcome of the servicing identifies the need for further investigation or maintenance work.

You will understand the safety precautions required when carrying out the inspection and servicing activities, especially those for isolating the equipment. 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.
Unit 45
Inspecting and servicing lift equipment

Performance statements:
You must:
a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Follow the relevant servicing schedules to carry out the required work
c. Carry out the servicing activities within the limits of your personal authority
d. Carry out the servicing activities in the specified sequence and in an agreed time scale
e. Report any instances where the servicing activities cannot be fully met or where there are identified defects outside the planned schedule
f. Complete relevant servicing records accurately and pass them on to the appropriate person

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:
1. Carry out all of the following during the planned servicing activities:
   • plan the inspection and servicing activities to cause minimum disruption to normal working
   • use the correct issue of company and/or manufacturers’ drawings and servicing documentation
   • adhere to risk assessment, COSHH and other relevant safety standards
   • ensure the safe isolation of equipment (such as mechanical, electricity or fluids)
   • provide safe access and working arrangements for the servicing area
   • follow the approved maintenance schedule for inspecting and servicing the lift equipment
   • carry out the inspection and servicing activities using appropriate techniques and procedures
   • reinstate and return the lift to service on completion of the activities
   • ensure that any potential future defects are identified and reported for future action
   • dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition

2. Carry out planned servicing activities on five of the following:
   • gearboxes
   • motors
   • lift car
   • lift well equipment
   • counterweight
   • buffers
   • hydraulic equipment
   • lighting
   • safety and emergency facilities
   • mechanical structures
   • customer-specific equipment

3. Follow planned servicing activities, using one of the following types of servicing schedules:
   • condition based servicing
   • scheduled servicing
   • calendar based servicing
   • total preventative maintenance (TPM)
4 Carry out all of the following planned servicing activities:
   • visual examination and use of test equipment against the servicing schedule
   • checking operation of the lift (such as quality of ride, landing doors/gates, levelling)
   • monitoring component condition/deterioration (eg traction sheave)
   • making other sensory checks (such as sound, touch, smell)
   • removing excessive dirt and grime
   • checking condition of belts, bearings, oil seals, guards, brushes, commutator, brakes, electrical equipment, ropes/chains, pulleys, locks, anti-creep
   • check clearances and alignment of running/sliding components
   • replenish/replace consumables (eg fluids, filters, grease, belts, lights, gaskets and seals, etc)
   • making routine adjustments
   • carry out leak checks on all connections
   • test and review lift operation, including safety and alarm systems
   • record the results of the servicing and report any defects found

5 Carry out inspections and servicing which complies with all the following:
   • contractual drawing
   • British and/or European standards
   • equipment manufacturer’s operating range
   • customer standards
   • company procedures and schedules
   • legal requirements

6 Ensure the maintained equipment meets all of the following quality and accuracy standards:
   • all components and subassemblies are fit for purpose
   • all connections are mechanically and electrically safe and sound
   • equipment operates within acceptable limits for safe operation and meets specification

7 Complete one of the following and pass it to the appropriate people:
   • job cards
   • servicing log or report
   • permit to work/formal risk assessment
Unit 45
Inspecting and servicing lift equipment

Knowledge statements:
You must have knowledge and understanding of:
1. The health and safety requirements of the area in which the inspection and servicing activity is to take place
2. The isolation procedures or permit-to-work procedure that applies to the equipment being serviced
3. The specific health and safety precautions to be applied during the planned servicing procedure, and their effects on others
4. The importance of wearing protective clothing and other appropriate safety equipment during the servicing process
5. Hazards associated with carrying out planned servicing activities on lifts and lift equipment (handling oils/greases, stored pressure/force, misuse of tools, working at height, moving parts of machinery), and how they can be minimised
6. How to recognise and deal with victims of electric shock (to include methods of safely removing the victim from the power source, isolating the power source, and methods of first aid resuscitation)
7. Where to obtain, and how to interpret, drawings, specifications, manufacturers’ manuals, servicing schedules and other relevant documents for the servicing activity
8. The various planned servicing schedules that are generally used (such as condition based servicing, scheduled servicing, calendar based servicing, and total preventative maintenance (TPM))
9. The procedure for obtaining consumables to be used during planned servicing activity
10. The appropriate test procedures to be adopted during servicing
11. The appropriate inspection techniques and procedures to be adopted during servicing
12. How to identify excessive wear and damage of components
13. How to make adjustments to components/assemblies to ensure they function to specification
14. The principles and functions of all lift components
15. How to complete servicing records/logs/reports in compliance with company policy and procedures
16. The problems associated with carrying out planned servicing, and how to resolve them
17. The correct and safe procedure to be adopted for the disposal of waste of all types of materials
18. The extent of your own responsibility and whom you should report to if you have problems that you cannot resolve
Unit 45  
Inspecting and servicing lift equipment

<table>
<thead>
<tr>
<th>evidence record sheet</th>
<th>evidence type</th>
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<table>
<thead>
<tr>
<th>Carry out all of the following during the planned servicing activities:</th>
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<tbody>
<tr>
<td>plan the inspection and servicing activities to cause minimum disruption to normal working</td>
</tr>
<tr>
<td>use the correct issue of company and/or manufacturers’ drawings and servicing documentation</td>
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<tr>
<td>adhere to risk assessment, COSHH and other relevant safety standards</td>
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<tr>
<td>ensure the safe isolation of equipment (such as mechanical, electricity or fluids)</td>
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<tr>
<td>provide safe access and working arrangements for the servicing area</td>
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<tr>
<td>follow the approved maintenance schedule for inspecting and servicing the lift equipment</td>
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<tr>
<td>carry out the inspection and servicing activities using appropriate techniques and procedures</td>
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<tr>
<td>reinstate and return the lift to service on completion of the activities</td>
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<td>ensure that any potential future defects are identified and reported for future action</td>
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<tr>
<td>dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition</td>
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</table>
## Unit 45
Inspecting and servicing lift equipment

<table>
<thead>
<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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<tbody>
<tr>
<td><strong>Carry out planned servicing activities on five of the following:</strong></td>
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<td>gearboxes</td>
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<td>motors</td>
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<td>lift car</td>
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<td>counterweight</td>
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<td>mechanical structures</td>
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<td>customer-specific equipment</td>
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<td>Follow planned servicing activities, using one of the following types of servicing schedules:</td>
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<tr>
<td>condition based servicing</td>
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<td>scheduled servicing</td>
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<td>calendar based servicing</td>
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<tr>
<td>total preventative maintenance (TPM)</td>
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<tr>
<td><strong>Carry out all of the following planned servicing activities:</strong></td>
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<tr>
<td>visual examination and use of test equipment against the servicing schedule</td>
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<tr>
<td>checking operation of the lift (such as quality of ride, landing doors/gates, levelling)</td>
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<tr>
<td>monitoring component condition/deterioration (e.g. traction sheave)</td>
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<td>making other sensory checks (such as sound, touch, smell)</td>
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<tr>
<td>removing excessive dirt and grime</td>
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<tr>
<td>checking condition of belts, bearings, oil seals, guards, brushes, commutator, brakes, electrical equipment, ropes/chains, pulleys, locks, anti-creep</td>
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<tr>
<td>check clearances and alignment of running/sliding components</td>
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Unit 45
Inspecting and servicing lift equipment

<table>
<thead>
<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
</tr>
</thead>
<tbody>
<tr>
<td>replenish/replace consumables (eg fluids, filters, grease, belts, lights, gaskets and seals, etc)</td>
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<tr>
<td>making routine adjustments</td>
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<tr>
<td>carry out leak checks on all connections</td>
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<tr>
<td>test and review lift operation, including safety and alarm systems</td>
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<tr>
<td>record the results of the servicing and report any defects found</td>
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**Carry out inspections and servicing which complies with all the following:**

- contractual drawing
- British and/or European standards
- equipment manufacturer's operating range
- customer standards
- company procedures and schedules
- legal requirements

**Ensure the maintained equipment meets all of the following quality and accuracy standards:**

- all components and subassemblies are fit for purpose
- all connections are mechanically and electrically safe and sound
- equipment operates within acceptable limits for safe operation and meets specification

**Complete one of the following and pass it to the appropriate people:**

- job cards
- servicing log or report
- permit to work/formal risk assessment

Knowledge and understanding reference:

Candidate: _______________________________________________  Date: ___________________

Assessor: ________________________________________________   Date: ___________________
Unit 46
Checking lift function

Unit summary
This unit identifies the competencies you need to carry out checks and adjustments to the operation of a lift installation whilst undertaking maintenance, in accordance with approved procedures. You will be required to select the appropriate tools and equipment to use, based upon the operations to be performed. The equipment to be checked and adjusted includes both traction and hydraulic lifts.

Your responsibilities will require you to comply with organisational policy and procedures for the checking and adjusting activities undertaken, and to report any problems with the checking and adjusting activities that you cannot personally resolve, or are outside your permitted authority, to the relevant people. You must ensure that all tools, equipment, and materials used in the checking and adjusting 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 minimum 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 checking and adjusting procedures on lift equipment. You will understand the lift equipment being checked and adjusted, and its application, and will know about the use of appropriate equipment and information, in adequate depth to provide a sound basis for carrying out the activities, correcting faults, and ensuring the lift operates to the required specification. You will also be expected to report where the outcome of the checks identifies the need for further investigation or maintenance work.

You will understand the safety precautions required when carrying out the checking activities, especially those for isolating the equipment. 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.
Unit 46
Checking lift function

Performance statements:
You must:
a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Follow the appropriate operating specifications for the equipment being maintained
c. Carry out adjustments within the limits of your personal authority
d. Make the required adjustments in the specified sequence and in an agreed time scale
e. Confirm that the adjusted equipment meets the required operating specification
f. Report any instances where the equipment fails to meet the required performance after adjustments or where there are identified defects outside the required adjustments
g. Maintain documentation in accordance with organisational requirements

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:
1. Carry out all the following activities during the checking and adjusting activity:
   • use the correct issue of drawings and specifications
   • adhere to risk assessments, COSHH and other relevant safety standards
   • ensure the lift area is clear of maintenance equipment, tools, debris and surplus materials
   • provide safe access and working arrangements for the area
   • follow the approved maintenance schedule for checking the lift function
   • carry out all checks to the appropriate standard at the relevant speed
   • confirm that the lift is operating to specification
   • leave the work area in a safe condition on completion of the activities

2. Carry out the checking and adjustment on all the following:
   • gearbox or hydraulic oil levels
   • lubrication points are oiled/greased to specification
   • safety circuits operate correctly
   • ropes and terminations
   • rope and chain tensioning
   • trailing cables (e.g., looped correctly)
   • counterweight (traction lifts only)
   • lift machine/hydraulic pump unit
   • ancillary equipment
   • door operators• overruns
   • door closing protection devices
   • alarm systems
   • safety mechanisms
   • controller
   • lift car travel
   • sequence and quality of lift ride
3 Make adjustments to all the following:
- tensions (such as ropes, belts, chains)
- switches (such as reed, micro, photo)
- clearances
- alignment
- speed of operation

4 Carry out checking and adjustment which complies with all the following:
- contractual drawing
- British and/or European standards
- equipment manufacturer's operating range
- customer standards
- company procedures and schedules
- legal requirements

5 Complete one of the following and pass it to the appropriate people:
- job cards
- servicing log or report
- permit to work/formal risk assessment
Knowledge statements:
You must have knowledge and understanding of:

1. The specific safety precautions to be taken when checking and adjusting the lift installation during maintenance, including any specific legislation, regulations or code of practice relating to the activity, equipment or materials used, and the responsibility these place on you.

2. The health and safety requirements of the work area in which you are carrying out the checking and adjustment.

3. Hazards associated with carrying out checks and adjustments on lifts and lift equipment (handling oils/greases, stored pressure/force, misuse of tools), and how they can be minimised.

4. The company procedure for safe systems of work, risk assessment and use of a permit to work.

5. The personal protective equipment you need to wear during the checking activities.


7. How to recognise and deal with victims of electric shock (to include methods of safely removing the victim from the power source, isolating the power source, and methods of first aid resuscitation).

8. How to obtain the required checking documentation and specifications for the lift being checked, and how to check their currency and validity.

9. How to read and interpret the specifications.

10. The principles of operation of the equipment being checked and set.

11. The tools and equipment to be used during the checking and adjusting activities.


14. What checks need to be made on tools and equipment that are used to ensure they are fit for service.

15. How you would know if the tools or equipment are covered by calibration or legislative inspections.

16. Tool control during the checking and adjusting of equipment.

17. What documentation needs to be completed for the activities undertaken.

18. The extent of your own responsibility and whom you should report to if you have problems that you cannot resolve.
Unit 46
Checking lift function

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<th>evidence record sheet</th>
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<th>performance evidence 2</th>
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**Carry out all the following activities during the checking and adjusting activity:**

- use the correct issue of drawings and specifications
- adhere to risk assessments, COSHH and other relevant safety standards
- ensure the lift area is clear of maintenance equipment, tools, debris and surplus materials
- provide safe access and working arrangements for the area
- follow the approved maintenance schedule for checking the lift function
- carry out all checks to the appropriate standard at the relevant speed
- confirm that the lift is operating to specification
- leave the work area in a safe condition on completion of the activities

**Carry out the checking and adjustment on all the following:**

- gearbox or hydraulic oil levels
- lubrication points are oiled/greased to specification
- safety circuits operate correctly
- ropes and terminations
- rope and chain tensioning
- trailing cables (eg, looped correctly)
- counterweight (traction lifts only)
- lift machine/hydraulic pump unit
- ancillary equipment
- door operators
- overruns
- door closing protection devices
## Unit 46
Checking lift function

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<td>lift car travel</td>
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<tr>
<td>sequence and quality of lift ride</td>
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### Make adjustments to all the following:
- tensions (such as ropes, belts, chains)
- switches (such as reed, micro, photo)
- clearances
- alignment
- speed of operation

### Carry out checking and adjustment which complies with all the following:
- contractual drawing
- British and/or European standards
- equipment manufacturer’s operating range
- customer standards
- company procedures and schedules
- legal requirements

### Complete one of the following and pass it to the appropriate people:
- job cards
- servicing log or report
- permit to work/formal risk assessment

Knowledge and understanding reference:

Candidate: ______________________ Date: ________________
Assessor: ______________________ Date: ________________
Unit 47
Rectifying faults in lifts

Unit summary
This unit identifies the competencies you need to rectify faults on traction and hydraulic lifts, in accordance with approved procedures. This will involve rectifying faults in cases of breakdowns, and will include faults in landing doors, lift doors, safety equipment, machine equipment, controller equipment, hydraulic equipment and ancillary equipment. Components to be replaced will include motors, pumps, switches, sensors, control boards, valves, brakes and 'lifed' items, such as bulbs, grease and oil. You will also be expected to check the repaired lift and to confirm its correct function. You will be required to select the appropriate tools and equipment to use, based upon the operations to be performed, the equipment, and the faults to be rectified.

Your responsibilities will require you to comply with organisational policy and procedures for the fault rectification activities undertaken, and to report any problems with the repair activities, tools or equipment used that you cannot personally resolve, or are outside your permitted authority, to the relevant people. You must ensure that all tools, equipment, and materials used in the fault rectifying 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 minimum 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 and rectification procedures on lift equipment. You will understand the operation of the lift equipment, and its application, and will know about the repair and rectification procedures, in adequate depth to provide a sound basis for carrying out the activities, correcting faults and ensuring the repaired lift operates safely and correctly to the required specification.

You will understand the safety precautions required when carrying out the repair activities, especially those for isolating the equipment. 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.
Unit 47
Rectifying faults in lifts

Performance statements:
You must:

a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Follow the relevant maintenance schedules to carry out the required work
c. Carry out the maintenance activities within the limits of your personal authority
d. Carry out the maintenance activities in the specified sequence and in an agreed time scale
e. Report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
f. Complete relevant maintenance records accurately and pass them on to the appropriate person
g. Dispose of waste materials in accordance with safe working practices and approved procedures

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:
1. Carry out all of the following during the fault rectifying activity:
   • verify that the fault exists
   • plan the activities to cause minimum disruption to normal working
   • use the correct issue of company and/or manufacturers' drawings and documentation
   • adhere to risk assessment, COSHH and other relevant safety standards
   • ensure the safe isolation of equipment (such as mechanical, electricity, fluids)
   • provide safe access and working arrangements for the area
   • follow the approved maintenance schedule for rectifying faults in lifts
   • carry out the activities using appropriate techniques and procedures
   • return the lift to service on completion of the repair activities
   • ensure that any potential defects are identified and reported for future action
   • dispose of waste items in safe and environmentally acceptable manner, and leave the work area in a safe condition

2. Rectify faults in all of the following lift equipment:
   • landing doors
   • lift doors
   • safety equipment
   • machine equipment
   • controller equipment
   • hydraulic equipment
   • ancillary equipment

3. Repair and/or replace all of the following lift equipment components:
   • motors
   • pumps
   • switches
   • sensors
   • lights
   • control boards
   • valves
   • brakes
4 Make adjustments to all of the following:
   • tensions (such as ropes, belts, chains)
   • switches (such as reed, micro, photo)
   • clearances
   • alignment
   • speed of operation

5 Ensure the maintained equipment meets all of the following quality and accuracy standards:
   • contractual drawing
   • British and/or European standards
   • equipment manufacturer’s operating range
   • customer standards
   • company procedures and schedules
   • legal requirements

6 Complete one of the following and pass it to the appropriate people:
   • job cards
   • servicing log or report
   • permit to work/formal risk assessment
Unit 47
Rectifying faults in lifts

Knowledge statements:
You must have knowledge and understanding of:
1. The health and safety requirements of the area in which you are carrying out the fault rectification activities
2. The specific safety precautions to be taken when carrying out the fault rectification of lift equipment
3. The isolation and lock-off procedures or permit-to-work procedure that applies
4. The importance of wearing protective clothing and other appropriate safety equipment during the fault rectification process; the type of equipment to be used, and where to obtain it
5. Hazards associated with carrying out fault rectification work on lifts (e.g., handling oils/greases, stored pressure/force, electrical contact, process controller interface, using faulty or damaged tools and equipment, using practices/procedures that do not follow laid-down procedures), and how they can be minimised
6. How to recognise and deal with victims of electric shock (to include methods of safely removing the victim from the power source, isolating the power source, and methods of first aid resuscitation)
7. The correct procedures for the emergency release of passengers
8. Where to obtain, and how to interpret, drawings, circuit diagrams, specifications, manufacturers’ manuals and other documents needed in the fault rectification process
9. The principles of operation of the equipment being repaired
10. The procedures for replacing or adjusting faulty equipment
11. How to evaluate the various types of information available for fault diagnosis (such as user reports, monitoring equipment, sensory inputs, machinery history records, and operation of the lift)
12. How to evaluate sensory information (sight, sound, smell, touch)
13. The types of tools and equipment that can be used in fault rectification (such as mechanical measuring instruments, electrical measuring instruments)
14. How to check that tools and equipment (such as mechanical measuring instruments, electrical measuring instruments) are calibrated or configured correctly for the intended use, and that they are free from damage and defects
15. The correct and safe procedure to be adopted for the disposal of waste of all types of materials
16. How to relate previous reports/records of similar fault conditions
17. How to prepare a report which complies with the company policy on fault rectification
18. The extent of your own responsibility and whom you should report to if you have problems that you cannot resolve
# Unit 47
Rectifying faults in lifts

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**Carry out all of the following during the fault rectifying activity:**

- verify that the fault exists
- plan the activities to cause minimum disruption to normal working
- use the correct issue of company and/or manufacturers' drawings and documentation
- adhere to risk assessment, COSHH and other relevant safety standards
- ensure the safe isolation of equipment (such as mechanical, electricity, fluids)
- provide safe access and working arrangements for the area
- follow the approved maintenance schedule for rectifying faults in lifts
- carry out the activities using appropriate techniques and procedures
- return the lift to service on completion of the repair activities
- ensure that any potential defects are identified and reported for future action
- dispose of waste items in safe and environmentally acceptable manner, and leave the work area in a safe condition

**Rectify faults in all of the following lift equipment:**

- landing doors
- lift doors
- safety equipment
- machine equipment
- controller equipment
- hydraulic equipment
- ancillary equipment
### Unit 47
Rectifying faults in lifts

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<td>Repair and/or replace all of the following lift equipment components:</td>
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<td>Make adjustments to all of the following:</td>
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<td>speed of operation</td>
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<td>Ensure the maintained equipment meets all of the following quality and accuracy standards:</td>
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<td>company procedures and schedules</td>
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<td>legal requirements</td>
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<td>Complete one of the following and pass it to the appropriate people:</td>
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<td>servicing log or report</td>
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<td>permit to work/formal risk assessment</td>
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Knowledge and understanding reference:

Candidate: ___________________________ Date: ____________

Assessor: ___________________________ Date: ____________
Unit 48
Repairing/replacing lift doors, chains and ropes

Unit summary
This unit identifies the competencies you need to remove and replace lift chains and ropes, and to remove, repair and refit or fit and adjust new replacement lift car and/or landing doors, in accordance with approved procedures. It includes both manual and power operated solid sliding doors, collapsible gates, shutter gates and bi-parting doors, on existing installations.

Your responsibilities will require you to comply with organisational policy and procedures for the maintenance activities undertaken, and to report any problems with the activities, or with the tools and equipment that are used that you cannot personally resolve, or are outside your permitted authority, to the relevant people. You must ensure that all tools, equipment, and materials used in the servicing 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 minimum 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 lift door, chains and rope repair/replacement procedures. You will understand the operation of the chains, ropes and doors, and their application, and will know about the door, chain and rope mechanisms, in adequate depth to provide a sound basis for carrying out the activities, correcting faults, and ensuring the repaired lifts operate safely and correctly, to the required specification. You will also be expected to report where the outcome of the replacement work identifies the need for further investigation or maintenance work.

You will understand the safety precautions required when carrying out the inspection and servicing activities, especially those for isolating the equipment. 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.
Unit 48
Repairing/replacing lift doors, chains and ropes

Performance statements:
You must:

a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Follow the relevant specifications for the component to be repaired
c. Prepare the component for repair
d. Carry out the repairs within agreed timescale using approved materials, components, methods and procedures
e. Ensure that the repaired component meets the specified operating conditions
f. Produce accurate and complete records of all repair work carried out

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:
1. Carry out all of the following during the repair/replacement activity:
   • verify the extent of the damage
   • plan the activities to cause minimum disruption to normal working
   • use permit-to-work procedures
   • use the correct issue of company and/or manufacturers’ drawings and documentation
   • adhere to risk assessment, COSHH and other relevant safety standards
   • ensure the safe isolation of equipment (such as mechanical, electricity, fluids)
   • follow the approved maintenance schedule for repairing/replacing lift doors, ropes and chains
   • provide safe access and working arrangements for the area
   • carry out the activities using appropriate techniques and procedures
   • return the lift to service on completion of the activities
   • ensure any potential defects are identified and reported for future action
   • dispose of waste items in safe and environmentally acceptable manner, and leave the work area in a safe condition

2. Repair and or replace all of the following:
   • powered operated doors
   • manual doors
   • collapsible gates
   • lift chains
   • bi-parting doors
   • lift ropes
   • shutter gates

3. Carry out all of the following activities:
   • remove doors
   • replace rollers
   • replace hangers
   • replace spigots
   • replace shoes
   • refit/replace doors
   • refit/replace safety devices
   • remove/replace lift ropes
   • remove/replace lift chains
4 Carry out all of the following checks and adjustments to the equipment:
   • check and adjust clearances
   • align rollers
   • align couplers and skates
   • check tension of ropes
   • ensure doors move freely
   • check doors function in accordance with specifications
   • check chain lengths

5 Ensure the maintained equipment meets all of the following quality and accuracy standards:
   • contractual drawing
   • British and/or European standards
   • equipment manufacturer’s operating range
   • customer standards
   • company procedures and schedules
   • legal requirements

6 Complete one of the following and pass it to the appropriate people:
   • job cards
   • servicing log or report
   • permit to work/formal risk assessment
Unit 48
Repairing/replacing lift doors, chains and ropes

Knowledge statements:
You must have knowledge and understanding of:
1. The specific safety precautions to be taken when working with lift doors, chains and ropes, including any specific legislation, regulations or code of practice relating to the activity, equipment or materials used, and the responsibility they place on you
2. The health and safety requirements of the work area in which you are carrying out the repair/replacement activities
3. The company procedure for safe systems of work and risk assessment
4. The isolation and lock-off procedures or permit-to-work procedure that applies
5. The personal protective equipment you need to wear during the repair/replacement activities
6. Safe methods of manual handling, and the safe use of mechanical lifting devices
7. Hazards associated with carrying out repair/replacement activities to lift doors, chains and ropes (eg, handling fluids, stored pressure(force), electrical contact, process controller interface, using faulty or damaged tools and equipment, using practices/procedures that do not follow laid-down procedures, working at height), and how they can be minimised
8. How to recognise and deal with victims of electric shock (to include methods of safely removing the victim from the power source, isolating the power source, and methods of first aid resuscitation)
9. Where to obtain, and how to interpret, drawings, circuit diagrams, specifications, manufacturers’ manuals and other documents needed in the repair/replacement activities
10. The principles of operation of the equipment being repair/replaced
11. The preparation of materials for fitting
12. The tools and equipment to be used during the repair/replacement activities
13. Appropriate method of alignment, using plumb lines and gauges/pointers
14. Methods of adjustments, settings and checks
15. What checks need to be made on tools and equipment that are used, to ensure they are fit for service
16. How you would know if the tools or equipment are covered by calibration or legislative inspections
17. Tool control during the repair/replacement activities
18. The care required when working with decorative finishes and surfaces
19. What documentation needs to be completed for the activities undertaken
20. The extent of your own responsibility and whom you should report to if you have problems that you cannot resolve
# Unit 48
Repairing/replacing lift doors, chains and ropes

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**Carry out all of the following during the repair/replacement activity:**

- verify the extent of the damage
- plan the activities to cause minimum disruption to normal working
- use permit-to-work procedures
- use the correct issue of company and/or manufacturers’ drawings and documentation
- adhere to risk assessment, COSHH and other relevant safety standards
- ensure the safe isolation of equipment (such as mechanical, electricity, fluids)
- follow the approved maintenance schedule for repairing/replacing lift doors, ropes and chains
- provide safe access and working arrangements for the area
- carry out the activities using appropriate techniques and procedures
- return the lift to service on completion of the activities
- ensure any potential defects are identified and reported for future action
- dispose of waste items in safe and environmentally acceptable manner, and leave the work area in a safe condition
Unit 48
Repairing/replacing lift doors, chains and ropes

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<td>collapsible gates</td>
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<tr>
<td>lift chains</td>
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<tr>
<td>bi-parting doors</td>
<td></td>
<td></td>
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<tr>
<td>lift ropes</td>
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<tr>
<td>shutter gates</td>
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<tr>
<td><strong>Carry out all of the following activities:</strong></td>
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<tr>
<td>remove doors</td>
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<tr>
<td>replace rollers</td>
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<tr>
<td>replace hangers</td>
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<tr>
<td>replace spigots</td>
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<tr>
<td>replace shoes</td>
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<tr>
<td>refit/replace doors</td>
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<tr>
<td>refit/replace safety devices</td>
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<tr>
<td>remove/replace lift ropes</td>
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<tr>
<td>remove/replace lift chains</td>
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<tr>
<td><strong>Carry out all of the following checks and adjustments to the equipment:</strong></td>
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<tr>
<td>check and adjust clearances</td>
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<td></td>
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<tr>
<td>align rollers</td>
<td></td>
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<tr>
<td>align couplers and skates</td>
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<tr>
<td>check tension of ropes</td>
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<tr>
<td>ensure doors move freely</td>
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<tr>
<td>check doors function in accordance with specifications</td>
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<tr>
<td>check chain lengths</td>
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<td><strong>Ensure the maintained equipment meets all of the following quality and accuracy standards:</strong></td>
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<tr>
<td>contractual drawing</td>
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<tr>
<td>British and/or European standards</td>
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<tr>
<td>equipment manufacturer’s operating range</td>
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<td>customer standards</td>
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<tr>
<td>company procedures and schedules</td>
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<tr>
<td>legal requirements</td>
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</tbody>
</table>
## Unit 48
Repairing/replacing lift doors, chains and ropes

<table>
<thead>
<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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</thead>
</table>

**Complete one of the following and pass it to the appropriate people:**

- job cards
- servicing log or report
- permit to work/formal risk assessment

**Knowledge and understanding reference:**

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Candidate: ___________________________  Date: ________________________

Assessor: ___________________________  Date: ________________________
Unit 49
Carrying out fault diagnosis on escalators

Unit summary
This unit identifies the competencies you need to carry out fault diagnosis on escalators, in accordance with approved procedures. You will be required to diagnose faults on an escalator involving two or more of the following interactive technologies: mechanical, electrical, or electronics, both at assembly and sub-assembly/component level. You will be expected to use a variety of fault diagnosis methods and techniques, and to utilise a number of diagnostic aids and equipment. From the evidence gained, you will be expected to identify the fault and its probable cause, and to suggest action to remedy the problem. The equipment to be diagnosed could be either an escalator or passenger conveyor equipment.

Your responsibilities will require you to comply with organisational policy and procedures for the fault diagnostic activities undertaken, and to report any problems with these activities, or the tools and equipment used that you cannot personally resolve, or are outside your permitted authority, to the relevant people. You will be expected to work with minimum 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 fault diagnosis procedures on escalators. You will understand the various fault diagnosis methods and techniques used, and their application. You will know how to apply and interpret information obtained from diagnostic aids and equipment, in adequate depth to provide a sound basis for carrying out the activities, and identifying faults or conditions that are outside the acceptable specification. You will know about the interaction of the other associated integrated technologies, and will have adequate knowledge to carry out fault diagnosis of the escalator installation effectively.

You will understand the safety precautions required when carrying out the fault diagnosis activities, especially those for isolating the equipment. 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.
Unit 49
Carrying out fault diagnosis on escalators

Performance statements:
You must:
a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Review and use all relevant information on the symptoms and problems associated with the products or assets
c. Investigate and establish the most likely causes of the faults
d. Select, use and apply diagnostic techniques, tools and aids to locate faults
e. Complete the fault diagnosis within the agreed time and inform the appropriate people when this cannot be achieved
f. Determine the implications of the fault for other work and for safety considerations
g. Use the evidence gained to draw valid conclusions about the nature and probable cause of the fault
h. Record details on the extent and location of the faults in an appropriate format

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:
1. Carry out all of the following during the fault diagnostic activities:
   - plan the fault diagnosis to cause minimum disruption to normal working
   - use the correct issue of company and/or manufacturers’ drawings and maintenance documentation
   - adhere to risk assessment, COSHH and other relevant safety standards
   - ensure the safe isolation of equipment (such as mechanical or electricity)
   - provide safe access and working arrangements for the maintenance area
   - carry out the fault diagnostic activities using approved techniques and procedures
   - identify the fault and determine appropriate corrective action
   - dispose of waste items in safe and environmentally acceptable manner, and leave the work area in a safe condition

2. Carry out fault diagnosis on two of the following types of escalator equipment:
   - mechanical
   - electrical
   - electronic

3. Collect evidence regarding the fault from four of the following sources:
   - the person who reported the fault
   - monitoring equipment
   - recording devices
   - sensory input (such as sight, sound, smell, touch)
   - escalator equipment records/history ∙ operation of the equipment
4 Use a range of fault diagnostic techniques to include:
   • half-split technique

   Plus one more from the following:
   • emergent problem sequence
   • six point technique
   • unit substitution
   • function testing
   • injection and sampling
   • input/output technique

5 Use a variety of diagnostic aids and equipment to include two of the following:
   • manufacturer's manual
   • algorithms
   • probability charts/reports
   • equipment self-diagnostics
   • circuit diagrams/specifications
   • logic diagrams
   • flow charts
   • fault analysis charts (fault trees)
   • troubleshooting guides

6 Use all of the following types of test equipment to help in the fault diagnosis:
   • mechanical measuring equipment (such as measuring instruments, dial test indicators, torque instruments)
   • electrical/electronic measuring instruments (such as multimeters, logic probes)

7 Find faults that have resulted in two of the following breakdown categories:
   • intermittent problem
   • partial failure/out-of-specification operation
   • complete breakdowns

8 Provide a record of the outcome of the fault diagnosis using one of the following:
   • step-by-step analytical report
   • preventative maintenance log/report
   • corrective action report
   • company-specific reporting procedure
Unit 49
Carrying out fault diagnosis on escalators

Knowledge statements:
You must have knowledge and understanding of:
1. The health and safety requirements of the area in which you are carrying out the fault diagnosis activities
2. The specific safety precautions to be taken when carrying out the fault diagnosis of escalator equipment
3. The isolation and lock-off procedures or permit-to-work procedure that applies
4. The importance of wearing protective clothing and other appropriate safety equipment during the fault diagnosis process; the type of equipment to be used, and where to obtain it
5. Hazards associated with carrying out fault diagnosis on escalators (e.g., handling oils/greases, electrical contact, process controller interface, using faulty or damaged tools and equipment, using practices/procedures that do not follow laid-down procedures), and how they can be minimised
6. How to recognise and deal with victims of electric shock (to include methods of safely removing the victim from the power source, isolating the power source, and methods of first aid resuscitation)
7. Where to obtain, and how to interpret, drawings, circuit diagrams, specifications, manufacturers’ manuals and other documents needed in the fault diagnosis process
8. 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)
9. How to evaluate the various types of information available for fault diagnosis (such as user reports, monitoring equipment, sensory input, machinery history records, and operation of the escalator)
10. How to evaluate sensory conditions by sight, sound, smell, touch
11. The procedures to be followed to investigate faults, and how to deal with intermittent conditions
12. How to use the various aids and reports available for fault diagnosis
13. The type of equipment that can be used to aid fault diagnosis (such as mechanical measuring instruments, electrical measuring instruments), and how to check it is calibrated or configured correctly for the intended use, and that it is free from damage and defects
14. The application of specific fault finding methods and techniques best suited to the problem
15. How to analyse and evaluate possible characteristics and causes of specific faults/problems
16. How to relate previous reports/records of similar fault conditions
17. How to evaluate the likely risk of running the equipment with the fault, and the effects the fault could have on the overall operation
18. How to prepare a report which complies with the company policy on fault diagnosis
19. The extent of your own responsibility and whom you should report to if you have problems that you cannot resolve
**Unit 49**
Carrying out fault diagnosis on escalators

<table>
<thead>
<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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</table>

### Carry out all of the following during the fault diagnostic activities:

- Plan the fault diagnosis to cause minimum disruption to normal working
- Use the correct issue of company and/or manufacturers’ drawings and maintenance documentation
- Adhere to risk assessment, COSHH and other relevant safety standards
- Ensure the safe isolation of equipment (such as mechanical or electricity)
- Provide safe access and working arrangements for the maintenance area
- Carry out the fault diagnostic activities using approved techniques and procedures
- Identify the fault and determine appropriate corrective action
- Dispose of waste items in safe and environmentally acceptable manner, and leave the work area in a safe condition

### Carry out fault diagnosis on two of the following types of escalator equipment:
- Mechanical
- Electrical
- Electronic

### Collect evidence regarding the fault from four of the following sources:
- The person who reported the fault
- Monitoring equipment
- Recording devices
- Sensory input (such as sight, sound, smell, touch)
- Escalator equipment records/history
- Operation of the equipment
### Unit 49
Carrying out fault diagnosis on escalators

<table>
<thead>
<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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#### Use a range of fault diagnostic techniques to include:
- half-split technique
- Plus one more from the following:
  - emergent problem sequence
  - six point technique
  - unit substitution
  - function testing
  - injection and sampling
  - input/output technique

#### Use a variety of diagnostic aids and equipment to include two of the following:
- manufacturer's manual
- algorithms
- probability charts/reports
- equipment self-diagnostics
- circuit diagrams/specifications
- logic diagrams
- flow charts
- fault analysis charts (fault trees)
- troubleshooting guides

#### Use all of the following types of test equipment to help in the fault diagnosis:
- mechanical measuring equipment (such as measuring instruments, dial test indicators, torque instruments)
- electrical/electronic measuring instruments (such as multimeters, logic probes)

#### Find faults that have resulted in two of the following breakdown categories:
- intermittent problem
- partial failure/out-of-specification operation
- complete breakdowns
# Unit 49
Carrying out fault diagnosis on escalators

<table>
<thead>
<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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</thead>
<tbody>
<tr>
<td><strong>Provide a record of the outcome of the fault diagnosis using one of the following:</strong></td>
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<tr>
<td>step-by-step analytical report</td>
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<tr>
<td>preventative maintenance log/report</td>
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<td>corrective action report</td>
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<tr>
<td>company-specific reporting procedure</td>
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</tbody>
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Knowledge and understanding reference:

Candidate: ____________________________  Date: ____________

Assessor: ____________________________  Date: ____________
Unit 50
Rectifying faults in escalators

Unit summary
This unit identifies the competencies you need to rectify faults on escalators, in accordance with approved procedures. This will involve rectifying faults in cases of breakdowns, and will include faults in steps, chain assemblies, control equipment, safety equipment, combs, gearbox, motors, hand rails, guide system, skirting, and ancillary equipment. Components to be replaced will include motors, pumps, switches, sensors, control boards, and ‘lifed’ items, such as grease and oil. You will also be expected to check the repaired escalator and to confirm its correct function. You will be required to select the appropriate tools and equipment to use, based upon the operations to be performed and the equipment to be repaired (which could be either escalator or passenger conveyor equipment).

Your responsibilities will require you to comply with organisational policy and procedures for the fault rectification activities undertaken, and to report any problems with the fault rectification activities, tools or equipment used that you cannot personally resolve, or 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 minimum 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, will and provide an informed approach to applying repair and rectification procedures on escalator equipment. You will understand the operation of the escalator equipment, and its application, and will know about the repair and rectification procedures, in adequate depth to provide a sound basis for carrying out the activities, correcting faults and ensuring the repaired escalator operates safely and correctly to the required specification.

You will understand the safety precautions required when carrying out the repair activities, especially those for isolating the equipment. 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.
Unit 50
Rectifying faults in escalators

Performance statements:
You must:

a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Follow the relevant maintenance schedules to carry out the required work
c. Carry out the maintenance activities within the limits of your personal authority
d. Carry out the maintenance activities in the specified sequence and in an agreed time scale
e. Report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
f. Complete relevant maintenance records accurately and pass them on to the appropriate person
g. Dispose of waste materials in accordance with safe working practices and approved procedures

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:

1. Carry out all of the following during the rectifying faults activity:
   - verify that the fault exists
   - plan the activities to cause minimum disruption to normal operation
   - use permit-to-work procedures
   - use the correct issue of company and/or manufacturers’ drawings and documentation
   - adhere to risk assessment, COSHH and other relevant safety standards
   - ensure the safe isolation of equipment (such as mechanical, electricity)
   - provide safe access and working arrangements for the area
   - follow the approved maintenance schedule for rectifying faults in escalators
   - carry out the activities using appropriate techniques and procedures
   - return the escalator to service on completion of activities
   - ensure any potential defects are identified and reported for future action
   - dispose of waste items in safe and environmentally acceptable manner, and leave the work area in a safe condition

2. Rectify faults in all of the following escalator equipment:
   - control equipment
   - gearbox
   - motor
   - guide system
   - balustrade/skirt equipment
   - brake equipment
   - comb plate and step mechanism
3 Repair and/or replace **all** of the following escalator equipment components:
   - steps
   - chains
   - handrail
   - control panel
   - combs
   - step rollers
   - step band
   - skirting
   - motor
   - brakes

4 Make adjustments to **all** the following:
   - handrails tensions
   - chain assemblies
   - skirting clearances
   - safety devices
   - guiding systems
   - gearbox backlash

5 Ensure the maintained equipment meets **all** of the following quality and accuracy standards:
   - contractual drawing
   - British and/or European standards
   - equipment manufacturer’s operating range
   - customer standards
   - company procedures and schedules
   - legal requirements

6 Complete **one** of the following and pass it to the appropriate people:
   - job cards
   - servicing log or report
   - permit to work/formal risk assessment
Unit 50
Rectifying faults in escalators

Knowledge statements:
You must have knowledge and understanding of:
1. The health and safety requirements of the area in which you are carrying out the rectification activities, and the responsibility they place on you
2. The specific safety precautions to be taken when carrying out the rectification of escalator equipment
3. The isolation and lock-off procedures or permit-to-work procedure that applies
4. The importance of wearing protective clothing and other appropriate safety equipment during the rectification process; the type of equipment to be used, and where to obtain it
5. Hazards associated with carrying out rectification work on escalators (e.g., handling oils/greases, stored pressure/force, electrical contact, using faulty or damaged tools and equipment, using practices/procedures that do not follow laid-down procedures), and how they can be minimised
6. How to recognise and deal with victims of electric shock (to include methods of safely removing the victim from the power source, isolating the power source, and methods of first aid resuscitation)
7. Where to obtain, and how to interpret, drawings, circuit diagrams, specifications, manufacturers’ manuals and other documents needed in the rectification process
8. The principles of operation of the equipment being rectified
9. The various procedures for replacing or adjusting faulty equipment
10. How to evaluate the various types of information available for fault diagnosis (such as user reports, monitoring equipment, sensory inputs, machinery history records, and operation of the escalator)
11. The types of tools and equipment that can be used in fault rectification (such as mechanical measuring instruments, electrical measuring instruments)
12. How to check tools and equipment (such as mechanical measuring instruments, electrical measuring instruments) are calibrated or configured correctly for the intended use, and are free from damage and defects
13. The correct and safe procedure to be adopted for the disposal of waste of all types of materials
14. How to relate previous reports/records of similar fault conditions
15. How to prepare a report which complies with the company policy on fault rectification
16. The extent of your own responsibility and whom you should report to if you have problems that you cannot resolve
## Unit 50
Rectifying faults in escalators

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<thead>
<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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<tr>
<td>evidence type</td>
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<td>date</td>
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<tr>
<td><strong>Carry out all of the following during the rectifying faults activity:</strong></td>
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<tr>
<td>verify that the fault exists</td>
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<tr>
<td>plan the activities to cause minimum disruption to normal operation</td>
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<tr>
<td>use permit-to-work procedures</td>
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<td>use the correct issue of company and/or manufacturers' drawings and documentation</td>
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<td>adhere to risk assessment, COSHH and other relevant safety standards</td>
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<td>ensure the safe isolation of equipment (such as mechanical, electricity)</td>
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<td>provide safe access and working arrangements for the area</td>
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<tr>
<td>follow the approved maintenance schedule for rectifying faults in escalators</td>
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<tr>
<td>carry out the activities using appropriate techniques and procedures</td>
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<td>return the escalator to service on completion of activities</td>
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<tr>
<td>ensure any potential defects are identified and reported for future action</td>
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<tr>
<td>dispose of waste items in safe and environmentally acceptable manner, and leave the work area in a safe condition</td>
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### Unit 50
Rectifying faults in escalators

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<th>evidence record sheet</th>
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<th>performance evidence 2</th>
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<th>additional performance evidence (if required)</th>
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<tbody>
<tr>
<td>Rectify faults in all of the following escalator equipment:</td>
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<tr>
<td>control equipment</td>
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<td>gearbox</td>
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<td>motor</td>
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<td>guide system</td>
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<td>balustrade/skirt equipment</td>
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<td>brake equipment</td>
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<tr>
<td>comb plate and step mechanism</td>
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<tr>
<td>Repair and/or replace all of the following escalator equipment components:</td>
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<td>steps</td>
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<td>chains</td>
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<td>handrail</td>
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<td>control panel</td>
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<td>combs</td>
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<td>step rollers</td>
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<td>step band</td>
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<td>skirting</td>
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<td>motor</td>
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<td>brakes</td>
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<td>Make adjustments to all the following:</td>
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<td>handrails tensions</td>
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<td>chain assemblies</td>
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<td>skirting clearances</td>
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<td>safety devices</td>
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<td>guiding systems</td>
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<td>gearbox backlash</td>
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<td>Ensure the maintained equipment meets all of the following quality and accuracy standards:</td>
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<td>contractual drawing</td>
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<td>British and/or European standards</td>
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<td>equipment manufacturer’s operating range</td>
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<td>customer standards</td>
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<td>company procedures and schedules</td>
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<td>legal requirements</td>
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Unit 50
Rectifying faults in escalators

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<th>evidence record sheet</th>
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Complete one of the following and pass it to the appropriate people:

- job cards
- servicing log or report
- permit to work/formal risk assessment

Knowledge and understanding reference:

Candidate: _______________________________________________  Date: ___________________
Assessor: ________________________________________________   Date: ___________________
Unit 51
Inspecting and servicing escalators

Unit summary
This unit identifies the competencies you need to carry out routine inspection and servicing of escalator installations, in accordance with approved procedures. You will be required to carry out routine inspection, adjustment and lubrication of escalator installations, including minor repair work, the routine replacement of components and servicing of escalator equipment. This servicing will be carried out to ensure that the escalator performs at optimal level and functions to specification, and that down time is minimised.

Your responsibilities will require you to comply with organisational policy and procedures for the inspection and servicing activities undertaken, and to report any problems with the servicing activities, or the tools and equipment used that you cannot personally resolve, or are outside your permitted authority, to the relevant people. You must ensure that all tools, equipment, and materials used in the servicing 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 minimum 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 planned servicing procedures on escalator equipment. You will understand the process of developing planned servicing, and its application, and will know about the servicing criteria, in adequate depth to provide a sound basis for carrying out the activities to the required specification. You will also be expected to report where the outcome of the servicing identifies the need for further investigation or maintenance work.

You will understand the safety precautions required when carrying out the inspection and servicing activities, especially those for isolating the equipment. 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.
Unit 51
Inspecting and servicing escalators

Performance statements:
You must:

a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Follow the relevant servicing schedules to carry out the required work
c. Carry out the servicing activities within the limits of your personal authority
d. Carry out the servicing activities in the specified sequence and in an agreed timescale
e. Report any instances where the servicing activities cannot be fully met or where there are identified defects outside the planned schedule
f. Complete relevant servicing records accurately and pass them on to the appropriate person
g. Dispose of waste materials in accordance with safe working practices and approved procedures

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:
1. Carry out all of the following during the planned inspection and servicing activities:
   - plan the inspection and servicing activities to cause minimum disruption to normal operation
   - use the correct issue of company and/or manufacturers’ drawings and servicing documentation
   - adhere to risk assessment, COSHH and other relevant safety standards
   - ensure the safe isolation of equipment (such as mechanical, electricity)
   - provide safe access and working arrangements for the servicing area
   - follow the approved maintenance schedule for inspecting and servicing escalators
   - carry out the inspection and servicing activities using appropriate techniques and procedures
   - reinstate and return the escalator to service on completion of the inspection and servicing activities
   - ensure any potential defects are identified and reported for future action
   - dispose of waste items in safe and environmentally acceptable manner, and leave the work area in a safe condition

2. Carry out planned inspection and servicing activities on all of the following:
   - gearbox
   - motor
   - step rollers
   - steps
   - brake equipment
   - step chains
   - handrail drive
   - skirtings
   - controller
   - guideways
   - safety devices
   - balustrades and deckings
   - comb plate and step mechanism
   - newels and guides
3 Follow planned servicing activities using **one** of the following types of servicing schedules:
   - condition based servicing
   - scheduled servicing
   - calendar based servicing
   - total preventative maintenance (TPM)

4 Carry out **all** of the following planned servicing activities:
   - checking operation of escalator
   - making routine adjustments
   - monitoring component condition/deterioration
   - visual examination and test equipment against servicing schedule
   - making other sensory checks (such as sound, touch, smell)
   - checking the condition of bearings, oil seals, guards, brushes, brakes, electrical equipment, drive chains, sprockets
   - check clearances and alignment of running/sliding components
   - replenish/replace consumables (such as grease, lights, gaskets and seals, etc)
   - test and review escalator operation, including safety and alarm systems
   - record the results of the servicing and report any defects found
   - removing excessive dirt, grime and rubbish

5 Carry out inspecting and servicing which complies with **all** of the following:
   - contractual drawing
   - British and/or European standards
   - equipment manufacturer’s operating range
   - customer standards
   - company procedures and schedules
   - legal requirements

6 Ensure the maintained equipment meets **all** of the following quality and accuracy standards:
   - all components and sub-assemblies are fit for purpose
   - all connections are mechanically and electrically safe and sound
   - equipment operates within acceptable limits for safe operation and meets specification

7 Complete **one** of the following and pass it to the appropriate people:
   - job cards
   - servicing log or report
   - permit to work/formal risk assessment
Unit 51
Inspecting and servicing escalators

Knowledge statements:
You must have knowledge and understanding of:
1. The health and safety requirements of the area in which the escalator inspection and servicing activity is to take place
2. The isolation procedures or permit-to-work procedure that applies to the escalator equipment being serviced
3. The specific health and safety precautions to be applied during the planned servicing procedure, and their effects on others
4. The importance of wearing protective clothing and other appropriate safety equipment during servicing process
5. Hazards associated with carrying out planned servicing activities on escalators (handling oils/greases, stored pressure/force, misuse of tools), and how they can be minimised
6. How to recognise and deal with victims of electric shock (to include methods of safely removing the victim from the power source, isolating the power source, and methods of first aid resuscitation)
7. Where to obtain, and how to interpret, drawings, specifications, manufacturers’ manuals, servicing schedules and other documents needed for the servicing activities
8. The various planned servicing schedules that are generally used (such as condition based servicing, scheduled servicing, calendar based servicing and total preventative maintenance (TPM))
9. The procedure for obtaining the consumables to be used during planned servicing activity
10. The appropriate testing procedures to be adopted during servicing
11. The appropriate inspection techniques and procedures to be adopted during servicing
12. How to identify excessive wear and damage of components
13. How to make adjustments to components/assemblies to ensure they function to specification
14. The principles and functions of all escalator components
15. How to complete servicing records/logs/reports which comply with company policy and procedures
16. The problems associated with carrying out planned servicing, and how to resolve them
17. The correct and safe procedure to be adopted for the disposal of waste of all types of materials
18. The extent of your own responsibility and whom you should report to if you have problems that you cannot resolve
# Unit 51
Inspection and servicing escalators

<table>
<thead>
<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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<td>evidence type</td>
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<td>date</td>
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<tr>
<td>Carry out all of the following during the planned inspection and servicing activities:</td>
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<tr>
<td>plan the inspection and servicing activities to cause minimum disruption to normal operation</td>
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<tr>
<td>use the correct issue of company and/or manufacturers’ drawings and servicing documentation</td>
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<td>adhere to risk assessment, COSHH and other relevant safety standards</td>
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<td>ensure the safe isolation of equipment (such as mechanical, electricity)</td>
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<td>provide safe access and working arrangements for the servicing area</td>
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<td>follow the approved maintenance schedule for inspecting and servicing escalators</td>
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<tr>
<td>carry out the inspection and servicing activities using appropriate techniques and procedures</td>
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<tr>
<td>reinstate and return the escalator to service on completion of the inspection and servicing activities</td>
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<td>ensure any potential defects are identified and reported for future action</td>
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<td>dispose of waste items in safe and environmentally acceptable manner, and leave the work area in a safe condition</td>
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## Unit 51
Inspecting and servicing escalators

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<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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<tbody>
<tr>
<td><strong>Carry out planned inspection and servicing activities on all of the following:</strong></td>
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<td>gearbox</td>
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<td>motor</td>
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<td>step rollers</td>
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<td>steps</td>
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<td>brake equipment</td>
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<td>step chains</td>
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<td>handrail drive</td>
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<td>skirtings</td>
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<td>controller</td>
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<td>guideways</td>
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<td>safety devices</td>
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<td>balustrades and deckings</td>
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<td>comb plate and step mechanism</td>
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<tr>
<td>newels and guides</td>
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<tr>
<td><strong>Follow planned servicing activities using one of the following types of servicing schedules:</strong></td>
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<tr>
<td>condition based servicing</td>
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<td>scheduled servicing</td>
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<tr>
<td>calendar based servicing</td>
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<td>total preventative maintenance (TPM)</td>
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<td><strong>Carry out all of the following planned servicing activities:</strong></td>
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<td>checking operation of escalator</td>
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<td>making routine adjustments</td>
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<td>monitoring component condition/deterioration</td>
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<td>visual examination and test equipment against servicing schedule</td>
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<td>making other sensory checks (such as sound, touch, smell)</td>
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<td>checking the condition of bearings, oil seals, guards, brushes, brakes, electrical equipment, drive chains, sprockets</td>
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## Unit 51
Inspecting and servicing escalators

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<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
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<tr>
<td>check clearances and alignment of running/sliding components</td>
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<td>replenish/replace consumables (such as grease, lights, gaskets and seals, etc)</td>
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<tr>
<td>test and review escalator operation, including safety and alarm systems</td>
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<td>record the results of the servicing and report any defects found</td>
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<tr>
<td>removing excessive dirt, grime and rubbish</td>
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**Carry out inspecting and servicing which complies with all of the following:**
- contractual drawing
- British and/or European standards
- equipment manufacturer’s operating range
- customer standards
- company procedures and schedules
- legal requirements

**Ensure the maintained equipment meets all of the following quality and accuracy standards:**
- all components and sub-assemblies are fit for purpose
- all connections are mechanically and electrically safe and sound
- equipment operates within acceptable limits for safe operation and meets specification

**Complete one of the following and pass it to the appropriate people:**
- job cards
- servicing log or report
- permit to work/formal risk assessment

Knowledge and understanding reference:

Candidate: ________________________________  Date: __________________

Assessor: ________________________________  Date: __________________
Unit 52
Testing and reinstating escalator installations

Unit summary
This unit identifies the competencies you need to carry out checks and adjustments to the operation of an escalator installation, to specified standards and in accordance with approved procedures. You will be required to select the appropriate tools and equipment to use, based upon the operations to be performed. The equipment to be checked and adjusted could be either an escalator or passenger conveyor equipment.

Your responsibilities will require you to comply with organisational policy and procedures for the testing and adjusting activities undertaken, and to report any problems with the testing and adjusting activities that you cannot personally resolve, or are outside your permitted authority, to the relevant people. You must ensure that all tools, equipment, and materials used in the testing and adjusting 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 minimum 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 testing and adjusting procedures on escalator installations. You will understand the escalator equipment being checked and adjusted, and its application, and will know about the use of appropriate equipment and information, in adequate depth to provide a sound basis for carrying out the activities, correcting faults, and ensuring the escalator operates safely and correctly to the required specification. You will also be expected to report where the outcome of the tests and adjustments identifies the need for further investigation or maintenance work.

You will understand the safety precautions required when carrying out the testing activities, especially those for isolating the equipment. 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.
Unit 52
Testing and reinstating escalator installations

Performance statements:
You must:
a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Follow the appropriate operating specifications for the equipment being maintained
c. Carry out adjustments within the limits of your personal authority
d. Make the required adjustments in the specified sequence and in an agreed time scale
e. Confirm that the adjusted equipment meets the required operating specification
f. Report any instances where the equipment fails to meet the required performance after adjustments or where there are identified defects outside the required adjustments
g. Maintain documentation in accordance with organisational requirements

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:
1  Carry out all of the following activities during the testing and adjusting activity:
   • use the correct issue of drawings and specifications
   • adhere to risk assessments, COSHH and other relevant safety standards
   • follow the approved maintenance schedule for testing and reinstating escalator installations (such as response (direction and stopping) and functional (speed, vibration, safety equipment))
   • ensure the escalator area is clear of maintenance equipment, tools, debris and surplus materials
   • provide safe access and working arrangements for the area
   • carry out all work to the appropriate testing standard, at the relevant speed
   • confirm the escalator installation is operating to specification
   • leave the work area in a safe condition on completion of the testing activities

2  Carry out the testing and adjustment activities on one of the following types of equipment:
   • escalator
   • passenger conveyor

3  Make adjustments to all of the following:
   • tensions
   • switches
   • clearances
   • alignment
   • speed of operation

4  Carry out testing activities which complies with all of the following:
   • contractual drawing
   • British and/or European standards
   • equipment manufacturer’s operating range
   • customer standards
   • company procedures and schedules
   • legal requirements

5  Complete one of the following and pass it to the appropriate people:
   • job cards
   • servicing log or report
   • permit to work/formal risk assessment
Unit 52
Testing and reinstating escalator installations

Knowledge statements:
You must have knowledge and understanding of:

1. The specific safety precautions to be taken when testing and adjusting the escalator installation, including any specific legislation, regulations or code of practice relating to the activity, equipment or materials used, and the responsibility they place on you.
2. The health and safety requirements of the work area in which you are carrying out the testing and adjustment.
3. The company procedure(s) for safe systems of work, risk assessment and use of a permit to work.
4. Hazards associated with carrying out testing and adjusting activities on escalators (e.g., handling oils/greases, electrical contact, process controller interface, using faulty or damaged tools and equipment, using practices/procedures that do not follow laid-down procedures, moving parts of equipment), and how they can be minimised.
5. The personal protective equipment you need to wear during the testing activities.
6. How to recognise and deal with victims of electric shock (to include methods of safely removing the victim from the power source, isolating the power source, and methods of first aid resuscitation).
7. Safe methods of manual handling, and the safe use of mechanical lifting devices.
8. How to obtain the required testing documentation and specifications for the escalator being tested, and how to check their currency and validity.
9. How to read and interpret the specifications.
10. The principles of operation of the equipment being tested or reinstated.
11. The tools and equipment to be used during the testing and adjusting activities.
14. What checks need to be made on tools and equipment that are used, to ensure they are fit for service.
15. How you would know if the tools or equipment are covered by calibration or legislative inspections.
16. Tool control during the testing and adjusting of equipment.
17. What documentation needs to be completed for the activities undertaken.
18. The extent of your own responsibility and whom you should report to if you have problems that you cannot resolve.
Unit 52
Testing and reinstating escalator installations

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<thead>
<tr>
<th>evidence record sheet</th>
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<th>performance evidence 2</th>
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**Carry out all of the following activities during the testing and adjusting activity:**

- use the correct issue of drawings and specifications
- adhere to risk assessments, COSHH and other relevant safety standards
- follow the approved maintenance schedule for testing and reinstating escalator installations (such as response (direction and stopping) and functional (speed, vibration, safety equipment))
- ensure the escalator area is clear of maintenance equipment, tools, debris and surplus materials
- provide safe access and working arrangements for the area
- carry out all work to the appropriate testing standard, at the relevant speed
- confirm the escalator installation is operating to specification
- leave the work area in a safe condition on completion of the testing activities

**Carry out the testing and adjustment activities on one of the following types of equipment:**

- escalator
- passenger conveyor

**Make adjustments to all of the following:**

- tensions
- switches
- clearances
- alignment
- speed of operation
# Unit 52
Testing and reinstating escalator installations

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<tr>
<th>evidence record sheet</th>
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<tr>
<td><strong>Carry out testing activities which complies with all of the following:</strong></td>
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<td>British and/or European standards</td>
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<td>equipment manufacturer’s operating range</td>
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<td>customer standards</td>
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<tr>
<td>company procedures and schedules</td>
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<td>legal requirements</td>
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<td><strong>Complete one of the following and pass it to the appropriate people:</strong></td>
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<td>job cards</td>
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<td>servicing log or report</td>
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<td>permit to work/formal risk assessment</td>
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Knowledge and understanding reference:

Candidate: ____________________________  Date: ____________________

Assessor: ____________________________  Date: ____________________
Unit 53
Carrying out fault diagnosis on communication-electronic systems

Unit summary
This unit identifies the competencies you need to carry out efficient and effective fault diagnosis on communication-electronic systems, in accordance with approved procedures. You will be required to diagnose faults on a range of communication-electronic systems, sub-systems or assemblies at line replacement unit (LRU) level. You will be expected to use a variety of fault diagnosis methods and techniques, and to utilise a number of diagnostic aids and equipment. From the evidence gained, you will be expected to identify the fault and its probable cause, and to suggest appropriate action to remedy the problem.

Your responsibilities will require you to comply with organisational policy and procedures for the fault diagnostic activities undertaken, and to report any problems with these activities or the tools and equipment used that you cannot personally resolve, or are outside your permitted authority, to the relevant people. You will be expected to work with minimum 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 fault diagnosis procedures on communication-electronic systems. You will understand the various fault diagnosis methods and techniques used, and their application. You will also know how to apply and interpret information obtained from diagnostic aids and equipment, in adequate depth to provide a sound basis for carrying out the activities and identifying faults or conditions that are outside the required specification.

You will understand the safety precautions required when carrying out the fault diagnosis activities, especially those for isolating the equipment and for 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.
Unit 53
Carrying out fault diagnosis on communication-electronic systems

Performance statements:

You must:

a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Review and use all relevant information on the symptoms and problems associated with the products or assets
c. Investigate and establish the most likely causes of the faults
d. Select, use and apply diagnostic techniques, tools and aids to locate faults
e. Complete the fault diagnosis within the agreed time and inform the appropriate people when this cannot be achieved
f. Determine the implications of the fault for other work and for safety considerations
g. Use the evidence gained to draw valid conclusions about the nature and probable cause of the fault
h. Record details on the extent and location of the faults in an appropriate format

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:

1. Carry out all of the following during the fault diagnostic activity:
   - plan the fault diagnosis prior to commencement
   - use the correct issue of company and/or manufacturer’s drawings and maintenance documentation
   - adhere to risk assessment, COSHH and other relevant safety standards
   - ensure the safe isolation of equipment
   - provide safe access and working arrangements for the faultfinding/maintenance area
   - carry out the fault diagnosis activities using appropriate procedures
   - collect equipment fault diagnosis evidence from live and isolated circuits
   - disconnect or isolate components or parts of circuits, when appropriate, to confirm diagnosis
   - identify the fault and determine appropriate corrective action
   - dispose of waste items in a safe and environmentally friendly manner and leave the work area in a safe condition

2. Carry out fault diagnosis on four communication electronic systems, sub-systems 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 electronics
- transmitters (such as HF, VHF, UHF, microwave transmitters)
- transceivers (such as HF, VHF, UHF, microwave)
- receivers (such as HF, VHF, UHF, microwave receivers)
- signal processing (analogue) (such as radar anti-clutter, comms audio and AGC stages)
- signal processing (digital) (such as digital MTI, multiplexers, AGC)
- aerial systems (such as phased arrays, long wire, and parabolic reflectors)
- transmission lines (such as optical fibres, co-ax, baluns, twin wire, waveguide)
- display systems (such as CRT, plasma, TFT, TV tab)
- man-machine interface (such as IS/ICT equipment or peripherals: keypads, keyboards, microphones)
• electro-optical systems (such as cameras, thermal imaging, targetting systems)
• hydraulic-electrical systems (such as hydraulic motors, HSUs, and actuators)
• cryptographic systems (such as data encryption and de-encryption)
• built-in test equipment
• data network systems (such as LANs, WANs)
• data network interfaces (such as switch, router, bridging networks)
• any other identifiable electronic system, sub-system or assemblies

**Group B – associated equipment**
• environmental control systems (such as temperature, humidity, vibration, shock, alarm and protection)
• electromechanical systems (such as servos, motors, relays, complex switches)
• power generation systems (such as fixed/transportable ac/dc generators, batteries)
• power distribution systems (such as single phase/3-phase distribution panels)
• power supply control systems (such as voltage/current series/shunt regulator/stabiliser)
• hybrid systems (such as ADC, DAC)

3 Collect fault diagnosis evidence from **four** of the following sources:
• person or operator who reported the fault
• test instrument measurements (such as wattmeters, multimeter, earth-loop impedance testers)
• circuit meters (such as voltmeter, power factor, ammeter)
• equipment self-diagnostics recording devices
• sensory (such as sight, sound, smell, touch)
• plant/equipment records
• condition of end product or output

4 Use a range of fault-diagnostic techniques to include:
• half-split

Plus one more from the following:
• injection and sampling
• six point
• emergent sequence
• unit substitution
• function testing

5 Use a variety of diagnostic aids, to include **two** of the following:
• logic diagrams
• flow charts or algorithms
• probability charts/reports
• computer-aided test equipment
• fault analysis charts
• manufacturers’ manuals
• troubleshooting guides
• electronic aids

6 Use **all** of the following fault diagnosis procedures:
• inspection
• operation
• measurement
7 Use four of the following types of test equipment to aid fault diagnosis:
   • oscilloscope
   • multimeter
   • logic probe
   • current tracer
   • signal generator
   • other specific test equipment

8 Find faults that have resulted in two of the following breakdown categories:
   • intermittent action/system failure
   • partial failure or reduced performance
   • complete breakdown

9 Provide a record of the outcome of the fault diagnosis, using one of the following:
   • step-by-step analytical report
   • preventative maintenance log/report
   • corrective action report
   • company-specific reporting procedure
Knowledge statements:
You must have knowledge and understanding of:
1. The health and safety requirements of the area in which the fault diagnosis 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
3. How to recognise and deal with victims of electric shock (to include methods of safely removing victims from the power source and methods of first aid resuscitation)
4. The importance of wearing protective clothing and other appropriate safety equipment during the fault diagnosis process
5. Hazards associated with carrying out fault diagnosis on communication-electronic systems (mains electricity, stored capacitive/inductive energy, misuse of tools), and how these can be minimised
6. The procedure to be adopted to establish background evidence of a fault
7. How to evaluate the various types of information available for fault diagnosis
8. How to use the various aids and reports available for fault diagnosis
9. How to use various items of fault diagnostic equipment to investigate the problem
10. The various fault finding techniques that can be used, and how they are applied (such as half-split, input-to-output, emergent sequence, six point technique, function testing, unit substitution, injection and sampling techniques, and equipment self diagnostics)
11. How to evaluate sensory conditions by sight, smell, sound or touch
12. How to analyse evidence and evaluate possible characteristics and causes of specific faults or problems
13. How to relate previous reports/records of similar fault conditions
14. The care, handling and application of electronic test instruments (such as multimeters, logic probes, oscilloscopes, etc)
15. How to determine the calibration state of the equipment, and the actions to be taken if equipment is out of calibration
16. How to ensure that the equipment used is free from damage or defect
17. How to obtain and interpret drawings, circuit diagrams, physical layouts, charts, specification, manufacturers’ manuals, history/maintenance reports, electronic/electrical symbols, and other documentation needed in the maintenance process
18. The principles of how communication-electronic or associated systems function and interact
19. How sub-systems and assemblies function within a system
20. The purpose of each LRU within a given system
21. How to evaluate the likely risk to yourself and others, and the effects the fault could have on the overall process
22. How to prepare and produce a risk analysis report, where appropriate
23. How to complete the necessary paperwork or take follow-up action, which satisfies the company policy on concluding fault diagnosis
24. The extent of your own responsibility and whom you should report to if you have problems that you cannot resolve
### Unit 53
Carrying out fault diagnosis on communication-electronic systems

<table>
<thead>
<tr>
<th>Evidence type</th>
<th>Performance evidence 1</th>
<th>Performance evidence 2</th>
<th>Performance evidence 3</th>
<th>Additional performance evidence (if required)</th>
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<td>Date</td>
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</table>

**Carry out all of the following during the fault diagnostic activity:**

- Plan the fault diagnosis prior to commencement
- Use the correct issue of company and/or manufacturer's drawings and maintenance documentation
- Adhere to risk assessment, COSHH and other relevant safety standards
- Ensure the safe isolation of equipment
- Provide safe access and working arrangements for the fault finding/maintenance area
- Carry out the fault diagnosis activities using appropriate procedures
- Collect equipment fault diagnosis evidence from live and isolated circuits
- Disconnect or isolate components or parts of circuits, when appropriate, to confirm diagnosis
- Identify the fault and determine appropriate corrective action
- Dispose of waste items in a safe and environmentally friendly manner and leave the work area in a safe condition
### Carrying out fault diagnosis on communication-electronic systems

#### Evidence Record Sheet

<table>
<thead>
<tr>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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<tbody>
<tr>
<td>Carry out fault diagnosis on four communication electronic systems, sub-systems or assemblies to LRU level, at least two of which must be selected from group A. <strong>Note:</strong> Any of the items below can be identified as a system, sub-system or assembly in its own right.</td>
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</tbody>
</table>

#### Group A – Communication Electronics

- Transmitters (such as HF, VHF, UHF, microwave transmitters)
- Transceivers (such as HF, VHF, UHF, microwave)
- Receivers (such as HF, VHF, UHF, microwave receivers)
- Signal processing (analogue) (such as radar anti-clutter, comms audio and AGC stages)
- Signal processing (digital) (such as digital MTI, multiplexers, AGC)
- Aerial systems (such as phased arrays, long wire, and parabolic reflectors)
- Transmission lines (such as optical fibres, co-ax, baluns, twin wire, waveguide)
- Display systems (such as CRT, plasma, TFT, TV tab)
- Man-machine interface (such as IS/ICT equipment or peripherals: keypads, keyboards, microphones)
- Electro-optical systems (such as cameras, thermal imaging, targeting systems)
- Hydraulic-electrical systems (such as hydraulic motors, HSUs, and actuators)
- Cryptographic systems (such as data encryption and decryption)
- Built-in test equipment
- Data network systems (such as LANs, WANs)
- Data network interfaces (such as switch, router, bridging networks)
- Any other identifiable electronic system, sub-system or assemblies
## Unit 53
Carrying out fault diagnosis on communication-electronic systems

<table>
<thead>
<tr>
<th>evidence record sheet</th>
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<th>performance evidence 3</th>
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<tr>
<td><strong>Group B – associated equipment</strong></td>
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<tr>
<td>environmental control systems (such as temperature, humidity, vibration, shock, alarm and protection)</td>
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<td>electromechanical systems (such as servos, motors, relays, complex switches)</td>
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<td>hybrid systems (such as ADC, DAC)</td>
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<td><strong>Collect fault diagnosis evidence from four of the following sources:</strong></td>
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<td>plant/equipment records</td>
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<td>condition of end product or output</td>
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<td><strong>Use a range of fault-diagnostic techniques to include:</strong></td>
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<td>half-split</td>
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<td>Plus one more from the following:</td>
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<td>injection and sampling</td>
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<td>six point</td>
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<td>emergent sequence</td>
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<td>unit substitution</td>
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<td>function testing</td>
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### Unit 53
Carrying out fault diagnosis on communication-electronic systems

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<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
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**Use a variety of diagnostic aids, to include two of the following:**
- logic diagrams
- flow charts or algorithms
- probability charts/reports
- computer-aided test equipment
- fault analysis charts
- manufacturers’ manuals
- troubleshooting guides
- electronic aids

**Use all of the following fault diagnosis procedures:**
- inspection
- operation
- measurement

**Use four of the following types of test equipment to aid fault diagnosis:**
- oscilloscope
- multimeter
- logic probe
- current tracer
- signal generator
- other specific test equipment

**Find faults that have resulted in two of the following breakdown categories:**
- intermittent action/system failure
- partial failure or reduced performance
- complete breakdown

**Provide a record of the outcome of the fault diagnosis, using one of the following:**
- step-by-step analytical report
- preventative maintenance log/report
- corrective action report
- company-specific reporting procedure

Knowledge and understanding reference:

Candidate: _______________________________  Date: __________________

Assessor: ________________________________  Date: __________________
Unit 54
Testing communication-electronic systems

Unit summary
This unit identifies the competencies you need to carry out inspections and tests on communication-electronic systems, in accordance with approved procedures. You will be required to carry out tests on a range of communication-electronic systems, sub-systems or assemblies to line replacement unit (LRU) level, to establish and ensure that they are functioning at optimal level and to specification. You will be required to carry out inspections, measurements and tests, which will include voltage and current levels, resistance values, waveform, clock/timer switching, pulse width/rise time, open/short circuit, logic state, frequency modulation/demodulation and signal noise/interference levels, as applicable to the equipment you are working on.

Your responsibilities will require you to comply with organisational policy and procedures for carrying out the testing activities and to report any problems with these activities that you cannot personally resolve, or are outside your permitted authority, to the relevant people. You will be expected to work with minimum 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 the procedures used for carrying out the required inspections and tests, and will provide an informed approach to applying the necessary testing procedures. You will understand the equipment being worked on, the test equipment being used, and the various test procedures and their application, in adequate depth to provide a sound basis for carrying out the activities to the required specification. In addition, you will be expected to review the outcome of the tests, compare the results with appropriate specifications, determine the action required, and record/report the results in the appropriate format.

You will understand the safety precautions required when carrying out the inspection and testing activities, especially those for isolating the equipment and for 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.
Unit 54
Testing communication-electronic systems

Performance statements:
You must:
a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Follow the appropriate procedures for use of tools and equipment to carry out the required tests
c. Set up and carry out the tests using the correct procedures and within agreed timescales
d. Record the results of the tests in the appropriate format
e. Review the results and carry out further tests if necessary

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:
1. Carry out all of the following during the testing activities:
   • plan the inspection and testing activities to cause minimum disruption to normal working
   • use the correct issue of company and/or manufacturers’ drawings and maintenance documentation
   • adhere to risk assessment, COSHH and other relevant safety standards
   • ensure the safe isolation of equipment
   • provide safe access and working arrangements for the maintenance area
   • carry out the inspection and testing activities using appropriate techniques and procedures
   • take electrostatic precautions when handling components and circuit boards
   • re-connect and return the equipment to service on completion of the testing activities
   • dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition

2. Carry out inspections and tests on four communication-electronic systems, sub systems 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 electronics
• transmitters (such as HF, VHF, UHF, microwave transmitters)
• transceivers (such as HF, VHF, UHF, microwave)
• receivers (such as HF, VHF, UHF, microwave receivers)
• signal processing (analogue) (such as radar anti-clutter, comms audio and AGC stages)
• signal processing (digital) (such as digital MTI, multiplexers, AGC)
• aerial systems (such as phased arrays, long wire, and parabolic reflectors)
• transmission lines (such as optical fibres, co-ax, baluns, twin wire, waveguide)
• display systems (such as CRT, plasma, TFT, TV tab)
• man-machine interface (such as IS/ICT equipment or peripherals: keypads, keyboards, microphones)
• electro-optical systems (such as cameras, thermal imaging, targetting systems)
• hydraulic-electrical systems (such as hydraulic motors, HSUs and actuators)
• cryptographic systems (such as data encryption and de-encryption)
• built-in test equipment
• data network systems (such as LANs, WANs)
• data network interfaces (such as switch, router, bridging networks)
• any other identifiable electronic system, sub-system or assemblies
Group B – associated equipment

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

3 Carry out tests using a range of tools and test equipment, to include four of the following:

- oscilloscope
- ammeter
- logic analyser
- Q meter
- current tracer
- signal generator
- multimeter
- computer-aided diagnostic equipment
- special-purpose testing equipment
- other specific test equipment
- temperature testing devices
- power meters
- valve tester
- spectrum analyser
- time domain reflectometer
- frequency counter
- protocol analyser
- breakout box
- automatic test equipment

4 Carry out all of the following tests or measurements, as applicable to the equipment being tested:

- logic states
- DC voltage/current levels
- AC voltage/current levels
- clock/timer switching
- pulse width/rise time
- open/short circuit
- resistance
- heat dissipation
- frequency modulation/demodulation
- performance of system, sub-system or assembly
- conditions of assemblies and components
- signal noise/interference levels

5 Carry out all of all the following checks to ensure the accuracy and quality of the tests carried out:

- test equipment is correctly calibrated
- test equipment used is appropriate for the tests being carried out
- test equipment is operated within its specification range
- test procedures used are up to date

6 Provide a record/report of the test outcome(s), using one of the following:

- preventative maintenance log/report
- company-specific reporting procedure
- inspection schedule
- specific test report
Knowledge statements:
You must have knowledge and understanding of:
1. The health and safety requirements of the area in which the testing activity is to take place, and the responsibility they place on you
2. Your responsibilities under regulations relevant to the communication-electronic testing activities being undertaken
3. The isolation and lock-off procedure, or permit-to-work procedure that applies to the testing activities (electrical isolation, locking off switch gear, removal of fuses, placing maintenance warning notices, proving the isolation has been achieved and secured)
4. Isolation procedures that are unique to communication-electronic systems
5. The specific safety precautions to be taken when carrying out formal inspection and testing of communication-electronic equipment
6. The hazards associated with testing communication-electronic systems and with the equipment that is used, and how these can be minimised
7. The importance of wearing protective clothing and other appropriate safety equipment during the testing activities
8. The importance of keeping the work area clean and tidy, and free from waste and surplus materials
9. How the testing activities may effect the work of others, and the procedure for informing them of the work to be carried out
10. The procedures and precautions to be adopted to eliminate electrostatic discharge
11. 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 the test
12. The principles of how communication-electronic or associated systems function and interact
13. How sub-systems and assemblies function within a system
14. How to determine suitable test points within a system, sub-system or assembly
15. How to set up and apply the appropriate test equipment
16. How to determine the calibration state of the equipment, and the actions to be taken if equipment is out of calibration,
17. How to ensure that the test equipment is free from damage or defect
18. How to check that tools and equipment are free from damage or defect, are in a safe and useable condition and are configured correctly for their intended purpose
19. The various testing methods and procedures, and how to apply them to different operating conditions
20. How to analyse test results, and how to use comparison and sequential techniques
21. The environmental control and company operating procedure relating to functional testing
22. The documentation required, and the procedures to be followed at the conclusion of the test
23. The extent of your authority and whom you should report to if you have problems that you cannot resolve
<table>
<thead>
<tr>
<th>evidence record sheet</th>
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<th>performance evidence 2</th>
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<tbody>
<tr>
<td>evidence type</td>
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<td>date</td>
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<tr>
<td><strong>Carry out all of the following during the testing activities:</strong></td>
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<tr>
<td>plan the inspection and testing activities to cause minimum disruption to normal working</td>
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<tr>
<td>use the correct issue of company and/or manufacturers’ drawings and maintenance documentation</td>
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<tr>
<td>adhere to risk assessment, COSHH and other relevant safety standards</td>
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<tr>
<td>ensure the safe isolation of equipment</td>
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<tr>
<td>provide safe access and working arrangements for the maintenance area</td>
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<tr>
<td>carry out the inspection and testing activities using appropriate techniques and procedures</td>
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<td>take electrostatic precautions when handling components and circuit boards</td>
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<tr>
<td>re-connect and return the equipment to service on completion of the testing activities</td>
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<td>dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition</td>
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## Unit 54
Testing communication-electronic systems

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<tbody>
<tr>
<td>Carry out inspections and tests on four communication-electronic systems, sub systems 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.</td>
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</table>

### Group A – communication electronics

- Transmitters (such as HF, VHF, UHF, microwave transmitters)
- Transceivers (such as HF, VHF, UHF, microwave)
- Receivers (such as HF, VHF, UHF, microwave receivers)
- Signal processing (analogue) (such as radar anti-clutter, comms audio and AGC stages)
- Signal processing (digital) (such as digital MTI, multiplexers, AGC)
- Aerial systems (such as phased arrays, long wire, and parabolic reflectors)
- Transmission lines (such as optical fibres, co-ax, baluns, twin wire, waveguide)
- Display systems (such as CRT, plasma, TFT, TV tab)
- Man-machine interface (such as IS/ICT equipment or peripherals: keypads, keyboards, microphones)
- Electro-optical systems (such as cameras, thermal imaging, targeting systems)
- Hydraulic-electrical systems (such as hydraulic motors, HSUs and actuators)
- Cryptographic systems (such as data encryption and de-encryption)
- Built-in test equipment
- Data network systems (such as LANs, WANs)
- Data network interfaces (such as switch, router, bridging networks)
- Any other identifiable electronic system, sub-system or assemblies
## Unit 54
Testing communication-electronic systems

<table>
<thead>
<tr>
<th>evidence record sheet</th>
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</thead>
<tbody>
<tr>
<td><strong>Group B – associated equipment</strong></td>
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<td>environmental control systems (such as temperature, humidity, vibration, shock, alarm and protection)</td>
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</tbody>
</table>

Carry out tests using a range of tools and test equipment, to include four of the following:

- oscilloscope
- ammeter
- logic analyser
- Q meter
- current tracer
- signal generator
- multimeter
- computer-aided diagnostic equipment
- special-purpose testing equipment
- other specific test equipment
- temperature testing devices
- power meters
- valve tester
- spectrum analyser
- time domain reflectometer
- frequency counter
- protocol analyser
- breakout box
- automatic test equipment
## Unit 54
### Testing communication-electronic systems

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<tr>
<th>Carry out all of the following tests or measurements, as applicable to the equipment being tested:</th>
</tr>
</thead>
<tbody>
<tr>
<td>logic states</td>
</tr>
<tr>
<td>DC voltage/current levels</td>
</tr>
<tr>
<td>AC voltage/current levels</td>
</tr>
<tr>
<td>clock/timer switching</td>
</tr>
<tr>
<td>pulse width/rise time</td>
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<tr>
<td>open/short circuit</td>
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<tr>
<td>resistance</td>
</tr>
<tr>
<td>heat dissipation</td>
</tr>
<tr>
<td>frequency modulation/demodulation</td>
</tr>
<tr>
<td>performance of system, sub-system or assembly</td>
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<tr>
<td>conditions of assemblies and components</td>
</tr>
<tr>
<td>signal noise/interference levels</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Carry out all of all the following checks to ensure the accuracy and quality of the tests carried out:</th>
</tr>
</thead>
<tbody>
<tr>
<td>test equipment is correctly calibrated</td>
</tr>
<tr>
<td>test equipment used is appropriate for the tests being carried out</td>
</tr>
<tr>
<td>test equipment is operated within its specification range</td>
</tr>
<tr>
<td>test procedures used are up to date</td>
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<table>
<thead>
<tr>
<th>Provide a record/report of the test outcome(s), using one of the following:</th>
</tr>
</thead>
<tbody>
<tr>
<td>preventative maintenance log/report</td>
</tr>
<tr>
<td>company-specific reporting procedure</td>
</tr>
<tr>
<td>inspection schedule</td>
</tr>
<tr>
<td>specific test report</td>
</tr>
</tbody>
</table>

Knowledge and understanding reference:

Candidate: ____________________________ Date: ______________

Assessor: ____________________________ Date: ______________
Unit 55
Repairing communication-electronic systems

Unit summary
This unit identifies the competencies 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 are outside your permitted authority, to the relevant people. You will be expected to work with minimum 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 faults and ensuring the repaired system is to the required specification.

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.
Unit 55
Repairing communication-electronic systems

Performance statements:
You must:

a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Follow the relevant maintenance schedules to carry out the required work
c. Carry out the maintenance activities within the limits of your personal authority
d. Carry out the maintenance activities in the specified sequence and in an agreed time scale
e. Report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
f. Complete relevant maintenance records accurately and pass them on to the appropriate person
g. Dispose of waste materials in accordance with safe working practices and approved procedures

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:

1. Carry out all of the following during the repair activities:
   • plan the repairing activities to cause minimum disruption to normal working
   • use the correct issue of company and/or manufacturers’ drawings and maintenance documentation
   • adhere to risk assessment, COSHH and other relevant safety standards
   • ensure the safe isolation of equipment
   • provide safe access and working arrangements for the maintenance area
   • carry out the inspection and testing activities, using appropriate techniques and procedures
   • take electrostatic precautions when handling components and circuit boards
   • re-connect and return the system to service on completion of the repair activities
   • dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition

2. Carry out repair activities on four communication-electronic systems, sub systems 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**
   • transmitters (such as HF, VHF, UHF, microwave transmitters)
   • transceivers (such as HF, VHF, UHF, microwave receivers)
   • signal processing (analogue) (such as radar anti-clutter, comms audio and AGC stages)
   • signal processing (digital) (such as digital MTI, multiplexers, AGC)
   • aerial systems (such as phased arrays, long wire and parabolic reflectors)
   • transmission lines (such as optical fibres, co-ax, baluns, twin wire, waveguide)
   • display systems (such as CRT, plasma, TFT, TV tab)
   • man-machine interface (such as IS/ICT equipment or peripherals: keypads, keyboards, microphones)
   • electro-optical systems (such as cameras, thermal imaging, targetting systems)
   • hydraulic-electrical systems (such as hydraulic motors, HSUs and actuators)
   • cryptographic systems (such as data encryption and de-encryption)
   • built-in test equipment
   • data network systems (such as LANs, WANs)
   • data network Interfaces (such as switch, router, bridging networks)
   • any other identifiable communication-electronic system, sub-system or assemblies
Group B – associated equipment
- environmental control systems (such as temperature, humidity, vibration, shock, alarm and protection)
- electromechanical systems (such as servos, motors, relays, complex switches)
- power generation systems (such as fixed/transportable ac/dc generators, batteries)
- power distribution systems (such as single phase/3-phase distribution panels)
- power supply control systems (such as voltage/current series/shunt regulator/stabiliser)
- hybrid systems (such as ADC, DAC)

3 Carry out all of the following repair activities:
- application of electrostatic discharge (ESD) precautions
- preparation of areas for repairing
- disconnection/dismantling of required LRUs
- replacement of faulty LRUs
- re-assembly of LRUs in line with specification
- functionally testing completed equipment
- making any adjustments required

4 Replace five different LRUs from communication-electronic systems, sub-systems 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
- transmitters (such as HF, VHF, UHF, microwave transmitters)
- transceivers (such as HF, VHF, UHF, microwave)
- receivers (such as HF, VHF, UHF, microwave receivers)
- signal processing (analogue) (such as radar anti-clutter, comms audio and AGC stages)
- signal processing (digital) (such as digital MTI, multiplexers, AGC)
- aerial systems (such as phased arrays, long wire and parabolic reflectors)
- transmission lines (such as optical fibres, co-ax, baluns, twin wire, waveguide)
- display systems (such as CRT, plasma, TFT, TV tab)
- man-machine interface (such as IS/ICT equipment or peripherals: keypads, keyboards, microphones)
- electro-optical systems (such as cameras, thermal imaging, targetting systems)
- hydraulic-electrical systems (such as hydraulic motors, HSUs and actuators)
- cryptographic systems (such as data encryption and de-encryption)
- built-in test equipment
- data network systems (such as LANs, WANs)
- data network Interfaces (such as switch, router, bridging networks)
- any other identifiable electronic system, sub-system or assemblies

Group B – associated equipment
- environmental control systems (such as temperature, humidity, vibration, shock, alarm and protection)
- electromechanical systems (such as servos, motors, relays, complex switches)
- power generation systems (such as fixed/transportable ac/dc generators, batteries)
- power distribution systems (such as single phase/3-phase distribution panels)
- power supply control systems (such as voltage/current series/shunt regulator/stabiliser)
- hybrid systems (such as ADC, DAC)
5 Use appropriate joining/connecting techniques to deal with **four** of the following types of connection:
- push-fit connectors
- soldering or de-soldering
- clip assemblies
- threaded connections
- crimped connections
- zero insertion force (ZIF)
- adhesive joints/assemblies
- edge connectors
- insulation displacement connections (IDC)

6 Ensure the repaired systems comply with **one or more** of the following quality and accuracy standards:
- organisational guidelines and codes of practice
- equipment manufacturers’ operation range
- BS and ISO standards
- Ministry of Defence (MoD)

7 Complete **all** relevant paperwork from the following, and pass it to the appropriate people:
- job cards
- permits-to-work/formal risk assessment
- maintenance logs or reports
Unit 55
Repairing communication-electronic systems

Knowledge statements:
You must have knowledge and understanding of:
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 (electrical isolation, locking off switch gear, removal of fuses, placing maintenance warning notices, proving the 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, sub-system or assembly being worked on
5. The importance of wearing protective clothing and other appropriate safety equipment during the repair activities
6. The hazards associated with repairing communication-electronic systems, sub-systems or assemblies, or with equipment that is used, and how these can be minimised
7. The importance of keeping the work area clean and tidy and free from waste and surplus materials
8. How the activities may effect the work of others, and the procedure for informing them of the work to be carried out
9. The procedures and precautions to be adopted to eliminate electrostatic discharge
10. 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
11. The principles of how communication-electronic or associated systems function and interact
12. How sub-systems and assemblies function within a system
13. Organisational policy on the repair or replacement of faulty LRUs during the maintenance process
14. How to check that the replacement LRUs meet the required specification/operating conditions (values, tolerance, current-carrying capacity, ambient temperatures)
15. Methods of removing and replacing the faulty LRUs from the equipment (unplugging, desoldering, removal of screwed, clamped, edge connected, zero insertion force, fitted and crimped connection)
16. The importance of removing faulting LRUs without causing damage to other components or the surrounding structure
17. Methods of attaching identification marks/labels to removed LRUs or connections, to assist with re-assembly
18. 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
19. 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
20. How to reconnect the equipment, and checks that need to be made prior to restoring power (checking components for correct polarity, ensuring there are no exposed conductors, cable insulation is not damaged, all connections are mechanically and electrically secure, casings are free from loose screws)
21. The importance of making ‘off-load’ checks before proving the equipment with the electrical supply on
22. How to make adjustments to LRUs to ensure they function correctly
23. The maintenance documentation and/or reports that need completing following the maintenance activity, and the importance of ensuring that these reports are completed accurately, legibly and using appropriate technical language
24. The organisational procedures to be adopted for the safe disposal of waste of all types of materials
25. The extent of your own authority and whom you should report to if you have a problem that you cannot resolve
# Unit 55
## Repairing communication-electronic systems

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** Carry out all of the following during the repair activities: **

- Plan the repairing activities to cause minimum disruption to normal working
- Use the correct issue of company and/or manufacturers' drawings and maintenance documentation
- Adhere to risk assessment, COSHH and other relevant safety standards
- Ensure the safe isolation of equipment
- Provide safe access and working arrangements for the maintenance area
- Carry out the inspection and testing activities, using appropriate techniques and procedures
- Take electrostatic precautions when handling components and circuit boards
- Re-connect and return the system to service on completion of the repair activities
- Dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition
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Repairing communication-electronic systems

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**Carry out repair activities on four communication-electronic systems, sub systems 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**

- transmitters (such as HF, VHF, UHF, microwave transmitters)
- transceivers (such as HF, VHF, UHF, microwave)
- receivers (such as HF, VHF, UHF, microwave receivers)
- signal processing (analogue) (such as radar anti-clutter, comms audio and AGC stages)
- signal processing (digital) (such as digital MTI, multiplexers, AGC)
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- electro-optical systems (such as cameras, thermal imaging, targeting systems)
- hydraulic-electrical systems (such as hydraulic motors, HSUs and actuators)
- cryptographic systems (such as data encryption and de-encryption)
- built-in test equipment
- data network systems (such as LANs, WANs)
- data network Interfaces (such as switch, router, bridging networks)
- any other identifiable communication-electronic system, sub-system or assemblies
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Repairing communication-electronic systems

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**Carry out all of the following repair activities:**

- application of electrostatic discharge (ESD) precautions
- preparation of areas for repairing
- disconnection/dismantling of required LRUs
- replacement of faulty LRUs
- re-assembly of LRUs in line with specification
- functionally testing completed equipment
- making any adjustments required
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**Replace five different LRUs from communication-electronic systems, sub-systems 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

- Transmitters (such as HF, VHF, UHF, microwave transmitters)
- Transceivers (such as HF, VHF, UHF, microwave)
- Receivers (such as HF, VHF, UHF, microwave receivers)
- Signal processing (analogue) (such as radar anti-clutter, comms audio and AGC stages)
- Signal processing (digital) (such as digital MTI, multiplexers, AGC)
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- Cryptographic systems (such as data encryption and decryption)
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Repairing communication-electronic systems

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</table>

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

- push-fit connectors
- soldering or de-soldering
- clip assemblies
- threaded connections
- crimped connections
- zero insertion force (ZIF)
- adhesive joints/assemblies
- edge connectors
- insulation displacement connections (IDC)

Ensure the repaired systems comply with one or more of the following quality and accuracy standards:

- organisational guidelines and codes of practice
- equipment manufacturers’ operation range
- BS and ISO standards
- Ministry of Defence (MoD)
# Unit 55
Repairing communication-electronic systems

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<td>job cards</td>
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<td>permits-to-work/formal risk assessment</td>
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<tr>
<td>maintenance logs or reports</td>
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</tbody>
</table>

Knowledge and understanding reference:

Candidate: ________________________________ Date: ________________
Assessor: ________________________________ Date: ________________
**Unit 56**  
Carrying out planned maintenance on communication-electronic systems

**Unit summary**
This unit identifies the competencies you need to carry out planned maintenance on communication-electronic systems, in accordance with approved procedures. You will be required to carry out planned maintenance on a range of communication–electronic systems, sub-systems or assemblies. You will need to organise and carry out the planned maintenance activities to minimise downtime and to ensure that the maintained system performs at optimal level and functions to the required specification.

Your responsibilities will require you to comply with organisational policy and procedures for carrying out planned maintenance activities, and to report any problems with these activities that you cannot personally resolve, or 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 minimum 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 planned maintenance procedures within a communication-electronic system. You will know about the integrated technologies within the system, how the system functions, and the potential problems or defects that may occur. You will understand the process of developing planned maintenance, and its application, and will know about the criteria in adequate depth to provide a sound basis for carrying out the activities safely and effectively, and ensuring the system is maintained to the required specification. In addition, you will be expected to report where the outcome identifies the need for further investigation or maintenance work.

You will understand the safety precautions required when carrying out the planned maintenance activities, especially those for isolating the equipment and for 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.
**Unit 56**
Carrying out planned maintenance on communication-electronic systems

**Performance statements:**
You must:

a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Follow the relevant maintenance schedules to carry out the required work
c. Carry out the maintenance activities within the limits of your personal authority
d. Carry out the maintenance activities in the specified sequence and in an agreed time scale
e. Report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
f. Complete relevant maintenance records accurately and pass them on to the appropriate person
g. Dispose of waste materials in accordance with safe working practices and approved procedures

**Scope of the unit:**
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:

1. Carry out all of the following during the maintenance activities:
   - plan the maintenance activities to cause minimum disruption to normal working
   - use the correct issue of company and/or manufacturers’ drawings and maintenance documentation
   - adhere to risk assessment, COSHH and other relevant safety standards
   - ensure the safe isolation of equipment
   - provide safe access and working arrangements for the maintenance area
   - carry out the maintenance activities using appropriate techniques and procedures
   - re-connect and return the equipment to service on completion of the maintenance activities
   - dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition

2. Carry out maintenance activities on four communication electronic systems, sub-systems 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**
- transmitters (such as HF, VHF, UHF, microwave)
- transceivers (such as HF, VHF, UHF, microwave)
- receivers (such as HF, VHF, UHF, microwave)
- signal processing (analogue) (such as radar anti-clutter, comms audio and AGC stages)
- signal processing (digital) (such as digital MTI, multiplexers, AGC)
- aerial systems (such as phased arrays, long wire and parabolic reflectors)
- transmission lines (such as optical fibres, co-ax, baluns, twin wire, waveguide)
- display systems (such as CRT, plasma, TFT, TV tab)
- man-machine interface (such as IS/ICT equipment or peripherals: keypads, keyboards, microphones)
- electro-optical systems (such as cameras, thermal imaging, targeting systems)
- hydraulic-electrical systems (such as hydraulic motors, HSUs and actuators)
- cryptographic systems (such as data encryption and de-encryption)
- built-in test equipment
- data network systems (such as LANs, WANs)
- data network interfaces (such as switch, router, bridging networks)
- any other identifiable electronic system, sub-system or assemblies
**Group B – associated equipment**

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

3 Follow planned maintenance activities using **one** of the following types of maintenance schedule:
  - condition based maintenance
  - scheduled maintenance
  - total preventative maintenance

4 Carry out **10** of the following planned maintenance activities:
  - visual examination and testing of a system against the maintenance schedule
  - monitoring component condition/deterioration
  - making sensory checks (such as sight, sound, smell or touch)
  - replacing 'lifed' consumables
  - carrying out system self-analysis checks
  - removing excessive dirt or grime
  - making routine adjustments
  - carrying out leak checks on connections (where appropriate)
  - testing and reviewing the system operation
  - recording the results of the maintenance activity and reporting any identified or potential defects
  - checking the condition of cables
  - checking the integrity of connections
  - making insulation resistance checks

5 Ensure the maintained system meets **one or more** of the following quality and accuracy standards:
  - organisational guidelines and codes of practice
  - equipment manufacturer’s operation range
  - BS and ISO standards
  - Ministry of Defence (MOD) standards

6 Complete **all** relevant paperwork and pass it to the appropriate people:
  - job cards
  - maintenance log or report
  - permit-to-work/formal risk assessment
Unit 56
Carrying out planned maintenance on communication-electronic systems

Knowledge statements:
You must have knowledge and understanding of:
1. The health and safety requirements of the area in which the planned maintenance activity is to take place, and the responsibility they place on you
2. Your responsibilities under regulations relevant to the maintenance activities being undertaken
3. The isolation and lock-off procedure or permit-to-work procedure that applies to planned maintenance activities (electrical isolation, locking off switch gear, removal of fuses, placing maintenance warning notices, proving the isolation has been achieved and secured)
4. Isolation procedures unique to communication-electronic systems, sub-systems or assemblies
5. The specific health and safety precautions needed to be applied during the planned maintenance procedure and their effects on others
6. The hazards associated with carrying out planned maintenance activities on communication-electronic systems, sub-systems or assemblies (such as exposure to live conductors, misuse of tools), and how they can be minimised
7. The importance of wearing protective clothing and other appropriate safety equipment during the maintenance activities
8. The importance of keeping the work area clean and tidy and free from waste and surplus materials
9. How the maintenance activities may effect the work of others, and the procedure for informing them of the work to be carried out
10. The procedures and precautions to be adopted to eliminate electrostatic discharge
11. How to obtain and interpret drawings, system and physical layouts, charts, specifications, manufacturers' manuals, history/maintenance reports, graphical electrical symbols and other documents needed in the maintenance process
12. The maintenance schedules and methods to be followed in order to comply with company procedures for planned maintenance
13. The principles of how communication-electronic or associated systems function and interact
14. How sub-systems and assemblies function within a system
15. The maintenance methods and procedures to be used to check that the system conforms to acceptable limits
16. How to make sensory checks by sight, sound, smell or touch
17. The procedure for obtaining consumables and ‘lifed’ items that will require replacing during the maintenance activity
18. Company policy on repair/replacement of systems, sub-systems and assemblies during the planned maintenance process
19. Methods of checking that systems, sub-systems and assemblies are fit for purpose, and the need to replace ‘lifed’ items, such as batteries
20. How to make adjustments to systems, sub-systems and assemblies to ensure they function correctly
21. The generation of maintenance documentation and/or reports following the maintenance activity
22. The problems that can occur during the planned maintenance activity, and how they can be overcome
23. The organisational procedure to be adopted for the safe disposal of waste of all types of materials
24. The extent of your authority and whom you should report to if you have problems that you cannot resolve
## Unit 56
Carrying out planned maintenance on communication-electronic systems

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<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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**Carry out all of the following during the maintenance activities:**

- plan the maintenance activities to cause minimum disruption to normal working
- use the correct issue of company and/or manufacturers' drawings and maintenance documentation
- adhere to risk assessment, COSHH and other relevant safety standards
- ensure the safe isolation of equipment
- provide safe access and working arrangements for the maintenance area
- carry out the maintenance activities using appropriate techniques and procedures
- re-connect and return the equipment to service on completion of the maintenance activities
- dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition
**Unit 56**  
Carrying out planned maintenance on communication-electronic systems

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</table>

**Carry out maintenance activities on four communication electronic systems, sub-systems 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**
- transmitters (such as HF, VHF, UHF, microwave)
- transceivers (such as HF, VHF, UHF, microwave)
- receivers (such as HF, VHF, UHF, microwave)
- signal processing (analogue) (such as radar anti-clutter, comms audio and AGC stages)
- signal processing (digital) (such as digital MTI, multiplexers, AGC)
- aerial systems (such as phased arrays, long wire and parabolic reflectors)
- transmission lines (such as optical fibres, co-ax, baluns, twin wire, waveguide)
- display systems (such as CRT, plasma, TFT, TV tab)
- man-machine interface (such as IS/ICT equipment or peripherals: keypads, keyboards, microphones)
- electro-optical systems (such as cameras, thermal imaging, targetting systems)
- hydraulic-electrical systems (such as hydraulic motors, HSUs and actuators)
- cryptographic systems (such as data encryption and de-encryption)
- built-in test equipment
- data network systems (such as LANs, WANs)
- data network interfaces (such as switch, router, bridging networks)
- any other identifiable electronic system, sub-system or assemblies
## Unit 56
Carrying out planned maintenance on communication-electronic systems

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<td><strong>Group B – associated equipment</strong></td>
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<td>power distribution systems (such as single phase/3-phase distribution panels)</td>
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<td>power supply control systems (such as voltage/current series/shunt regulator/stabiliser)</td>
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<td>hybrid systems (such as ADC, DAC)</td>
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**Follow planned maintenance activities using one of the following types of maintenance schedule:**

- condition based maintenance
- scheduled maintenance
- total preventative maintenance

**Carry out 10 of the following planned maintenance activities:**

- visual examination and testing of a system against the maintenance schedule
- monitoring component condition/deterioration
- making sensory checks (such as sight, sound, smell or touch)
- replacing ‘lifed’ consumables
- carrying out system self-analysis checks
- removing excessive dirt or grime
- making routine adjustments
- carrying out leak checks on connections (where appropriate)
### Unit 56
Carrying out planned maintenance on communication-electronic systems

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<td>recording the results of the maintenance activity and reporting any identified or potential defects</td>
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<td>making insulation resistance checks</td>
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**Ensure the maintained system meets one or more of the following quality and accuracy standards:**

- organisational guidelines and codes of practice
- equipment manufacturer’s operation range
- BS and ISO standards
- Ministry of Defence (MOD) standards

**Complete all relevant paperwork and pass it to the appropriate people:**

- job cards
- maintenance log or report
- permit-to-work/formal risk assessment

Knowledge and understanding reference:

Candidate: _______________________________________________  Date: ___________________

Assessor: ________________________________________________   Date: ___________________
Unit 57
Modifying communication-electronic systems

Unit summary
This unit identifies the competencies you need to modify communications-electronic systems, sub-systems or assemblies, in accordance with approved procedures. You will be required to change, modify and update communication-electronic systems, sub-systems or assemblies, in accordance with modification leaflets, latest issue drawings and standards. You will be expected to remove and replace cables, add new cables and change the route of cables. You will also be expected to modify LRUs (line replacement units) within communication-electronic systems. You will need to show proficiency in using various tools and techniques during the modification process.

Your responsibilities will require you to comply with organisational policy and procedures for the modifications undertaken, and to report any problems with the modification activities or components that you cannot personally resolve, or are outside your permitted authority, to the relevant people. You will be expected to work with minimum supervision, taking full responsibility for your 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 modifications procedures to communication-electronic systems. You will understand the modification, and its application, and will know about the modification requirements and methods, in adequate depth to provide sound basis for carrying out the activities, correcting faults and ensuring the completed modification is to the required specification.

You will understand the safety precautions required when carrying out the modifications. You will be required to demonstrate safe practices throughout, and will understand the responsibility you owe to yourself and others in the workplace.
Unit 57
Modifying communication-electronic systems

Performance statements:
You must:
a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Obtain and follow the relevant modification specifications and job instructions
c. Confirm and agree what modifications are to be carried out to meet the specification
d. Prepare the communication-electronic system for the required modification
e. Carry out the system modification using approved materials, methods and procedures
f. Complete the modification within the agreed timescale
g. Ensure the modified communication-electronic system meets the specified operating conditions
h. Produce accurate and complete records of all modification work carried out
i. Deal promptly and effectively with problems within your control and report those that cannot be solved

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:
1 Carry out all of the following during the modification activity:
   • use the correct issue of company and/or manufacturers’ documentation
   • adhere to risk assessment, COSHH and other relevant safety standards
   • ensure the safe isolation of equipment
   • provide safe access and working arrangements for the work area
   • modify ground electronic systems using approved techniques and procedures
   • apply safe working practices and procedures at all times
   • dispose of waste items in a safe and environmentally acceptable manner
   • leave the work area in a safe condition

2 Carry out modification activities on four communication electronic systems, sub-systems 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
• transmitters (such as HF, VHF, UHF, microwave)
• transceivers (such as HF, VHF, UHF, microwave)
• receivers (such as HF, VHF, UHF, microwave)
• signal processing (analogue) (such as radar anti-clutter, comms audio and AGC stages)
• signal processing (digital) (such as digital MTI, multiplexers, AGC)
• aerial systems (such as phased arrays, long wire and parabolic reflectors)
• transmission lines (such as optical fibres, co-ax, baluns, twin wire, waveguide)
• display systems (such as CRT, plasma, TFT, TV tab)
• man-machine interface (such as IS/ICT equipment or peripherals: keypads, keyboards, microphones)
• electro-optical systems (such as cameras, thermal imaging, targeting systems)
• hydraulic-electrical systems (such as hydraulic motors, HSUs and actuators)
• cryptographic systems (such as data encryption and de-encryption)
• built-in test equipment
• data network systems (such as LANs, WANs)
• data network interfaces (such as switch, router, bridging networks)
• any other identifiable electronic system, sub-system or assemblies
Group B – associated equipment

• environmental control systems (such as temperature, humidity, vibration, shock, alarm and protection)
• electromechanical systems (such as servos, motors, relays, complex switches)
• power generation systems (such as fixed/transportable ac/dc generators, batteries)
• power distribution systems (such as single phase/3-phase distribution panels)
• power supply control systems (such as voltage/current series/shunt regulator/stabiliser)
• hybrid systems (such as ADC, DAC)

3  Carry out **six** of the following types of modification:

• removing cables
• adding cables
• changing routes of cables
• making changes to looms
• making changes to LRUs
• adding or removing LRUs
• altering settings
• upgrading mechanical systems
• upgrading electrical systems
• upgrading electronic systems
• improving equipment safety
• improving personal safety
• improving equipment performance

4  Carry out **six** of the following processes during the modification activities:

• soldering and de-soldering
• heat shrinking (devices or boots)
• crimping
• stripping
• removing cable end fittings
• changing components
• repositioning units
• removing cable protection
• making mechanical/screwed/clamped connections
• allocating identification markings
• changing LRUs

5  Produce modifications, which comply with **one or more** of the following standards:

• customer standards and requirements
• company standards and requirements
• BS and ISO standards and procedures
• Ministry of Defence (MOD)
• manufacturers’ standards and requirements

6  Complete relevant paperwork, to include **one** of the following, and pass it to the appropriate people:

• job cards
• maintenance log or report
• modification record
• permit-to-work/formal risk assessment
Unit 57
Modifying communication-electronic systems

Knowledge statements:
You must have knowledge and understanding of:
1. The specific safety precautions and procedures to be observed whilst carrying out the modification to ground communication-electronic systems, including any specific regulations or codes of practice related to the activities, equipment or materials
2. The health and safety requirements of the work area in which you are carrying out the modification activities, and the responsibilities these requirements place on you
3. The hazards associated with carrying out modifications to ground communication-electronic systems, and how they can be minimised
4. Personal protective equipment and clothing to be worn during the modification activities
5. The various types of drawing and specifications that are used during the modification (such as physical layouts, charts, specifications, manufacturers' manuals, history/maintenance reports, graphical electrical symbols)
6. How to identify the components to be used; component identification systems (codes and component orientation indicators)
7. Preparations that need to be undertaken on the system, prior to carrying out the modification
8. The methods and techniques to be used for soldering and de-soldering, and the importance of adhering to them
9. The methods and techniques to be used for crimping and heat shrinking, and the importance of adhering to them
10. The procedures and precautions to be adopted to eliminate electrostatic discharge
11. The basic operation of the communication-electronic system, sub-system and assembly being modified, and the purpose of associated components
12. The different types of cable protection, and reasons for using each type
13. The various mechanical fasteners that will be used, and their method of installation
14. The importance of using the specified fasteners for the modification, and why you must not use substitutes
15. The quality control procedures to be followed during the modification operations
16. How to conduct any necessary checks to ensure the accuracy and quality of the modification
17. How to recognise defects (such as misalignment, ineffective fasteners, foreign object damage or contamination)
18. The problems that can occur with the modification operations, and how these can be overcome
19. The organisational procedures to be adopted for the safe disposal of waste of all types of materials
20. The documentation and/or reports to be completed following the modification activity, and the importance of ensuring that these reports are completed accurately and legibly
21. The organisational policy on modification and how the process should be undertaken
22. The extent of your own responsibility and whom you should report to if you have problems that you cannot resolve
### Unit 57
Modifying communication-electronic systems

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**Carry out all of the following during the modification activity:**

- Use the correct issue of company and/or manufacturers’ documentation
- Adhere to risk assessment, COSHH and other relevant safety standards
- Ensure the safe isolation of equipment
- Provide safe access and working arrangements for the work area
- Modify ground electronic systems using approved techniques and procedures
- Apply safe working practices and procedures at all times
- Dispose of waste items in a safe and environmentally acceptable manner
- Leave the work area in a safe condition

**Carry out modification activities on four communication electronic systems, sub-systems 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**

- Transmitters (such as HF, VHF, UHF, microwave)
- Transceivers (such as HF, VHF, UHF, microwave)
- Receivers (such as HF, VHF, UHF, microwave)
- Signal processing (analogue) (such as radar anti-clutter, comms audio and AGC stages)
- Signal processing (digital) (such as digital MTI, multiplexers, AGC)
- Aerial systems (such as phased arrays, long wire and parabolic reflectors)
# Unit 57
Modifying communication-electronic systems

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### Group B – associated equipment

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Modifying communication-electronic systems

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**Carry out six of the following types of modification:**

- removing cables
- adding cables
- changing routes of cables
- making changes to looms
- making changes to LRUs
- adding or removing LRUs
- altering settings
- upgrading mechanical systems
- upgrading electrical systems
- upgrading electronic systems
- improving equipment safety
- improving personal safety
- improving equipment performance

**Carry out six of the following processes during the modification activities:**

- soldering and de-soldering
- heat shrinking (devices or boots)
- crimping
- stripping
- removing cable end fittings
- changing components
- repositioning units
- removing cable protection
- making mechanical/screwed/clamped connections
- allocating identification markings
- changing LRUs

**Produce modifications, which comply with one or more of the following standards:**

- customer standards and requirements
- company standards and requirements
- BS and ISO standards and procedures
- Ministry of Defence (MOD)
- manufacturers’ standards and requirements
Unit 57
Modifying communication-electronic systems

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<td><strong>Complete relevant paperwork, to include one of the following, and pass it to the appropriate people:</strong></td>
<td>job cards</td>
<td>maintenance log or report</td>
<td>modification record</td>
<td>permit-to-work/formal risk assessment</td>
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</tbody>
</table>

Knowledge and understanding reference:

Candidate: _______________________________________________  Date: ___________________

Assessor: ________________________________________________   Date: ___________________
Unit 58
Configure communication-electronic systems

Unit summary
This unit identifies the competencies you need to carry out configuration tasks on communication-electronic systems, in accordance with approved procedures. You will be required to configure a range of communication-electronic systems, sub-systems or assemblies into a complete communication-electronic operating system. You will need to carry out the configuration activities to ensure that the system, sub-system or assembly performs to the optimal level and functions as per the required specifications.

Your responsibilities will require you to comply with organisational policy and procedures for the configuration activities undertaken, and to report any problems with the configuration activities that you cannot personally resolve, or are outside your permitted authority, to the relevant people. You will be expected to work with minimum supervision, taking full 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 configuration procedures to communication-electronic systems and equipment. You will understand the configuration activity and its application, and will know about the various sub-assemblies and their purpose within the system, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

You will understand the safety precautions required when carrying out the configuration activities, especially those for isolating the equipment and for 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.
Unit 58
Configure communication-electronic systems

Performance statements:
You must:
a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Follow all relevant setting up and operating specifications for the products or assets being configured
c. Follow the defined procedures and set up the equipment correctly ensuring that all operating parameters are achieved
d. Deal promptly and effectively with problems within your control and report those that cannot be solved
e. Check that the configuration is complete and that the equipment operates to specification
f. Complete all relevant documentation accurately and legibly

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:
1. Carry out all the following during the configuration activities:
   • use the correct issue of company publications and/or manufacturers’ documentation
   • use and adhere to copies of relevant COSHH sheets and risk assessments
   • configure communication-electronic systems using approved methods and techniques
   • apply safe working practices and procedures at all times
   • dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition

2. Configure systems that contain at least four communication-electronic sub-systems or assemblies, at least two of which must be selected from group A. Note: Any of the items below can be identified as a sub-system or assembly in its own right.

Group A – communication electronic
• transmitters (such as HF, VHF, UHF, microwave)
• transceivers (such as HF, VHF, UHF, microwave)
• receivers (such as HF, VHF, UHF, microwave)
• signal processing (analogue) (such as radar anti-clutter, comms audio and AGC stages)
• signal processing (digital) (such as digital MTI, multiplexers, AGC)
• aerial systems (such as phased arrays, long wire and parabolic reflectors)
• transmission lines (such as optical fibres, co-ax, baluns, twin wire, waveguide)
• display systems (such as CRT, plasma, TFT, TV tab)
• man-machine interface (such as IS/ICT equipment or peripherals: keypads, keyboards, microphones)
• electro-optical systems (such as cameras, thermal imaging, targetting systems)
• hydraulic-electrical systems (such as hydraulic motors, HSUs and actuators)
• cryptographic systems (such as data encryption and de-encryption)
• built-in test equipment
• data network systems (such as LANs, WANs)
• data network interfaces (such as switch, router, bridging networks)
• any other identifiable electronic sub-system or assemblies to LRU level
Group B – associated equipment
- environmental control systems (such as temperature, humidity, vibration, shock, alarm and protection)
- electromechanical systems (such as servos, motors, relays, complex switches)
- power generation systems (such as fixed/transportable ac/dc generators, batteries)
- power distribution systems (such as single phase/3-phase distribution panels)
- power supply control systems (such as voltage/current series/shunt regulator/stabiliser)
- hybrid systems (such as ADC, DAC)

3 Configure systems using a range of tools and equipment, to include four of the following:
- oscilloscope
- ammeter
- logic analyser
- Q meter
- current tracer
- signal generator
- multimeter
- computer aided diagnostic equipment
- special-purpose testing equipment
- temperature testing devices
- power meters
- valve tester
- spectrum analyser
- time domain reflectometer
- frequency counter
- protocol analyser
- breakout box
- automatic test equipment
- other specific equipment

4 Adjust the systems using all of the following, as applicable to the equipment being configured:
- logic states
- DC voltage/current levels
- AC voltage/current levels
- clock/timer switching
- pulse width/rise time
- open/short circuit
- resistance
- heat dissipation
- frequency modulation/demodulation
- performance of system, sub-system or assembly
- conditions of assemblies and components
- signal noise/interference levels

5 Carry out all of the following checks during the configuration process:
- system location and security are correct
- system earth bonding is correct
- all connections are correctly made (mechanical and electrical)
- system powers up correctly
- system powers down correctly
Ensure the configured system meets **all** of the following quality and accuracy standards:
- system operates to specifications
- any potential defects are identified and reported to the appropriate authority for further action
- all relevant documentation is completed accurately and legibly
- the system is formally accepted by the end user

Provide a record/report of the configuration outcome(s), using **one** of the following:
- job card
- company-specific reporting procedure
- specific configuration report
Unit 58
Configure communication-electronic systems

Knowledge statements:
You must have knowledge and understanding of:
1. The specific safety practices and procedures that you need to observe when configuring communication-electronic systems (including any specific legislation, regulations/codes of practice for the activities, equipment or materials)
2. How to recognise and deal with victims of electric shock (to include methods of safely removing victims from the power source and methods of first aid resuscitation)
3. The health and safety requirements of the work area where you are carrying out the activities, and the responsibility these requirements place on you
4. The hazards associated with configuring communication-electronic systems, and how they can be minimised
5. The personal protective equipment that you need to use during the configuration activities
6. The interpretation of drawings, standards, quality control procedures and specifications used for the configuration activity
7. The methods used during the configuring of a communication-electronic system
8. The components to be configured, and their function within the particular communications-electronic systems
9. The quality control procedures to be followed during the configuration process
10. The techniques used to check the position, alignment and security of the components in a communication-electronic system
11. Why electrical bonding is critical, and why it must be both mechanically and electrically secure
12. How to conduct any necessary checks and adjustments to the equipment to ensure the system integrity, functionality, accuracy and quality
13. The various system operating procedures and their specific configuration requirements
14. The tools and equipment used in the configuration process, and their calibration/care and control procedures
15. Why tool/equipment control is critical, and what to do if a tool or piece of equipment is unaccounted for on completion of the configuration process
16. The problems that can occur with the configuration process, and how these can be overcome
17. What recording documentation needs to be completed for the configuration activities undertaken
18. The extent of your own responsibility and whom you should report to if you have problems that you cannot resolve
Unit 58
Configure communication-electronic systems

<table>
<thead>
<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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</table>

**Carry out all the following during the configuration activities:**

- use the correct issue of company publications and/or manufacturers’ documentation
- use and adhere to copies of relevant COSHH sheets and risk assessments
- configure communication-electronic systems using approved methods and techniques
- apply safe working practices and procedures at all times
- dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition

**Configure systems that contain at least four communication-electronic sub-systems or assemblies, at least two of which must be selected from group A:**

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

**Group A – communication electronic**

- transmitters (such as HF, VHF, UHF, microwave)
- transceivers (such as HF, VHF, UHF, microwave)
- receivers (such as HF, VHF, UHF, microwave)
- signal processing (analogue) (such as radar anti-clutter, comms audio and AGC stages)
- signal processing (digital) (such as digital MTI, multiplexers, AGC)
- aerial systems (such as phased arrays, long wire and parabolic reflectors)
- transmission lines (such as optical fibres, co-ax, baluns, twin wire, waveguide)
- display systems (such as CRT, plasma, TFT, TV tab)
**Unit 58**  
Configure communication-electronic systems

<table>
<thead>
<tr>
<th>evidence record sheet</th>
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<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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<tbody>
<tr>
<td>man-machine interface (such as IS/ICT equipment or peripherals: keypads, keyboards, microphones)</td>
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<td>electro-optical systems (such as cameras, thermal imaging, targeting systems)</td>
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<td>hydraulic-electrical systems (such as hydraulic motors, HSUs and actuators)</td>
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<td>cryptographic systems (such as data encryption and decryption)</td>
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<td>built-in test equipment</td>
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<td>data network systems (such as LANs, WANs)</td>
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<td>data network interfaces (such as switch, router, bridging networks)</td>
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<td>any other identifiable electronic sub-system or assemblies to LRU level</td>
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<td><strong>Group B – associated equipment</strong></td>
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<td>environmental control systems (such as temperature, humidity, vibration, shock, alarm and protection)</td>
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<td>electromechanical systems (such as servos, motors, relays, complex switches)</td>
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<td>power generation systems (such as fixed/transportable ac/dc generators, batteries)</td>
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<td>power distribution systems (such as single phase/3-phase distribution panels)</td>
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<td>power supply control systems (such as voltage/current series/shunt regulator/stabiliser)</td>
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<td>hybrid systems (such as ADC, DAC)</td>
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Unit 58
Configure communication-electronic systems

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<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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<tbody>
<tr>
<td>Configure systems using a range of tools and equipment, to include four of the following:</td>
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<td>oscilloscope</td>
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<td>ammeter</td>
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<td>logic analyser</td>
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<td>Q meter</td>
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<td>current tracer</td>
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<td>signal generator</td>
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<td>multimeter</td>
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<td>computer aided diagnostic equipment</td>
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<td>special-purpose testing equipment</td>
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<td>temperature testing devices</td>
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<td>power meters</td>
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<td>valve tester</td>
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<td>spectrum analyser</td>
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<td>time domain reflectometer</td>
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<td>frequency counter</td>
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<td>protocol analyser</td>
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<td>breakout box</td>
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<tr>
<td>automatic test equipment</td>
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<td>other specific equipment</td>
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<tr>
<td>Adjust the systems using all of the following, as applicable to the equipment being configured:</td>
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<td>logic states</td>
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<td>DC voltage/current levels</td>
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<td>AC voltage/current levels</td>
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<td>clock/timer switching</td>
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<td>pulse width/rise time</td>
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<td>open/short circuit</td>
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<td>resistance</td>
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<td>frequency modulation/demodulation</td>
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<td>performance of system, sub-system or assembly</td>
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<td>conditions of assemblies and components</td>
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<tr>
<td>signal noise/interference levels</td>
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Unit 58
Configure communication-electronic systems

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<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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<tr>
<td><strong>Carry out all of the following checks during the configuration process:</strong></td>
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<tr>
<td>system location and security are correct</td>
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<tr>
<td>system earth bonding is correct</td>
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<tr>
<td>all connections are correctly made (mechanical and electrical)</td>
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<tr>
<td>system powers up correctly</td>
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<td>system powers down correctly</td>
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| **Ensure the configured system meets all of the following quality and accuracy standards:** |
| system operates to specifications |
| any potential defects are identified and reported to the appropriate authority for further action |
| all relevant documentation is completed accurately and legibly |
| the system is formally accepted by the end user |

| **Provide a record/report of the configuration outcome(s), using one of the following:** |
| job card |
| company-specific reporting procedure |
| specific configuration report |

Knowledge and understanding reference:

Candidate: ___________________________ Date: ___________________

Assessor: __________________________ Date: ___________________
Unit 59
Installing communication-electronic systems

Unit summary
This unit identifies the competencies you need to install communication-electronic systems, in accordance with approved procedures. You will be required to use appropriate installation publications, orders and specifications to install the various systems, sub-systems or assemblies. You will be expected to position, align and connect communication-electronic systems, sub-systems or assemblies in their correct locations, using the specified or appropriate techniques.

Your responsibilities will require you to comply with organisational policy and procedures for the installation activities undertaken, and to report any problems with the installation activities, components or equipment that you cannot personally resolve, or are outside your permitted authority, to the relevant people. You will be expected to work with minimum 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 installation techniques and procedures. You will understand the communication-electronic systems being installed, and their application, and will know about the installation techniques, tools and methods, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

You will understand the safety precautions required when carrying out installation activities, especially those for ensuring safe isolation of 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.
Unit 59
Installing communication-electronic systems

Performance statements:
You must:
a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Follow all relevant drawings and specifications for the installation being carried out
c. Use the correct tools and equipment for the installation operations and check that they are in a safe and usable condition
d. Install, position and secure the equipment and components in accordance with the specification
e. Ensure that all necessary connections to the equipment are complete
f. Deal promptly and effectively with problems within your control and report those that cannot be solved
g. Check that the installation is complete and that all components are free from damage

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.
You must:
1  Carry out all of the following during the installation activity:
   • use the correct issue of company publications and planning documentation
   • use and adhere to copies of relevant COSHH sheets and risk assessments
   • check the calibration dates of tools and test equipment to be used
   • use approved deployment/installation techniques and procedures at all times
   • provide safe access and working arrangements to the work area
   • dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition
2  Install systems that contain four communication-electronic sub-systems or assemblies, 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
• transmitters (such as HF, VHF, UHF, microwave)
• transceivers (such as HF, VHF, UHF, microwave)
• receivers (such as HF, VHF, UHF, microwave)
• signal processing (analogue) (such as radar anti-clutter, comms audio and AGC stages)
• signal processing (digital) (such as digital MTI, multiplexers, AGC)
• aerial systems (such as phased arrays, long wire and parabolic reflectors)
• transmission lines (such as optical fibres, co-ax, baluns, twin wire, waveguide)
• display systems (such as CRT, plasma, TFT, TV tab)
• man-machine interface (such as IS/ICT equipment or peripherals: keypads, keyboards, microphones)
• electro-optical systems (such as cameras, thermal imaging, targetting systems)
• hydraulic-electrical systems (such as hydraulic motors, HSUs and actuators)
• cryptographic systems (such as data encryption and de-encryption)
• built-in test equipment
• data network systems (such as LANs, WANs)
• data network interfaces (such as switch, router, bridging networks)
• any other identifiable electronic system, sub-system or assemblies to LRU level
Group B – associated equipment

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

3 Use all the following installation methods and techniques:
- levelling and aligning
- earth bonding
- taking ESSD precautions
- securing and locking

4 Make three of the following types of mechanical securing connections:
- nuts & bolts
- locking devices
- screws
- torque load bolts
- quick release fasteners

5 Make five of the following types of electrical connection:
- co-axial
- D10
- screened
- quad
- data cable
- free plugs and sockets
- earth bonding points
- fibre-optic

6 Carry out installations which comply with one or more of the following standards:
- customer standards and requirements
- company standards and requirements
- BS or ISO standards and procedures
- Ministry of Defence (MOD)
- manufacturers’ standards and requirements

7 Complete the relevant paperwork, to include one from the following, and pass it to the appropriate people:
- job cards
- specific deployment/installation report
- build records
Knowledge statements:
You must have knowledge and understanding of:
1. The specific safety practices and procedures that you need to observe when installing communication-electronic systems (including any specific legislation, regulations/codes of practice for the activities, equipment or materials)
2. The health and safety requirements of the work area where you are carrying out the installation activities, and the responsibility these requirements place on you
3. The hazards associated with installing communication-electronic systems, and how they can be minimised
4. The personal protective equipment that you need to use during the installation activities
5. The interpretation of drawings, standards, quality control procedures and specifications used for installation
6. The components, communication-electronic systems, sub-systems and assemblies to be installed, and their function within the particular communication-electronic systems
7. The various mechanical fasteners that will be used, and their method of installation
8. The importance of using the specified fasteners for the particular installation, and why you must not substitute others
9. What the torque loading requirements are on the fasteners, and what to do if these loadings are exceeded or not achieved
10. The quality control procedures to be followed during the installation operations
11. Procedures for ensuring you have the correct tools, equipment, components and fasteners for the activities
12. The techniques used to position, align, adjust and secure the components of the communication-electronic systems without damage
13. Methods of lifting, handling and supporting the components/equipment during the installation activities
14. Why electrical bonding is critical, and why it must be both mechanically and electrically secure
15. How to conduct any necessary checks to ensure the system integrity, functionality, accuracy and quality of the installation
16. The tools and equipment used in the installation activities, and their calibration/care and control procedures
17. Why tool/equipment control is critical, and what to do if a tool or piece of equipment is unaccounted for on completion of the activities
18. The problems that can occur with the installation operations, and how these can be overcome
19. What recording documentation must be completed for the installation activities undertaken
20. The extent of your own responsibility and whom you should report to if you have problems that you cannot resolve
**Unit 59**
Installing communication-electronic systems

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<thead>
<tr>
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<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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**evidence type**

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**Carry out all of the following during the installation activity:**

- use the correct issue of company publications and planning documentation
- use and adhere to copies of relevant COSHH sheets and risk assessments
- check the calibration dates of tools and test equipment to be used
- use approved deployment/installation techniques and procedures at all times
- provide safe access and working arrangements to the work area
- dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition

**Install systems that contain four communication-electronic sub-systems or assemblies, 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

- transmitters (such as HF, VHF, UHF, microwave)
- transceivers (such as HF, VHF, UHF, microwave)
- receivers (such as HF, VHF, UHF, microwave)
- signal processing (analogue) (such as radar anti-clutter, comms audio and AGC stages)
- signal processing (digital) (such as digital MTI, multiplexers, AGC)
- aerial systems (such as phased arrays, long wire and parabolic reflectors)
- transmission lines (such as optical fibres, co-ax, baluns, twin wire, waveguide)
# Unit 59
## Installing communication-electronic systems

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<tbody>
<tr>
<td>display systems (such as CRT, plasma, TFT, TV tab)</td>
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<tr>
<td>man-machine interface (such as IS/ICT equipment or peripherals: keypads, keyboards, microphones)</td>
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<tr>
<td>electro-optical systems (such as cameras, thermal imaging, targeting systems)</td>
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<tr>
<td>hydraulic-electrical systems (such as hydraulic motors, H5Us and actuators)</td>
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<td>cryptographic systems (such as data encryption and de-encryption)</td>
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<tr>
<td>built-in test equipment</td>
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<tr>
<td>data network systems (such as LANs, WANs)</td>
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<tr>
<td>data network interfaces (such as switch, router, bridging networks)</td>
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<tr>
<td>any other identifiable electronic system, sub-system or assemblies to LRU level</td>
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</table>

### Group B – associated equipment

<table>
<thead>
<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
</tr>
</thead>
<tbody>
<tr>
<td>environmental control systems (such as temperature, humidity, vibration, shock, alarm and protection)</td>
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<tr>
<td>electromechanical systems (such as servos, motors, relays, complex switches)</td>
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<tr>
<td>power generation systems (such as fixed/transportable ac/dc generators, batteries)</td>
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<tr>
<td>power distribution systems (such as single phase/3-phase distribution panels)</td>
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<tr>
<td>power supply control systems (such as voltage/current series/shunt regulator/stabiliser)</td>
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<td>hybrid systems (such as ADC, DAC)</td>
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</table>
# Unit 59
## Installing communication-electronic systems

### Evidence Record Sheet

<table>
<thead>
<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
</tr>
</thead>
</table>

**Use all the following installation methods and techniques:**

- levelling and aligning
- earth bonding
- taking ESSD precautions
- securing and locking

**Make three of the following types of mechanical securing connections:**

- nuts & bolts
- locking devices
- screws
- torque load bolts
- quick release fasteners

**Make five of the following types of electrical connection:**

- co-axial
- D10
- screened
- quad
- data cable
- free plugs and sockets
- earth bonding points
- fibre-optic

**Carry out installations which comply with one or more of the following standards:**

- customer standards and requirements
- company standards and requirements
- BS or ISO standards and procedures
- Ministry of Defence (MOD)
- manufacturers’ standards and requirements

**Complete the relevant paperwork, to include one from the following, and pass it to the appropriate people:**

- job cards
- specific deployment/installation report
- build records

Knowledge and understanding reference:

Candidate: _______________________________ Date: ________________

Assessor: ________________________________ Date: ________________
Unit 60:
Carrying Out Fault Diagnosis on Medical Equipment

Unit Summary
This unit identifies the competences you need to carry out efficient and effective fault diagnosis on medical equipment, in accordance with approved procedures. You will be required to diagnose faults on a range of medical equipment, both at unit and component level. This will include equipment such as cardiovascular equipment, physiological, monitoring and infusion equipment, anaesthetic and ventilation equipment, operating theatre and surgical equipment, medical imaging equipment, laboratory equipment, dental equipment, therapeutic equipment and mechanical or electromechanical assisted technology (AT) equipment.

You will be expected to use a variety of fault diagnostic methods and techniques, and to utilise a number of diagnostic aids and equipment. From the evidence gained, you will be expected to identify the fault and its probable cause, and to suggest appropriate action to remedy the problem.

Your responsibilities will require you to comply with organisational policy and procedures for the fault diagnostic activities undertaken, and to report any problems with these activities or with the tools and equipment used, that you cannot personally resolve or are outside your permitted authority, to the relevant people. You will be expected to work with a minimum of supervision, taking full 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 fault diagnostic procedures to medical equipment. You will understand the various fault diagnostic methods and techniques used, and their application. You will also know how to apply and interpret information obtained from diagnostic aids and equipment, in adequate depth to provide a sound basis for carrying out the activities and for identifying faults or conditions that are outside the required specification.

You will understand the safety precautions required when carrying out the servicing 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.
Unit 60:
Carrying Out Fault Diagnosis on Medical Equipment

Performance statements:
You must:

a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Review and use all relevant information on the symptoms and problems associated with the products or assets
c. Investigate and establish the most likely causes of the faults
d. Select, use and apply diagnostic techniques, tools and aids to locate faults
e. Complete the fault diagnosis within the agreed time and inform the appropriate people when this cannot be achieved
f. Determine the implications of the fault for other work and for safety considerations
g. Use the evidence gained to draw valid conclusions about the nature and probable cause of the fault
h. Record details on the extent and location of the faults in an appropriate format

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:
1. Carry out all of the following during the fault diagnostic activity:
   - plan the fault diagnosis, using all available information about the fault, prior to starting
   - use the correct issue of company and/or manufacturer’s drawings and maintenance documentation
   - adhere to risk assessment, COSHH and other relevant safety standards
   - ensure that the correct equipment decontamination procedure has been adhered to, before and after the fault diagnostic activities
   - ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
   - provide safe access and working arrangements for the maintenance area
   - carry out the fault diagnostic activities, using approved procedures
   - disconnect or isolate components, or parts of circuits when appropriate, to confirm the diagnosis
   - where appropriate, apply electrostatic discharge (ESD) protection procedures when handling sensitive components and circuit boards
   - identify the fault and determine the appropriate corrective action
   - dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition

2. Carry out fault diagnosis on three of the following types of medical equipment:
   - cardiovascular equipment
   - physiological monitoring and infusion equipment
   - anaesthetic and ventilation equipment
   - operating theatre and surgical equipment
   - mechanical/electromechanical AT equipment
   - medical imaging equipment
   - laboratory equipment
   - dental equipment
   - therapeutic equipment
3. Collect evidence about the fault from **four** of the following sources:
   - the person who reported the fault
   - test instrument measurements
   - medical equipment simulators
   - equipment self-diagnosis
   - equipment outputs
   - circuit meters (such as voltmeter, power factor meter, ammeter)
   - sensory input (such as sight, sound, smell, touch)
   - recording/indicator devices
   - servicing records

4. Use a range of fault diagnostic techniques, to include:
   - six point technique
   - Plus **three** more from the following:
     - emergent sequence
     - input/output technique
     - half-split technique
     - unit substitution
     - function testing
     - injection and sampling

5. Use a variety of diagnostic aids and equipment, to include **four** of the following:
   - logic diagrams
   - flow charts or algorithms
   - probability charts/reports
   - computer-aided test equipment
   - fault analysis charts (such as fault trees)
   - manufacturers’ manuals
   - troubleshooting guides
   - electronic aids

6. Use **all** of the following fault diagnostic procedures:
   - inspection (such as breakages, wear/deterioration, signs of overheating, missing parts, loose fittings)
   - operation (such as manual switching off and on, automatic switching/timing/sequencing, outputs)
   - measurement (such as voltage, current, continuity, logic state, noise, frequency, signal shape and level)

7. Use **eight** of the following types of test equipment to aid fault diagnosis:
   - oscilloscope
   - multimeter
   - medical equipment simulators
   - ammeter
   - logic analyser
   - logic probe
   - voltmeter
   - signal tracer
   - signal generator
   - electrical safety analyser
   - special purpose testing equipment
   - BITE (built in test equipment)
   - insulation resistance tester
   - residual current (RCD) tester
   - portable appliance tester (PAT)
• temperature measuring devices
• flow measuring devices
• pressure measuring devices

8. Find faults that have resulted in **two** of the following breakdown categories:
   • intermittent problem
   • partial failure/out-of-specification output
   • complete breakdown

9. Provide a record of the outcome of the fault diagnosis, using **one** of the following:
   • step-by-step analytical report
   • preventative maintenance log/report
   • corrective action report
   • company-specific reporting procedure
Unit 60: Carrying Out Fault Diagnosis on Medical Equipment

Knowledge statements:
You must have knowledge and understanding of:

1. The health and safety, infection control and de-contamination requirements of the area in which the fault diagnostic activity is to take place, and the responsibility these requirements place on you
2. The statutory and advisory documentation relating to medical devices (such as warnings and guidance from the regulatory authority, and British and European standards)
3. The importance of reporting any equipment adverse incidents to the regulatory authority
4. The isolation procedure or permit-to-work procedure that applies
5. How to recognise and deal with victims of electric shock (to include methods of safely removing the victim from the power source, isolating the power source, and methods of first aid resuscitation)
6. The importance of wearing protective clothing and other appropriate safety equipment during the fault diagnostic activities
7. Hazards associated with carrying out fault diagnosis on electronic equipment (such as mains electricity, stored capacitive/inductive/electrostatic energy, misuse of tools), and how they can be minimised
8. The basic principles of how the medical equipment functions, its operating sequence, the function/purpose of individual units/components, and how they interact
9. How to obtain and interpret documents needed in the fault diagnostic activities (such as drawings, circuit and physical layouts, charts, specifications, manufacturers’ manuals, history/maintenance reports, graphical electronic/electrical symbols and BS7671/IEE wiring regulations)
10. The procedure to be adopted to establish the background of the fault
11. How to evaluate the various types of information available for fault diagnosis
12. How to use the various aids and reports available for fault diagnosis
13. How to use various types of fault diagnostic equipment to investigate the problem
14. Digital circuits and their operation (including logic truth tables and Boolean algebra for AND, OR, NAND, NOR, NOT and EXCLUSIVE-OR gates)
15. The various fault finding techniques that can be used, and how they are applied (such as half-split, input-to-output, emergent problem sequence, six point technique, function testing, unit substitution, injection and sampling techniques, and equipment self-diagnostics)
16. How to evaluate sensory conditions (sight, sound, smell, touch)
17. How to analyse evidence and evaluate possible characteristics and causes of specific faults/problems
18. How to relate previous reports/records of similar fault conditions
19. The care, handling and application of electronic test instruments (such as multimeter, logic probes, oscilloscopes, signal tracers, signal generators)
20. How to calibrate test instruments and check that they are free from damage and defects
21. The precautions (use of wrist straps, special packaging and handling areas) to be taken to prevent electrostatic discharge (ESD) damage to electronic circuits and components
22. How to evaluate the likely risk to yourself and others, and the effects that the fault could have on the overall system or process
23. How to prepare and produce a risk analysis report, where appropriate
24. How to prepare a report, or take follow-up action, on conclusion of the fault diagnosis, in accordance with company policy
25. The extent of your own authority and whom you should report to if you have problems that you cannot resolve
**Unit 60:**
Carrying Out Fault Diagnosis on Medical Equipment

<table>
<thead>
<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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<tr>
<td>evidence type</td>
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<td>date</td>
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</table>

**Carry out all of the following during the fault diagnosis activity (ALL)**

- plan fault diagnosis
- use correct documentation
- adhere to risk assessment and safety standards
- ensure correct decontamination procedure
- ensure safe isolation
- provide safe access
- use approved procedures
- disconnect components and circuits as required
- apply ESD protection
- identify fault and determine appropriate action
- correctly dispose of waste and leave work area in a safe condition

**Carry out fault diagnosis on three of the following types of medical equipment (THREE)**

- cardiovascular equipment
- physiological monitoring and infusion equipment
- anaesthetic and ventilation equipment
- operating theatre and surgical equipment
- mechanical or electromechanical assistive technology equipment
- medical imaging equipment
- laboratory equipment
- dental equipment
- therapeutic equipment

**Collect evidence about the fault from four of the following sources (FOUR)**

- person who reported fault
- test instrument measurements
- medical equipment simulator
## Unit 60:
Carrying Out Fault Diagnosis on Medical Equipment

<table>
<thead>
<tr>
<th>evidence record sheet</th>
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<tbody>
<tr>
<td>equipment self diagnosis</td>
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<tr>
<td>equipment outputs</td>
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<tr>
<td>circuit meters</td>
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<tr>
<td>sensory input</td>
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<tr>
<td>recording/indicator devices</td>
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<td>servicing records</td>
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</table>

**Use a range of fault diagnostic techniques to include (ALL)**

- six point technique

**PLUS three more from the following (THREE)**

- emergent sequence
- input/output
- half split
- unit substitution
- function testing
- injection and sampling

**Use a variety of diagnostic aids and equipment to include four of the following (FOUR)**

- logic diagrams
- flow charts/algorithms
- probability charts/reports
- computer-aided test equipment
- fault analysis charts
- manufacturers manuals
- troubleshooting guides
- electronic aids

**Use all of the following fault diagnostic procedures (ALL)**

- inspection
- operation
- measurement

**Use eight of the following types of test equipment to aid fault diagnosis (EIGHT)**

- oscilloscope
- multimeter
- medical equipment simulators
- ammeter
- logic analyser
- logic probe
- voltmeter
- signal tracer
- signal generator
- electricity safety analyser
- special purpose equipment
- BITE
Unit 60: Carrying Out Fault Diagnosis on Medical Equipment

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<th>evidence record sheet</th>
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<th>additional performance evidence (if required)</th>
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<tbody>
<tr>
<td>insulation resistance tester</td>
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<tr>
<td>RCD tester</td>
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<tr>
<td>PAT</td>
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<tr>
<td>temperature measuring devices</td>
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<td>flow measuring devices</td>
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<td>pressure measuring devices</td>
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</table>

Find faults that have resulted in two of the following breakdown categories (TWO)

- intermittent problem
- partial failure/out-of-specification output
- complete breakdown

Provide a record of the outcome of the fault diagnosis using one of the following (ONE)

- step-by-step report
- preventive maintenance log/report
- corrective action report
- company specific procedure

Knowledge and understanding reference:

Candidate: _____________________________ Date: ________________
Assessor: ______________________________ Date: ________________
Unit 61: Testing Medical Equipment

Unit Summary
This unit identifies the competences you need to carry out inspections and tests on medical equipment, in accordance with approved procedures. You will be required to carry out tests on a range of medical equipment, such as cardiovascular equipment, physiological monitoring and infusion equipment, anaesthetic and ventilation equipment, operating theatre and surgical equipment, medical imaging equipment, laboratory equipment, dental equipment, therapeutic equipment and mechanical/electromechanical assisted technology (AT) equipment, to establish that it is functioning at optimal level and to specification.

You will be required to carry out inspections and tests, which will include open and short circuits, resistance, insulation, earth bonding, pulse width/rise time, ac voltage/current levels, frequency, dc voltage/current levels, logic states, and temperature, pressure and flow measurements.

Your responsibilities will require you to comply with organisational policy and procedures for carrying out the testing activities, and to report any problems with these activities that you cannot personally resolve, or are outside your permitted authority, to the relevant people. 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 the procedures for carrying out the required inspections and tests, and will provide an informed approach to applying the necessary test procedures. You will understand the medical equipment being worked on, the test equipment being used, the various testing procedures and their application, in adequate depth to provide a sound basis for carrying out the activities to the required specification. In addition, you will be expected to review the outcome of the tests, compare the results with appropriate specifications, determine the action required, and record/report the results in the appropriate format.

You will understand the safety precautions required when carrying out the inspection and testing 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.
Unit 61:
Testing Medical Equipment

Performance statements:
You must:

a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Follow the appropriate procedures for use of tools and equipment to carry out the required tests
c. Set up and carry out the tests using the correct procedures and within agreed timescales
d. Record the results of the tests in the appropriate format
e. Review the results and carry out further tests if necessary

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:

1. Carry out all of the following during the testing activities:
   • plan the inspection and testing activities so as to minimise disruption to normal working
   • use the correct issue of company and/or manufacturers’ drawings and maintenance documentation
   • adhere to risk assessment, COSHH and other relevant safety standards
   • ensure that the correct equipment decontamination procedure has been adhered to before and after testing
   • ensure the safe isolation of equipment
   • provide safe access and working arrangements for the testing area
   • carry out the inspection and testing activities using appropriate techniques and procedures
   • take electrostatic discharge (ESD) precautions when handling sensitive components and circuit boards
   • return the equipment to service on completion of the testing activities
   • dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition

2. Carry out inspections and tests on three of the following types of medical equipment:
   • cardiovascular equipment
   • physiological monitoring and infusion equipment
   • anaesthetic and ventilation equipment
   • operating theatre and surgical equipment
   • mechanical/electromechanical AT equipment
   • medical imaging equipment
   • laboratory equipment
   • dental equipment
   • therapeutic equipment
3. Carry out tests on medical equipment, using a range of tools and test equipment, to include all of the following:
   • oscilloscope
   • multimeter
   • medical equipment simulators
   • electrical safety analyser
   • special purpose testing equipment

   Plus two more from the following:
   • ammeter
   • logic analyser
   • logic probe
   • voltmeter
   • signal tracer
   • residual current (RCD) tester
   • signal generator
   • insulation resistance tester
   • BITE (built in test equipment)
   • portable appliance tester (PAT)
   • temperature measuring devices
   • flow measuring devices
   • pressure measuring devices

4. Carry out thirteen of the following tests/measurements:
   • functional check
   • continuity check
   • operating range check
   • logic states
   • dc voltage/current levels
   • ac voltage/current levels
   • clock/timer switching
   • earth bonding
   • open/short circuit
   • resistance
   • pulse width/rise time
   • heat dissipation
   • current leakage
   • power output
   • protective conductor resistance values
   • soak tests
   • safety device trip speed
   • frequency values
   • performance tests
   • condition of assemblies and components
   • signal noise/interference levels
   • gas/fluid leak tests
   • pressure
   • flow
   • temperature
   • ‘special-to-type’ tests
5. **Carry out all** of the following checks to ensure the accuracy and quality of the tests carried out:
   - the test equipment is correctly calibrated
   - test equipment used is appropriate for the tests being carried out
   - ESD precautions and procedures are applied
   - test procedures to be used are up to date and follow laid-down procedures
   - test equipment is operated within its specified range

6. Provide a record/report of the test outcomes, using **one** of the following:
   - preventative maintenance log/report
   - company specific reporting procedure
   - inspection schedule
   - specific test report
Unit 61:
Testing Medical Equipment

Knowledge statements:
You must have knowledge and understanding of:
1. The health and safety, infection control and de-contamination requirements of the work area and equipment being serviced, and the responsibility these requirements place on you
2. The statutory and advisory documentation relating to medical devices (such as warnings and guidance from the regulatory authority, and British and European standards)
3. The importance of reporting any equipment adverse incidents to the regulatory authority
4. Your responsibilities under regulations relevant to the medical equipment testing activities being undertaken
5. The isolation procedure that applies to the testing activities (such as electrical isolation, removal of fuses, placing of warning notices, proving that isolation has been achieved and secured)
6. The isolation procedure(s) specific to the medical equipment being tested
7. The specific safety precautions to be taken when carrying out formal inspection, safety and circuit testing of medical equipment
8. The hazards associated with testing medical equipment, and with the equipment that is used, and how these hazards can be minimised
9. The importance of wearing protective clothing, and other appropriate safety equipment, during the testing activities
10. The importance of keeping the work area clean, tidy and free from waste and surplus materials
11. How the testing activities may affect the work of others, and the procedure for informing them of the work to be carried out
12. The procedures and precautions to be adopted to eliminate/protect against electrostatic discharge (ESD) when working on sensitive equipment or devices
13. How to obtain and interpret the documentation required in the testing activities (such as drawings, Boolean algebra, truth tables, logic symbols, circuit diagrams, specifications, manufacturers’ manuals and test procedures)
14. The basic principles of how the medical equipment functions, its operating sequence, the function/purpose of individual units/components, and how they interact
15. How to determine the most suitable test points within the equipment
16. How to set up and apply the appropriate test equipment
17. 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 their intended purpose
18. How to ensure that the test equipment used is within current calibration dates
19. How to set up the test equipment for the particular tests being carried out
20. The various testing methods and procedures, and how to apply them to different equipment and operating conditions
21. The importance of carrying out tests in the specified sequence, and what could happen if you do not
22. The things that may cause errors or discrepancies with the test results, and how to avoid these
23. Whom to seek authorisation from if you need to alter or change the test procedures
24. How to record the results of each individual test, and the documentation that must be used
25. How to analyse test results and make valid decisions about the acceptability of the equipment
26. The types and limits of adjustments that can be made to the equipment on completion of the testing activity
27. The procedure to be followed if the equipment fails to meet the test specification
28. The environmental control requirements and company operating procedures relating to functional testing
29. The documentation required, and the procedures to be followed, at the conclusion of the test
30. The extent of your own authority and whom you should report to if you have problems that you cannot resolve
### Unit 61:
Testing Medical Equipment

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<thead>
<tr>
<th>evidence record sheet</th>
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<tr>
<td>evidence type</td>
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<td>date</td>
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#### Carry out all of the following during the testing activity (ALL)

- Plan inspection and testing to minimise disruption to normal working
- Use correct documentation
- Adhere to risk assessment and safety standards
- Ensure correct decontamination procedure
- Ensure safe isolation
- Provide safe access
- Use approved testing procedures and practices
- Disconnect components and circuits as required
- Apply ESD protection
- Return equipment to service on completion of testing
- Correctly dispose of waste and leave work area in a safe condition

#### Carry out inspection and test on three of the following types of medical equipment (THREE)

- Cardiovascular equipment
- Physiological monitoring and infusion equipment
- Anaesthetic and ventilation equipment
- Operating theatre and surgical equipment
- Mechanical or electromechanical assistive technology equipment
- Medical imaging equipment
- Laboratory equipment
- Dental equipment
- Therapeutic equipment
### Unit 61: Testing Medical Equipment

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<tbody>
<tr>
<td><strong>Carry out tests on medical equipment using a range of tools and test equipment to include all of the following (ALL)</strong></td>
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<td>oscilloscope</td>
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<tr>
<td>multimeter</td>
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<tr>
<td>medical equipment simulators</td>
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<tr>
<td>electricity safety analyser</td>
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<td>special purpose equipment</td>
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<td><strong>PLUS two more from the following (TWO)</strong></td>
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<td>logic analyser</td>
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<td>logic probe</td>
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<td>voltmeter</td>
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<td>signal tracer</td>
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<td>RCD tester</td>
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<td>signal generator</td>
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<tr>
<td>insulation resistance tester</td>
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<td>temperature measuring devices</td>
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<td>flow measuring devices</td>
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<td>pressure measuring devices</td>
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<td><strong>Carry out thirteen of the following tests/measurements (THIRTEEN)</strong></td>
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<tr>
<td>functional check</td>
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<td>continuity check</td>
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<tr>
<td>operating range check</td>
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<tr>
<td>logic states</td>
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<tr>
<td>dc voltage/current levels</td>
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<tr>
<td>ac voltage current levels</td>
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<tr>
<td>clock/timer switching</td>
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<td>earth/bonding</td>
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<td>open/short circuit</td>
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<tr>
<td>resistance</td>
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<td>heat dissipation</td>
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<td>current leakage</td>
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<td>power output</td>
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<td>protective conductor resistance values</td>
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<td>soak tests</td>
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<td>safety device trip speed</td>
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<td>frequency values</td>
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## Unit 61:
Testing Medical Equipment

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<th>evidence record sheet</th>
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<th>additional performance evidence (if required)</th>
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<tbody>
<tr>
<td>performance tests</td>
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<tr>
<td>condition of assemblies and components</td>
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<tr>
<td>signal noise/interference levels</td>
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<td>gas/fluid leak tests</td>
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<td>pressure</td>
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<td>temperature</td>
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<td>‘special-to-type’ tests</td>
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</table>

**Carry out all of the following checks to ensure the accuracy and quality of the test carried out (ALL)**

- test equipment is correctly calibrated
- test equipment used is appropriate
- ESD precautions and procedures are applied
- test procedures are up to date and follow laid-down procedures
- test equipment is operated within its specified range

**Provide a record/report of the test outcomes using one of the following (ONE)**

- preventive maintenance log/report
- company specific procedure
- inspection schedule
- specific test report

Knowledge and understanding reference:

Candidate: ___________________________ Date: ___________________________
Assessor: ___________________________ Date: ___________________________
Unit 62:
Carrying Out Scheduled Servicing on Medical Equipment

Unit Summary
This unit identifies the competences you need to carry out scheduled servicing activities on medical equipment, in accordance with approved procedures. You will be required to carry out scheduled servicing activities on a range of medical equipment such as cardiovascular equipment, physiological monitoring and infusion equipment, operating theatre and surgical equipment, anaesthetic and ventilation equipment, medical imaging equipment, laboratory equipment, dental equipment, therapeutic equipment and mechanical/electromechanical assisted technology (AT) equipment, in order to minimise down time caused by breakdowns, and to ensure that the equipment performs at optimal levels and functions to specification.

Your responsibilities will require you to comply with organisational policy and procedures for the scheduled servicing activities undertaken, and to report any problems with these activities, or with the tools and equipment that are used that you cannot personally resolve, or are outside your permitted authority, to the relevant people. You must ensure that all tools, equipment and materials used in the servicing 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 full 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 scheduled servicing procedures to medical equipment. You will understand the process of developing scheduled servicing systems, and their application, and will know about the servicing criteria in adequate depth to provide a sound basis for carrying out the activities to the required specification. In addition, you will be expected to report where the outcome identifies the need for further investigation or maintenance work.

You will understand the safety precautions required when carrying out the servicing 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.

Note: Corrective/breakdown servicing activities are the subject of other standards.
Unit 62: Carrying Out Scheduled Servicing on Medical Equipment

Performance statements:
You must:

a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Follow the relevant servicing schedules to carry out the required work
c. Carry out the servicing activities within the limits of your personal authority
d. Carry out the servicing activities in the specified sequence and in an agreed timescale
e. Report any instances where the servicing activities cannot be fully met or where there are identified defects outside the planned schedule
f. Complete the relevant servicing records accurately and pass them on to the appropriate person
g. Dispose of waste materials in accordance with safe working practices and approved procedures

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:

1. Carry out all of the following scheduled servicing activities:
   • plan the servicing activities so as to minimise disruption to normal working
   • use the correct issue of company and/or manufacturers’ drawings and servicing documentation
   • adhere to risk assessment, COSHH and other relevant safety standards
   • ensure that the correct equipment decontamination procedure has been adhered to before and after servicing
   • ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
   • provide safe access and working arrangements for the servicing area
   • carry out the scheduled maintenance activity, using appropriate techniques and procedures
   • re-connect and return the equipment to service on completion of the activities
   • dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition

2. Carry out scheduled servicing on three of the following types of medical equipment:
   • cardiovascular equipment
   • physiological monitoring and infusion equipment
   • anaesthetic and ventilation equipment
   • operating theatre and surgical equipment
   • mechanical/electromechanical AT equipment
   • medical imaging equipment
   • laboratory equipment
   • dental equipment
   • therapeutic equipment
3. Carry out all of the following scheduled servicing activities:
   - visual examination of condition and security of enclosures
   - checking and replacing ‘lifed’ items (such as batteries, bulbs, seals, masks, filters and hoses etc)
   - removing excessive dirt from equipment
   - checking the integrity of connections
   - inspecting and cleaning sensors
   - monitoring the condition/deteriation of components
   - making sensory checks (sight, sound, smell, touch)
   - making insulation resistance checks
   - carrying out electrical safety checks
   - checking the condition of cables and wires
   - making routine adjustments
   - carrying out equipment self-analysis checks
   - checking and reviewing the system function
   - checking the integrity and security of earth bonding
   - checking the operation of gauges (where appropriate)
   - carrying out leak checks on gas connections (where appropriate)
   - recording the results of the servicing and reporting any defects found

4. Ensure that the serviced equipment meets all of the following quality and accuracy standards and/or advisory documentation:
   - organisational guidelines and codes of practice
   - equipment manufacturer’s operation range
   - relevant and current HTM documentation
   - equipment and associated BSEN standards, CE marking and, where appropriate, BS7671/IEE wiring regs
   - the equipment functions to specification
   - all potential defects are identified and reported for future action

5. Complete the relevant paperwork, to include one of the following, and pass it to the appropriate people:
   - job cards
   - servicing log or report
   - permit to work/formal risk assessment
Unit 62: Carrying Out Scheduled Servicing on Medical Equipment

Knowledge statements:

You must have knowledge and understanding of:

1. The health and safety requirements of the area in which the scheduled servicing activity is to take place, and the responsibility these requirements place on you
2. The statutory and advisory documentation relating to medical devices (such as warnings and guidance from the regulatory authority and British and European standards)
3. The importance of reporting any equipment adverse incidents to the regulatory authority
4. The isolation or permit-to-work procedure that applies to the servicing activities (such as electrical isolation, removal of fuses, placing of maintenance warning notices, proving that isolation has been achieved and secured)
5. The specific health and safety precautions to be applied during the scheduled servicing activities, and their effects on others
6. The importance of wearing protective clothing and other appropriate safety equipment during the servicing activities
7. How to recognise and deal with victims of electric shock (to include methods of safely removing the victim from the power source, isolating the power source, and methods of first aid resuscitation)
8. The working practices of, and the need to respect the hospital ward and/or patient environment
9. Hazards associated with carrying out scheduled servicing activities on medical equipment (such as exposure to live conductors, misuse of tools), and how they can be minimised.
10. How to obtain and interpret documents needed in the servicing activities (such as drawings, circuit and physical layouts, charts, specifications, manufacturers' manuals, history/maintenance reports, graphical electronic/electrical symbols and BS7671/IEE wiring regulations)
11. The servicing schedules and methods to be followed, in order to comply with company procedures for scheduled servicing activities on medical equipment
12. The basic principle of operation of the medical equipment/circuits being serviced, and the function/purpose of individual components within the equipment/circuit
13. The human physiology directly associated with the medical equipment being serviced
14. The risks to the human body from external energy sources associated with the equipment being serviced
15. The different types of cabling (such as multicore cables, single core cables, steel wire armoured (SWA), mineral insulated (MI), screened cables), and their application
16. The different types of control system, their various components and maintenance requirements
17. The application and functions of a range of electrical components (such as plugs, switches, sockets, lighting and fittings, junction boxes, consumer units), and the types of checks required by each of them
18. Methods of checking that components are fit for purpose, and the need to replace ‘lifed’ items (such as hoses, seals, filters, masks and overload protection devices)
19. The procedures and precautions to be adopted to eliminate/protect against electrostatic discharge (ESD) when working on sensitive equipment or devices
20. How to make sensory checks (by sight, sound, smell, touch)
21. How to check that replacement components meet the required specification/operating conditions (such as values, tolerance, current carrying capacity, voltage rating, power rating, working temperature range)
22. The procedure for obtaining the consumables to be used during the scheduled servicing activity
23. The importance of carrying out electrical safety tests on medical equipment, and the implications if this is not carried out
24. How to complete servicing records/logs/reports that comply with company policy and procedures
25. The equipment operating and control procedures, and how to apply them in order to carry out scheduled servicing
26. The problems that can occur whilst carrying out the scheduled servicing activities, and how they can be avoided
27. The organisational procedure to be adopted for the safe disposal of waste of all types of materials
28. The extent of your own authority and whom you should report to if you have problems that you cannot resolve
## Unit 62:
Carrying Out Scheduled Servicing on Medical Equipment

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<thead>
<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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<td>evidence type</td>
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<td>date</td>
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**Carry out all of the following scheduled servicing activities (ALL)**
- plan servicing to minimise disruption to working
- use correct documentation
- adhere to risk assessment and safety standards
- ensure correct decontamination procedure
- ensure safe isolation
- provide safe access
- use approved techniques and procedures
- return equipment to service on completion
- correctly dispose of waste & leave work area safe

**Carry out scheduled servicing on three of the following types of medical equipment (THREE)**
- cardiovascular equipment
- physiological monitoring and infusion equipment
- anaesthetic and ventilation equipment
- operating theatre and surgical equipment
- mechanical and electromechanical AT equipment
- medical imaging equipment
- laboratory equipment
- dental equipment
- therapeutic equipment

**Carry out all of the following scheduled servicing activities (ALL)**
- visual examination
- checking/replacing ‘lifed’ items
- removing excessive dirt
- checking integrity of connections
Unit 62:
Carrying Out Scheduled Servicing on Medical Equipment

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<th>evidence record sheet</th>
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<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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<tbody>
<tr>
<td>inspecting and cleaning sensors</td>
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<td>monitoring components by sensory checks</td>
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<tr>
<td>making insulation resistance checks</td>
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<tr>
<td>carrying out electrical safety checks</td>
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<tr>
<td>checking conditions of cables and wiring</td>
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<td>making routine adjustments</td>
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<td>carrying out equipment self-analysis checks</td>
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<td>checking and reviewing system function</td>
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<td>checking earth bonding</td>
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<td>checking operation of gauges</td>
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<td>checking gas connections</td>
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<td>recording results and reporting defects</td>
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Ensure that the serviced equipment meets all of the following quality and accuracy standards and/or advisory documentation (ALL)

- organisational guidelines and codes of practice
- equipment manufacturer’s operation range
- relevant and current HTM documentation
- equipment and associated BSEN standards, CE marking, BS7671/IEE Wiring Regulations
- the equipment functions to specification
- all potential defects are identified and reported for future action
### Unit 62:
Carrying Out Scheduled Servicing on Medical Equipment

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<th>additional performance evidence (if required)</th>
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<td>job cards</td>
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<tr>
<td>servicing logs or reports</td>
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<tr>
<td>permit to work/formal risk assessment</td>
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Knowledge and understanding reference:

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<th>Candidate:</th>
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Unit Summary
This unit identifies the competences you need to carry out servicing activities on cardiovascular equipment, in accordance with approved procedures. You will be required to service a range of cardiovascular equipment, such as ECG monitors, pacemakers, defibrillators, pulse oximeters and blood pressure devices. This will involve dismantling, removing and replacing faulty items, at component or unit level, on a variety of different types of cardiovascular equipment. You will be expected to apply a range of dismantling and reassembly methods and techniques, which are appropriate to the equipment being serviced and the types of component being removed/replaced, and which will include electrical, electronic and mechanical units and components.

Your responsibilities will require you to comply with organisational policy and procedures for the servicing activities undertaken, and to report any problems with the activities that you cannot personally resolve, or are outside your permitted authority, to the relevant people. You must ensure that all tools, equipment and materials used in the servicing 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 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 the correct servicing procedures. You will understand the dismantling and reassembly methods and procedures used, and their application. You will know about the cardiovascular equipment worked on, component properties, functions and associated defects, in adequate depth to provide a sound basis for carrying out the servicing activities, correcting faults and ensuring that the serviced equipment functions to the required specification.

You will understand the safety precautions required when carrying out the servicing 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.
Unit 63: Servicing Cardiovascular Equipment

Performance statements:
You must:

a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Follow the relevant servicing schedules to carry out the required work
c. Carry out the servicing activities within the limits of your personal authority
d. Carry out the servicing activities in the specified sequence and in an agreed timescale
e. Report any instances where the servicing activities cannot be fully met or where there are identified defects outside the planned schedule
f. Complete the relevant servicing records accurately and pass them on to the appropriate person
g. Dispose of waste materials in accordance with safe working practices and approved procedures

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:
1. Carry out all of the following during the servicing activities:
   - plan the servicing activities so as to minimise disruption to normal working
   - use the correct issue of company and/or manufacturers’ drawings and servicing documentation
   - adhere to risk assessment, COSHH and other relevant safety standards
   - ensure that the correct equipment decontamination procedure has been adhered to before and after the servicing activities
   - ensure the safe isolation of equipment (such as electricity, mechanical, gas, air or fluids)
   - provide safe access and working arrangements for the servicing area
   - carry out the servicing activities, using appropriate techniques and procedures
   - return the equipment to service on completion of the activities
   - dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition

2. Carry out servicing on four of the following types of cardiovascular equipment:
   - electrocardiograph (ECG)
   - pacemaker
   - pulse oximeters
   - defibrillators
   - blood pressure devices
3. Carry out all of the following activities, as applicable to the equipment being serviced:
   • isolating the equipment
   • applying electrostatic discharge (ESD) precautions
   • dismantling equipment to the appropriate level
   • disconnecting and reconnecting wires and cables
   • attaching suitable cable identification markers
   • removing and replacing electrical units/components
   • removing and replacing mechanical units/components
   • soldering and de-soldering
   • checking components for serviceability
   • replacing damaged/defective components
   • replacing all ‘lifed’ items
   • tightening fastenings to the required torque
   • setting and adjusting replaced components
   • making visual checks before powering up
   • checking equipment operating parameters
   • re-calibrating and/or adjusting equipment
   • carrying out electrical safety tests
   • functionally testing the serviced equipment

4. Replace a range of components, to include twelve of the following:
   • cables and connectors
   • printed circuit boards
   • overload protection devices
   • switches
   • locking and retaining devices
   • power supplies
   • analog or digital integrated circuits
   • potentiometers
   • regulators
   • rectifiers
   • sensors
   • thermistors
   • transformers
   • transducers
   • timers
   • seals
   • batteries
   • display units/meters
   • indicators (lamps, LEDs)
   • valves
   • pumps
   • motors
   • hoses/pipework
   • ancillary components (such as electrodes, cuffs and finger probes)
5. Service cardiovascular equipment, in compliance with all of the following quality and accuracy standards and/or advisory documentation:
   - organisational guidelines and codes of practice
   - equipment manufacturer’s operation range
   - relevant and current HTM documentation
   - equipment and associated BSEN standards, CE marking and where appropriate BS7671/IEE wiring
   - regulations
   - the equipment functions to specification
   - all potential defects are identified and reported for future action

6. Complete the relevant paperwork, to include one of the following, and pass it to the appropriate people:
   - job cards
   - servicing logs or reports
   - other specific documentation
Unit 63:
Servicing Cardiovascular Equipment

Knowledge statements:
You must have knowledge and understanding of:
1. The health and safety, infection control and de-contamination requirements of the work area and equipment being serviced, and the responsibility these requirements place on you
2. The statutory and advisory documentation relating to medical devices (such as warnings and guidance from the regulatory authority, British and European standards)
3. The importance of reporting any equipment adverse incidents to the regulatory authority
4. The isolation procedure that applies to the servicing activities (such as electrical isolation, removal of fuses, placing of maintenance warning notices)
5. How to recognise and deal with victims of electric shock (to include methods of safely removing the victim from the power source, isolating the power source, and methods of first aid resuscitation)
6. The importance of wearing protective clothing and other appropriate safety equipment
7. How to obtain and interpret documents needed in the servicing activities (such as drawings, circuit and physical layouts, charts, specifications, manufacturers’ manuals, history/maintenance reports, graphical electronic/electrical symbols and BS7671/IEE wiring regulations)
8. The working practices of, and the need to respect the hospital ward and/or patient environment
9. The basic principles of operation of the cardiovascular equipment being serviced, and the function of individual components
10. The human physiology directly associated with the cardiovascular equipment being serviced
11. The associated risks to the human body from external energy sources on the cardiovascular equipment
12. The application and functions of a range of components used in the equipment (such as switches, sensors, overload protection devices, transformers, thermistors, rectifiers, printed circuit boards, valves, pumps)
13. The care, handling and application of ohmmeters, multimeters and other electrical measuring instruments (including dedicated test equipment)
14. Company policy on the repair/replacement of components, and the procedure for obtaining replacement parts, materials and other consumables necessary for the servicing activities
15. How to check that replacement components meet the required specification/operating conditions (such as values, tolerance, current carrying capacity, voltage rating, power rating, working temperature range)
16. The techniques used to dismantle/assemble cardiovascular equipment (such as unplugging, desoldering, removal of screwed, clamped and crimped connections, removal of pipes, hoses and mechanical components)
17. Methods of removing and replacing components without causing damage to the equipment or other components
18. The procedures and precautions to be adopted to eliminate/protect against electrostatic discharge (ESD) when working on sensitive equipment or devices
19. The different types of cabling (such as multicore cables, single core cables, steel wire armoured (SWA), mineral insulated (MI), screened cables), and their application
20. The use of BS 7671/IEE wiring, and other, regulations when replacing wires and cables
21. Methods of attaching identification markers/labels to removed components or cables to assist with re-assembly
22. The tools and equipment used in the servicing activities (including the use of cable stripping tools, crimping tools, soldering irons)
23. Methods of checking that components are fit for purpose, and the need to replace ‘lifed’ items
24. How to make adjustments to components/assemblies to ensure that they function correctly
25. 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
26. The importance of carrying out electrical safety tests on cardiovascular equipment, and the implications if this is not carried out
27. The importance of making visual checks before proving the equipment with the electrical supply on
28. The generation of documentation and/or reports following the servicing activity
29. The equipment operating and control procedures to be applied during the servicing activity
30. The problems that can occur during the servicing activity, and how they can be overcome
31. The organisational procedure(s) to be adopted for the safe disposal of waste of all types of materials
32. The extent of your own authority and whom you should report to if you have a problem that you cannot resolve
Unit 63:
Servicing Cardiovascular Equipment

<table>
<thead>
<tr>
<th>evidence record sheet</th>
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<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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**Carry out all of the following during the servicing activities (ALL)**
- plan servicing to minimise disruption to working
- use correct documentation
- adhere to risk assessment and safety standards
- ensure correct decontamination procedure
- ensure safe isolation
- provide safe access
- use approved techniques and procedures
- return equipment to service on completion
- correctly dispose of waste & leave work area safe

**Carry out servicing on four of the following (FOUR)**
- electrocardiograph (ECG)
- pacemaker
- pulse oximeters
- defibrillators
- blood pressure devices

**Carry out all of the following activities as applicable to the equipment being serviced (ALL)**
- isolating the equipment
- applying ESD precautions
- dismantling equipment to the appropriate level
- disconnecting and reconnecting wires/cables
- attaching suitable cable identification markers
- remove/replace electrical units/components
- remove/replace mechanical units/components
- soldering and desoldering
- checking components for serviceability
## Unit 63:
Servicing Cardiovascular Equipment

<table>
<thead>
<tr>
<th>evidence record sheet</th>
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<th>performance evidence 2</th>
<th>performance evidence 3</th>
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<tbody>
<tr>
<td>replace damaged/defective components</td>
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<tr>
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<td>tightening fastenings to the required torque</td>
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<tr>
<td>setting and adjusting replaced components</td>
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<td>making visual checks before powering up</td>
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<td>checking equipment operating parameters</td>
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<tr>
<td>re-calibrating and/or adjusting equipment</td>
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<td>carrying out electrical safety tests</td>
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<tr>
<td>functionally testing the serviced equipment</td>
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<tr>
<td>Replace a range of components to include twelve of the following (TWELVE)</td>
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<tr>
<td>cables and connectors</td>
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<td>transformers</td>
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<td>timers</td>
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<td>display units/meters</td>
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<td>indicators</td>
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<td>motors</td>
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<td>hoses/pipework</td>
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<tr>
<td>ancillary components</td>
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## Unit 63:
Servicing Cardiovascular Equipment

<table>
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<tbody>
<tr>
<td>Service cardiovascular equipment, in compliance with all of the following quality and accuracy standards and/or advisory documentation (ALL)</td>
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<tr>
<td>organisational guidelines and codes of practice</td>
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<td>equipment manufacturer's operation range</td>
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<td>relevant and current HTM documentation</td>
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<tr>
<td>equipment &amp; associated BSEN standards, CE marking, BS7671/IEE Wiring Regulations</td>
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<td>the equipment functions to specification</td>
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<td>all potential defects are identified and reported for future action</td>
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<tr>
<td><strong>Complete relevant paperwork to include one of the following &amp; pass to the appropriate people (ONE)</strong></td>
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<td>job cards</td>
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<tr>
<td>servicing logs or reports</td>
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<tr>
<td>other specific documentation</td>
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Knowledge and understanding reference:

Candidate: _______________________________  Date: _______________________________

Assessor: _______________________________  Date: _______________________________
Unit 64: Servicing Physiological Monitoring and Infusion Equipment

Unit Summary
This unit identifies the competences you need to carry out servicing activities on physiological monitoring and infusion equipment, in accordance with approved procedures. You will be required to service a range of physiological monitoring and infusion equipment, such as infusion and feeding pumps, baby incubators, phototherapy devices, dialysis machines, radiant heat warmers, suction pumps/aspiration devices, oxygen delivery and monitoring systems, apnoea devices and monitoring equipment. This will involve dismantling, removing and replacing faulty items, at component or unit level, on a variety of different types of physiological monitoring and infusion equipment. You will be expected to apply a range of dismantling and reassembly methods and techniques, which are appropriate to the equipment being serviced and the type of components being removed/replaced, and which will include electrical, electronic and mechanical units and components.

Your responsibilities will require you to comply with organisational policy and procedures for the servicing activities undertaken, and to report any problems with the activities that you cannot personally resolve, or are outside your permitted authority, to the relevant people. You must ensure that all tools, equipment and materials used in the servicing 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 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 the correct servicing procedures. You will understand the dismantling and reassembly methods and procedures used, and their application. You will know about the physiological monitoring and infusion equipment worked on, and component properties, functions and associated defects, in adequate depth to provide a sound basis for carrying out the servicing activities, correcting faults and ensuring that the serviced equipment functions to the required specification.

You will understand the safety precautions required when carrying out the servicing 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.
Unit 64: Servicing Physiological Monitoring and Infusion Equipment

Performance statements:
You must:

a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Follow the relevant servicing schedules to carry out the required work
c. Carry out the servicing activities within the limits of your personal authority
d. Carry out the servicing activities in the specified sequence and in an agreed timescale
e. Report any instances where the servicing activities cannot be fully met or where there are identified defects outside the planned schedule
f. Complete the relevant servicing records accurately and pass them on to the appropriate person
g. Dispose of waste materials in accordance with safe working practices and approved procedures

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:
1. Carry out all of the following during the servicing activities:
   - plan the servicing activities so as to minimise disruption to normal working
   - use the correct issue of company and/or manufacturers’ drawings and servicing documentation
   - adhere to risk assessment, COSHH and other relevant safety standards
   - ensure that the correct equipment decontamination procedure has been adhered to before and after the servicing activities
   - ensure the safe isolation of equipment (such as electricity, mechanical, gas, air or fluids)
   - provide safe access and working arrangements for the servicing area
   - carry out the servicing activities, using appropriate techniques and procedures
   - return the equipment to service on completion of the activities
   - dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition

2. Carry out servicing on seven of the following types of physiological monitoring and infusion equipment:
   - infusion pump
   - syringe driver
   - feeding pump
   - baby incubators
   - phototherapy devices
   - radiant heater warmers
   - dialysis equipment
   - foetal heart monitoring devices
   - suction pumps/aspiration devices
   - oxygen delivery and monitoring devices
   - apnoea devices and monitoring equipment
3. Carry out all of the following activities, as applicable to the equipment being serviced:
   • isolating and locking off the equipment
   • applying electrostatic discharge (ESD) precautions
   • dismantling equipment to the appropriate level
   • disconnecting and reconnecting wires and cables
   • attaching suitable cable identification markers
   • removing and replacing electrical units/components
   • removing and replacing mechanical units/components
   • soldering and de-soldering
   • checking components for serviceability
   • replacing damaged/defective components
   • replacing all 'lifed' items
   • tightening fastenings to the required torque
   • setting and adjusting replaced components
   • making visual checks before powering up
   • checking equipment operating parameters
   • re-calibrating and/or adjusting equipment
   • carrying out electrical safety tests
   • functionally testing the serviced equipment

4. Replace a range of components, to include fourteen of the following:
   • cables and connectors
   • printed circuit boards
   • overload protection devices
   • switches
   • locking and retaining devices
   • power supplies
   • analog or digital integrated circuits
   • potentiometers
   • phototherapy lighting tubes
   • regulators
   • rectifiers
   • sensors
   • thermistors
   • transformers
   • transducers
   • timers
   • seals
   • batteries
   • heater elements
   • oxygen cells
   • display units/meters
   • indicators (lamps, LEDs)
   • valves
   • pumps
   • motors
   • hoses/pipework
   • structural components (such as hinges, covers and wheels)
5. Service physiological monitoring and infusion equipment, in compliance with **all** of the following quality and accuracy standards and/or advisory documentation:
   - organisational guidelines and codes of practice
   - equipment manufacturer’s operation range
   - relevant and current HTM documentation
   - equipment and associated BSEN standards, CE marking and, where appropriate, BS 7671/IEE wiring regulations
   - the equipment functions to specification
   - all potential defects are identified and reported for future action

6. Complete the relevant paperwork, to include **one** of the following, and pass it to the appropriate people:
   - job cards
   - servicing logs or reports
   - other specific documentation
Unit 64: Servicing Physiological Monitoring and Infusion Equipment

Knowledge statements:
You must have knowledge and understanding of:
1. The health and safety, infection control and de-contamination requirements of the work area and equipment being serviced, and the responsibility these requirements place on you
2. The statutory and advisory documentation relating to medical devices (such as warnings and guidance from the regulatory authority and British and European standards)
3. The importance of reporting any equipment adverse incidents to the regulatory authority
4. The isolation procedure that applies to the servicing activities (such as electrical isolation, removal of fuses, placing of maintenance warning notices)
5. How to recognise and deal with victims of electric shock (to include methods of safely removing the victim from the power source, isolating the power source, and methods of first aid resuscitation)
6. The importance of wearing protective clothing and other appropriate safety equipment during the servicing activities
7. How to obtain and interpret documents needed in the servicing activities (such as drawings, circuit and physical layouts, charts, specifications, manufacturers’ manuals, history/maintenance reports, graphical electronic/electrical symbols and BS7671/IEE wiring regulations)
8. The working practices of, and the need to respect the hospital ward and/or patient environment
9. The basic principles of operation of the physiological monitoring and infusion equipment being serviced, and the function of individual components
10. The human physiology directly associated with the infusion and monitoring equipment being serviced
11. The risks on the human body from external energy sources associated with physiological monitoring and infusion equipment
12. The application and functions of a range of components used in the equipment (such as switches, sensors, overload protection devices, transformers, thermistors, rectifiers, printed circuit boards, valves, pumps)
13. The care, handling and application of ohmmeters, multimeters and other electrical measuring instruments (including dedicated test equipment)
14. Company policy on the repair/replacement of components, and the procedure for obtaining replacement parts, materials and other consumables necessary for the servicing activities
15. How to check that the replacement components meet the required specification/operating conditions (such as values, tolerance, current carrying capacity, voltage rating, power rating, working temperature range)
16. The techniques used to dismantle/assemble physiological monitoring and infusion equipment (such as unplugging, de-soldering, removal of screwed, clamped and crimped connections, removal of pipes, hoses and mechanical components)
17. Methods of removing and replacing components without causing damage to the equipment or components
18. The procedures and precautions to be adopted to eliminate/protect against electrostatic discharge (ESD) when working on sensitive equipment or devices
19. The different types of cabling (such as multicore cables, single core cables, steel wire armoured (SWA), mineral insulated (MI), screened cables), and their application
20. The use of BS7671/IEE wiring, and other, regulations when replacing wires and cables
21. Methods of attaching identification markers/labels to removed components or cables to assist with re-assembly
22. The tools and equipment used in the servicing activities (including the use of cable stripping tools, crimping tools, soldering irons)
23. Methods of checking that components are fit for purpose, and the need to replace ‘lifed’ items
24. How to make adjustments to components/assemblies to ensure that they function correctly
25. 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
26. The importance of carrying out electrical safety tests on equipment, and the implications if this is not carried out
27. The importance of making visual checks before proving the equipment with the electrical supply on
28. The generation of documentation and/or reports following the servicing activity
29. The equipment operating and control procedures to be applied during the servicing activity
30. The problems that can occur during the servicing activity, and how they can be overcome
31. The organisational procedure(s) to be adopted for the safe disposal of waste of all types of materials
32. The extent of your own authority and whom you should report to if you have a problem that you cannot resolve
## Unit 64:
Servicing Physiological Monitoring and Infusion Equipment

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### Carry out all of the following during the servicing activities (ALL)
- Plan servicing to minimise disruption to working
- Use correct documentation
- Adhere to risk assessment and safety standards
- Ensure correct decontamination procedure
- Ensure safe isolation
- Provide safe access
- Use approved techniques and procedures
- Return equipment to service on completion
- Correctly dispose of waste & leave work area safe

### Carry out servicing on seven of the following (SEVEN)
- Infusion pump
- Syringe driver
- Feeding pump
- Baby incubators
- Phototherapy devices
- Radiant heater warmers
- Dialysis equipment
- Foetal heart monitoring devices
- Suction pumps/aspiration devices
- Oxygen delivery and monitoring devices
- Apnoea devices and monitoring equipment

### Carry out all of the following activities as applicable to the equipment being serviced (ALL)
- Isolating the equipment
- Applying ESD precautions
- Dismantling equipment to the appropriate level
- Disconnecting and reconnecting wires/cables
- Attaching suitable cable identification markers
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Servicing Physiological Monitoring and Infusion Equipment

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<td>replace damaged/defective components</td>
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<td>functionally testing the serviced equipment</td>
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**Replace a range of components to include fourteen of the following (FOURTEEN)**

- cables and connectors
- printed circuit boards
- overload protection devices
- switches
- locking/retaining devices
- power supplies
- analogue or digital integrated circuits
- potentiometers
- phototherapy lighting tubes
- regulators
- rectifiers
- sensors
- thermistors
- transformers
- transducers
- timers
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Servicing Physiological Monitoring and Infusion Equipment

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<td>oxygen cells</td>
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<td>display units/meters</td>
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**Service physiological monitoring and infusion equipment, in compliance with all of the following quality and accuracy standards and/or advisory documentation (ALL)**

- organisational guidelines and codes of practice
- equipment manufacturer’s operation range
- relevant and current HTM documentation
- equipment & associated BSEN standards, CE marking, BS7671/IEE Wiring Regulations
- the equipment functions to specification
- all potential defects are identified and reported for future action

**Complete relevant paperwork to include one of the following & pass to the appropriate people (ONE)**

- job cards
- servicing logs or reports
- other specific documentation

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Knowledge and understanding reference:

<table>
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<tr>
<th>Candidate:</th>
<th>Date:</th>
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<tr>
<td>Assessor:</td>
<td>Date:</td>
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Unit 65:
Servicing Anaesthetic and Ventilation Equipment

Unit Summary
This unit identifies the competences you need to carry out servicing activities on anaesthetic and ventilation equipment, in accordance with approved procedures. You will be required to service a range of anaesthetic and ventilation equipment, such as anaesthetic machines, anaesthetic vaporisers, breathing circuits, ventilation units, anaesthetic gas scavenging system (AGSS) and medical gas cylinders. This will involve dismantling, removing and replacing faulty items, at component or unit level, on a variety of different types of anaesthetic and ventilation equipment. You will be expected to apply a range of dismantling and reassembly methods and techniques, which are appropriate to the equipment being serviced and the type of components being removed/replaced, and which will include electrical, electronic and mechanical units and components.

Your responsibilities will require you to comply with organisational policy and procedures for the servicing activities undertaken, and to report any problems with the activities that you cannot personally resolve, or are outside your permitted authority, to the relevant people. You must ensure that all tools, equipment and materials used in the servicing 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 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 the correct servicing procedures. You will understand the dismantling and reassembly methods and procedures used, and their application. You will know about the anaesthetic and ventilation equipment being worked on, and component properties, functions and associated defects, in adequate depth to provide a sound basis for carrying out the servicing activities, correcting faults and ensuring that the serviced equipment functions to the required specification.

You will understand the safety precautions required when carrying out the servicing 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.
**Unit 65:**
Servicing Anaesthetic and Ventilation Equipment

**Performance statements:**
**You must:**
- a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
- b. Follow the relevant servicing schedules to carry out the required work
- c. Carry out the servicing activities within the limits of your personal authority
- d. Carry out the servicing activities in the specified sequence and in an agreed timescale
- e. Report any instances where the servicing activities cannot be fully met or where there are identified defects outside the planned schedule
- f. Complete the relevant servicing records accurately and pass them on to the appropriate person
- g. Dispose of waste materials in accordance with safe working practices and approved procedures

**Scope of the unit:**
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

**You must:**
1. Carry out all of the following during the servicing activities:
   - plan the servicing activities so as to minimise disruption to normal working
   - use the correct issue of company and/or manufacturers’ drawings and servicing documentation
   - adhere to risk assessment, COSHH and other relevant safety standards
   - ensure that the correct equipment decontamination procedure has been adhered to before and after the servicing activities
   - ensure the safe isolation of equipment (such as electricity, mechanical, gas, air or fluids)
   - provide safe access and working arrangements for the servicing area
   - carry out the servicing activities, using appropriate techniques and procedures
   - return the equipment to service on completion of the activities
   - dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition

2. Carry out servicing on five of the following types of anaesthetic and ventilation equipment:
   - anaesthetic machines
   - anaesthetic vaporisers
   - breathing circuits
   - ventilation units
   - anaesthetic gas scavenging system (AGSS)
   - medical gas cylinders and associated equipment
3. Carry out all of the following activities, as applicable to the equipment being serviced:
   - isolating the equipment
   - applying electrostatic discharge (ESD) precautions
   - dismantling equipment to the appropriate level
   - disconnecting and reconnecting wires and cables
   - attaching suitable cable identification markers
   - removing and replacing electrical units/components
   - removing and replacing mechanical units/components
   - soldering and de-soldering
   - checking components for serviceability
   - replacing damaged/defective components
   - replacing all ‘lifed’ items
   - tightening fastenings to the required torque
   - setting and adjusting replaced components
   - making visual checks before powering up
   - checking equipment operating parameters
   - re-calibrating and/or adjusting equipment
   - carrying out electrical safety tests
   - functionally testing the serviced equipment

4. Replace a range of components, to include fifteen of the following:
   - cables and connectors
   - printed circuit boards
   - overload protection devices
   - switches
   - locking and retaining devices
   - power supplies
   - analog or digital integrated circuits
   - potentiometers
   - flow meters
   - diaphragms
   - rectifiers
   - filters
   - sensors
   - thermistors
   - transformers
   - transducers
   - regulators
   - canisters
   - timers
   - seals
   - batteries
   - gauges
   - display units
   - indicators (lamps, LEDs)
   - valves
   - pumps
   - motors
   - hoses/pipework
   - bellows
   - structural components
5. Service anaesthetic and ventilation equipment, in compliance with all of the following quality and accuracy standards and/or advisory documentation:
   - organisational guidelines and codes of practice
   - equipment manufacturer’s operation range
   - relevant and current HTM documentation
   - equipment and associated BSEN standards, CE marking and, where appropriate, BS7671/IEE wiring regulations
   - the equipment functions to specification
   - all potential defects are identified and reported for future action

6. Complete the relevant paperwork, to include one of the following, and pass it to the appropriate people:
   - job cards
   - servicing logs or reports
   - other specific documentation
Unit 65:
Servicing Anaesthetic and Ventilation Equipment

Knowledge statements:
You must have knowledge and understanding of:
1. The health and safety, infection control and de-contamination requirements of the work area and equipment being serviced, and the responsibility these requirements place on you
2. The statutory and advisory documentation relating to medical devices (such as warnings and guidance from the regulatory authority British and European standards)
3. The importance of reporting any equipment adverse incidents to the regulatory authority
4. The isolation procedure that applies to the servicing activities (such as electrical isolation, removal of fuses, placing of maintenance warning notices)
5. How to recognise and deal with victims of electric shock (to include methods of safely removing the victim from the power source, isolating the power source, and methods of first aid resuscitation)
6. The importance of wearing protective clothing and other appropriate safety equipment during the servicing activities
7. How to obtain and interpret documents needed in the servicing activities (such as drawings, circuit and physical layouts, charts, specifications, manufacturers' manuals, history/maintenance reports, graphical electronic/electrical symbols and BS7671/IEE wiring regulations)
8. The working practices of, and the need to respect the hospital ward and/or patient environment
9. The basic principle of operation of the anaesthetic and ventilation equipment being serviced, and the function of individual components
10. The human physiology directly associated with the anaesthetic and ventilation equipment being serviced
11. The risks to the human body from external energy sources associated with anaesthetic and ventilation equipment
12. The application and functions of a range of components used in the equipment (such as switches, sensors, overload protection devices, transformers, thermistors, rectifiers, printed circuit boards, valves, pumps)
13. The care, handling and application of ohmmeters, multimeters and other electrical measuring instruments (including dedicated test equipment)
14. Company policy on the repair/replacement of components, and the procedure for obtaining replacement parts, materials and other consumables necessary for the servicing activities
15. How to check that the replacement components meet the required specification/operating conditions (such as values, tolerance, current carrying capacity, voltage rating, power rating, working temperature range)
16. The techniques used to dismantle/reassemble anaesthetic and ventilation equipment (such as unplugging, de-soldering, removal of screwed, clamped and crimped connections, removal of pipes, hoses and mechanical components)
17. Methods of removing and replacing components without causing damage to the equipment or other components
18. The procedures and precautions to be adopted to eliminate/protect against electrostatic discharge (ESD) when working on sensitive equipment or devices
19. The different types of cabling (such as multicore cables, single core cables, steel wire armoured (SWA), mineral insulated (MI), screened cables), and their application
20. The use of BS7671/IEE wiring, and other, regulations when replacing wires and cables
21. Methods of attaching identification markers/labels to removed components or cables to assist with re-assembly
22. The tools and equipment used in the servicing activities (including the use of cable stripping tools, crimping tools, soldering irons)
23. Methods of checking that components are fit for purpose, and the need to replace ‘lifed’ items
24. How to make adjustments to components/assemblies to ensure that they function correctly
25. 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
26. The importance of carrying out electrical safety tests on anaesthetic and ventilation equipment, and the implications if this is not carried out
27. The importance of making visual checks before proving the equipment with the electrical supply on
28. The generation of documentation and/or reports following the servicing activity
29. The equipment operating and control procedures to be applied during the servicing activity
30. The problems that can occur during the servicing activity, and how they can be overcome
31. The organisational procedure(s) to be adopted for the safe disposal of waste of all types of materials
32. The extent of your own authority and whom you should report to if you have a problem that you cannot resolve
### Unit 65:
Servicing Anaesthetic and Ventilation Equipment

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<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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**Carry out all of the following during the servicing activities (ALL)**

- Plan servicing to minimise disruption to working
- Use correct documentation
- Adhere to risk assessment and safety standards
- Ensure correct decontamination procedure
- Ensure safe isolation
- Provide safe access
- Use approved techniques and procedures
- Return equipment to service on completion
- Correctly dispose of waste & leave work area safe

**Carry out servicing on five of the following types of anaesthetic and ventilation equipment (FIVE)**

- Anaesthetic machines
- Anaesthetic vaporisers
- Breathing circuits
- Ventilation units
- AGSS
- Gas cylinders and equipment

**Carry out all of the following activities as applicable to the equipment being serviced (ALL)**

- Isolating the equipment
- Applying ESD precautions
- Dismantling equipment to the appropriate level
- Disconnecting and reconnecting wires/cables
- Attaching suitable cable identification markers
- Removing/Replacing electrical units/components
- Removing/Replacing mechanical units/components
## Unit 65:
Servicing Anaesthetic and Ventilation Equipment

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<td>functionally testing the serviced equipment</td>
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**Replace a range of components to include fifteen of the following (FIFTEEN)**

- cables and connectors
- printed circuit boards
- overload protection devices
- switches
- locking/retaining devices
- power supplies
- analogue or digital integrated circuits
- potentiometers
- flow meters
- diaphragms
- rectifiers
- filters
- sensors
- thermistors
- transformers
- transducers
- regulators
- canisters
- timers
- seals
- batteries
**Unit 65:**
Servicing Anaesthetic and Ventilation Equipment

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<td>Hoses/Pipework</td>
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<td>Bellows</td>
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<td>Structural Components</td>
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**Service Anaesthetic and Ventilation Equipment, in compliance with all of the following quality and accuracy standards and/or advisory documentation (ALL)**

- Organisational guidelines and codes of practice
- Equipment manufacturer’s operation range
- Relevant and current HTM documentation
- Equipment & associated BSEN standards, CE marking, BS7671/IEE Wiring Regulations
- The equipment functions to specification
- All potential defects are identified and reported for future action

**Complete relevant paperwork to include one of the following & pass to the appropriate people (ONE)**

- Job cards
- Servicing logs or reports
- Other specific documentation

Knowledge and understanding reference:

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<th>Date:</th>
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Unit 66: Servicing Operating Theatre and Surgical Equipment

Unit Summary
This unit identifies the competences you need to carry out servicing activities on operating theatre and surgical equipment, in accordance with approved procedures. You will be required to service a range of operating theatre and surgical equipment, such as insufflators, surgical diathermy devices, endoscopic equipment, camera systems, tourniquet devices, cryo-surgical devices, gas monitoring devices, pneumatic drilling/sawing devices, operating tables and surgical lighting equipment. This will involve dismantling, removing and replacing faulty items, at component or unit level, on a variety of different types of operating theatre and surgical equipment. You will be expected to apply a range of dismantling and reassembly methods and techniques, which are appropriate to the equipment being serviced and the type of components being removed/replaced, and which will include electrical, electronic and mechanical units and components.

Your responsibilities will require you to comply with organisational policy and procedures for the servicing activities undertaken, and to report any problems with the activities that you cannot personally resolve, or are outside your permitted authority, to the relevant people. You must ensure that all tools, equipment and materials used in the servicing 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 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 the correct servicing procedures. You will understand the dismantling and reassembly methods and procedures used, and their application. You will know about the operating theatre and surgical equipment being worked on, and component properties, functions and associated defects, in adequate depth to provide a sound basis for carrying out the servicing activities, correcting faults and ensuring that the serviced equipment functions to the required specification.

You will understand the safety precautions required when carrying out the servicing 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.
Unit 66:
Servicing Operating Theatre and Surgical Equipment

Performance statements:
You must:

a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Follow the relevant servicing schedules to carry out the required work
c. Carry out the servicing activities within the limits of your personal authority
d. Carry out the servicing activities in the specified sequence and in an agreed timescale
e. Report any instances where the servicing activities cannot be fully met or where there are identified defects outside the planned schedule
f. Complete the relevant servicing records accurately and pass them on to the appropriate person
g. Dispose of waste materials in accordance with safe working practices and approved procedures

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:
1. Carry out all of the following during the servicing activities:
   - plan the servicing activities so as to minimise disruption to normal working
   - use the correct issue of company and/or manufacturers’ drawings and servicing documentation
   - adhere to risk assessment, COSHH and other relevant safety standards
   - ensure that the correct equipment decontamination procedure has been adhered to before and after the servicing activities
   - ensure the safe isolation of equipment (such as electricity, mechanical, gas, air or fluids)
   - provide safe access and working arrangements for the servicing area
   - carry out the servicing activities, using appropriate techniques and procedures
   - return the equipment to service on completion of the activities
   - dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition

2. Carry out servicing on five of the following types of operating theatre and surgical equipment:
   - insufflators
   - surgical diathermy devices
   - tourniquet devices
   - cryo-surgical devices
   - gas monitoring devices
   - endoscopic equipment
   - camera systems
   - operating tables
   - surgical lighting equipment
   - pneumatic drilling/sawing devices
3. Carry out all of the following activities, as applicable to the equipment being serviced:
   - isolating the equipment
   - applying electrostatic discharge (ESD) precautions
   - dismantling equipment to the appropriate level
   - disconnecting and reconnecting wires and cables
   - attaching suitable cable identification markers
   - removing and replacing electrical units/components
   - removing and replacing mechanical units/components
   - soldering and de-soldering
   - checking components for serviceability
   - replacing damaged/defective components
   - replacing all ‘lifed’ items
   - tightening fastenings to the required torque
   - setting and adjusting replaced components
   - making visual checks before powering up
   - checking equipment operating parameters
   - re-calibrating and/or adjusting equipment
   - carrying out electrical safety tests
   - functionally testing the serviced equipment

4. Replace a range of components, to include twelve of the following:
   - cables and connectors
   - printed circuit boards
   - overload protection devices
   - switches
   - locking and retaining devices
   - power supplies
   - analog or digital integrated circuits
   - potentiometers
   - diaphragms
   - rectifiers
   - filters
   - sensors
   - thermistors
   - transformers
   - transducers
   - regulators
   - timers
   - seals
   - batteries
   - gears
   - bearings
   - lighting bulbs
   - gauges
   - display units
   - indicators (lamps, LEDs)
   - valves
   - pumps
   - motors
   - hoses/pipework
   - structural components
5. Service operating theatre and surgical equipment, in compliance with **all** of the following quality and accuracy standards and/or advisory documentation:
   - organisational guidelines and codes of practice
   - equipment manufacturer’s operation range
   - relevant and current HTM documentation
   - equipment and associated BSEN standards, CE marking and, where appropriate, BS7671/IEE wiring regulations
   - the equipment functions to specification
   - all potential defects are identified and reported for future action

6. Complete the relevant paperwork, to include **one** of the following, and pass it to the appropriate people:
   - job cards
   - servicing logs or reports
   - other specific documentation
Unit 66:
Servicing Operating Theatre and Surgical Equipment

Knowledge statements:
You must have knowledge and understanding of:
1. The health and safety, infection control and de-contamination requirements of the work area and equipment being serviced, and the responsibility these requirements place on you
2. The statutory and advisory documentation relating to medical devices (such as warnings and guidance from the regulatory authority British and European standards)
3. The importance of reporting any equipment adverse incidents to the regulatory authority
4. The isolation procedure that applies to the servicing activities (such as electrical isolation, removal of fuses, placing of maintenance warning notices)
5. How to recognise and deal with victims of electric shock (to include methods of safely removing the victim from the power source, isolating the power source, and methods of first aid resuscitation)
6. The importance of wearing protective clothing and other appropriate safety equipment during the servicing activities
7. How to obtain and interpret documents needed in the servicing activities (such as drawings, circuit and physical layouts, charts, specifications, manufacturers' manuals, history/maintenance reports, graphical electronic/ electrical symbols and BS7671/IEE wiring regulations)
8. The working practices of, and the need to respect the hospital theatre, ward and/or patient environment
9. The basic principles of operation of the operating theatre and surgical equipment being serviced, and the function of individual components
10. The human physiology directly associated with the operating theatre and surgical equipment being serviced
11. The risks on the human body from external energy sources associated with operating theatre and surgical equipment
12. The application and functions of a range of components used in the equipment (such as switches, sensors, overload protection devices, transformers, thermistors, rectifiers, printed circuit boards, valves, pumps)
13. The care, handling and application of ohmmeters, multimeters and other electrical measuring instruments (including dedicated test equipment)
14. Company policy on the repair/replacement of components, and the procedure for obtaining replacement parts, materials and other consumables necessary for the servicing activities
15. How to check that the replacement components meet the required specification/operating conditions (such as values, tolerance, current carrying capacity, voltage rating, power rating, working temperature range)
16. The techniques used to dismantle/reassemble operating theatre and surgical equipment (such as unplugging, de-soldering, removal of screwed, clamped and crimped connections, removal of pipes, hoses and mechanical components)
17. Methods of removing and replacing components without causing damage to the equipment or components
18. The procedures and precautions to be adopted to eliminate/protect against electrostatic discharge (ESD) when working on sensitive equipment or devices
19. The different types of cabling (such as multicore cables, single core cables, steel wire armoured (SWA), mineral insulated (MI), screened cables), and their application
20. The use of BS7671/IEE wiring, and other, regulations when replacing wires and cables
21. Methods of attaching identification markers/labels to removed components or cables to assist with re-assembly
22. The tools and equipment used in the servicing activities (including the use of cable stripping tools, crimping tools, soldering irons)
23. Methods of checking that components are fit for purpose, and the need to replace ‘lifed’ items
24. How to make adjustments to components/assemblies to ensure that they function correctly
25. 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

26. The importance of carrying out electrical safety tests on operating theatre and surgical equipment, and the implications if this is not carried out

27. The importance of making visual checks before proving the equipment with the electrical supply on

28. The generation of documentation and/or reports following the servicing activity

29. The equipment operating and control procedures to be applied during the servicing activity

30. The problems that can occur during the servicing activity, and how they can be overcome

31. The organisational procedure(s) to be adopted for the safe disposal of waste of all types of materials

32. The extent of your own authority and whom you should report to if you have a problem that you cannot resolve
### Unit 66:
Servicing Operating Theatre and Surgical Equipment

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**Carry out all of the following during the servicing activities (ALL)**

- plan servicing to minimise disruption to working
- use correct documentation
- adhere to risk assessment and safety standards
- ensure correct decontamination procedure
- ensure safe isolation
- provide safe access
- use approved techniques and procedures
- return equipment to service on completion
- correctly dispose of waste & leave work area safe

**Carry out servicing on five of the following types of operating theatre and surgical equipment (FIVE)**

- insufflators
- surgical diathermy devices
- tourniquet devices
- cryo-surgical devices
- gas monitoring devices
- endoscopic equipment
- camera systems
- operating tables
- surgical lighting equipment
- pneumatic drilling/sawing devices

**Carry out all of the following activities as applicable to the equipment being serviced (ALL)**

- isolating the equipment
- applying ESD precautions
- dismantling equipment to the appropriate level
- disconnecting and reconnecting wires/cables
- attaching suitable cable identification markers
## Unit 66:
Servicing Operating Theatre and Surgical Equipment

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<td>functionally testing the serviced equipment</td>
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</table>

**Replace a range of components to include twelve of the following (TWELVE)**
- cables and connectors
- printed circuit boards
- overload protection devices
- switches
- locking/retaining devices
- power supplies
- analogue or digital integrated circuits
- potentiometers
- diaphragms
- rectifiers
- filters
- sensors
- thermistors
- transformers
- transducers
- regulators
- timers
## Unit 66: Servicing Operating Theatre and Surgical Equipment

<table>
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<tr>
<th>evidence record sheet</th>
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<th>performance evidence 3</th>
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<td>hoses/pipework</td>
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<tr>
<td>structural components</td>
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</tbody>
</table>

**Service operating theatre and surgical equipment, in compliance with all of the following quality and accuracy standards and/or advisory documentation (ALL)**

- organisational guidelines and codes of practice
- equipment manufacturer's operation range
- relevant and current HTM documentation
- equipment & associated BSEN standards, CE marking, BS7671/IEE Wiring Regulations
- the equipment functions to specification
- all potential defects are identified and reported for future action

**Complete relevant paperwork to include one of the following & pass to the appropriate people (ONE)**

- job cards
- servicing logs or reports
- other specific documentation

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Knowledge and understanding reference:

Candidate: ___________________________  Date: ____________

Assessor: ___________________________  Date: ____________
Unit 67: Servicing Medical Imaging Equipment

Unit Summary
This unit identifies the competences you need to carry out servicing activities on medical imaging equipment, in accordance with approved procedures. You will be required to service a range of equipment, which includes static and mobile X-ray suites, dental X-ray equipment, ultrasound equipment, imaging and processing equipment and imaging tables. This will involve dismantling, removing and replacing faulty items, at component or unit level, on a variety of different types of imaging equipment. You will be expected to apply a range of dismantling and reassembly methods and techniques, which are appropriate to the equipment being serviced and the type of components being removed/replaced, and which will include electrical, electronic and mechanical units and components.

Your responsibilities will require you to comply with organisational policy and procedures for the servicing activities undertaken, and to report any problems with the activities that you cannot personally resolve, or are outside your permitted authority, to the relevant people. You must ensure that all tools, equipment and materials used in the servicing 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 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 the correct servicing procedures. You will understand the dismantling and reassembly methods and procedures used, and their application. You will know about the medical imaging equipment being worked on, and component properties, functions and associated defects, in adequate depth to provide a sound basis for carrying out the servicing activities, correcting faults and ensuring that the serviced equipment functions to the required specification.

You will understand the safety precautions required when carrying out the servicing 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.
Unit 67:
Servicing Medical Imaging Equipment

Performance statements:
You must:
a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Follow the relevant servicing schedules to carry out the required work
c. Carry out the servicing activities within the limits of your personal authority
d. Carry out the servicing activities in the specified sequence and in an agreed timescale
e. Report any instances where the servicing activities cannot be fully met or where there are identified defects outside the planned schedule
f. Complete the relevant servicing records accurately and pass them on to the appropriate person
g. Dispose of waste materials in accordance with safe working practices and approved procedures

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.
You must:
1. Carry out all of the following during the servicing activities:
   - plan the servicing activities so as to minimise disruption to normal working
   - use the correct issue of company and/or manufacturers’ drawings and servicing documentation
   - adhere to risk assessment, COSHH and other relevant safety standards
   - ensure that the correct equipment decontamination procedure has been adhered to before and after the servicing activities
   - ensure the safe isolation of equipment (such as electricity, mechanical, gas, air or fluids)
   - provide safe access and working arrangements for the servicing area
   - carry out the servicing activities, using appropriate techniques and procedures
   - return the equipment to service on completion of the activities
   - dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition

2. Carry out servicing on both of the following types of medical imaging equipment:
   - X-ray equipment (static and/or mobile equipment)
   - ultrasound equipment (static and/or mobile equipment)

   Plus two more of the following
   - digital imaging equipment
   - x-ray processing equipment
   - imaging tables
3. Carry out all of the following activities, as applicable to the equipment being serviced:
   - isolating the equipment
   - applying electrostatic discharge (ESD) precautions
   - dismantling equipment to the appropriate level
   - disconnecting and reconnecting wires and cables
   - attaching suitable cable identification markers
   - removing and replacing electrical units/components
   - removing and replacing mechanical units/components
   - soldering and de-soldering
   - checking components for serviceability
   - replacing damaged/defective components
   - replacing all ‘lifed’ items
   - tightening fastenings to the required torque
   - setting and adjusting replaced components
   - making visual checks before powering up
   - checking equipment operating parameters
   - re-calibrating and/or adjusting equipment
   - carrying out electrical safety tests
   - functionally testing the serviced equipment

4. Replace a range of components, to include twelve of the following:
   - cables and connectors
   - printed circuit boards
   - overload protection devices
   - switches
   - locking and retaining devices
   - power supplies
   - analog or digital integrated circuits
   - potentiometers
   - diaphragms
   - rectifiers
   - filters
   - sensors
   - thermistors
   - transformers
   - transducers
   - regulators
   - timers
   - seals
   - batteries
   - gears
   - bearings
   - lighting bulbs
   - potentiometers
   - gauges
   - display units
   - indicators (lamps, LEDs)
   - valves
   - pumps
   - motors
   - hoses/pipework
   - structural components
5. Service medical imaging equipment, in compliance with **all** of the following quality and accuracy standards and/or advisory documentation:
   - organisational guidelines and codes of practice
   - equipment manufacturer’s operation range
   - relevant and current HTM documentation
   - equipment and associated BSEN standards, CE marking and where appropriate BS7671/IEE wiring regulations
   - the equipment functions to specification
   - all potential defects are identified and reported for future action

6. Complete the relevant paperwork, to include **one** of the following, and pass it to the appropriate people:
   - job cards
   - servicing logs or reports
   - other specific documentation
Unit 67:
Servicing Medical Imaging Equipment

Knowledge statements:
You must have knowledge and understanding of:
1. The health and safety, infection control and de-contamination requirements of the work area and equipment being serviced, and the responsibility these requirements place on you
2. The statutory and advisory documentation relating to medical imaging equipment (such as warnings and guidance from the regulatory authority British and European standards)
3. The ionising and radiation regulations, and the responsibility they place upon you when servicing medical imaging equipment
4. The importance of reporting any equipment adverse incidents to the regulatory authority
5. The isolation procedure that applies to servicing activities (such as electrical isolation, removal of fuses, placing of maintenance warning notices)
6. How to recognise and deal with victims of electric shock (to include methods of safely removing the victim from the power source, isolating the power source, and methods of first aid resuscitation)
7. The importance of wearing protective clothing and other appropriate safety equipment during the servicing activities
8. How to obtain and interpret documents needed in the servicing activities (such as drawings, circuit and physical layouts, charts, specifications, manufacturers’ manuals, history/maintenance reports, graphical electronic/electrical symbols and BS7671/IEE wiring regulations)
9. The working practices of, and the need to respect the medical imaging department/environment
10. The basic principles of operation of the medical imaging equipment being serviced, and the function of individual components
11. The human physiology directly associated with medical imaging radiation
12. The risks to the human body from x-ray radiation and other energy sources associated with medical imaging equipment
13. The application and functions of a range of components used in the equipment (such as switches, sensors, overload protection devices, transformers, thermistors, rectifiers, printed circuit boards, valves, pumps)
14. The care, handling and application of ohmmeters, multimeters and other electrical measuring instruments (including dedicated test equipment)
15. Company policy on the repair/replacement of components, and the procedure for obtaining replacement parts, materials and other consumables necessary for the servicing activities
16. How to check that replacement components meet the required specification/operating conditions (such as values, tolerance, current carrying capacity, voltage rating, power rating, working temperature range)
17. The techniques used to dismantle/reassemble medical imaging equipment (such as unplugging, de-soldering, removal of screwed, clamped and crimped connections, removal of pipes, hoses and mechanical components)
18. Methods of removing and replacing components without causing damage to the equipment or other components
19. The procedures and precautions to be adopted to eliminate/protect against electrostatic discharge (ESD) when working on sensitive equipment or devices
20. The different types of cabling (such as multicore cables, single core cables, steel wire armoured (SWA), mineral insulated (MI), screened cables), and their application
21. The use of BS7671/IEE wiring, and other, regulations when replacing wires and cables
22. Methods of attaching identification markers/labels to removed components or cables to assist with re-assembly
23. The tools and equipment used in the servicing activities (including the use of cable stripping tools, crimping tools, soldering irons)
24. Methods of checking that components are fit for purpose, and the need to replace ‘lifed’ items
25. How to make adjustments to components/assemblies to ensure that they function correctly
26. 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
27. The importance of carrying out electrical safety tests on medical imaging equipment, and the implications if this is not carried out
28. The importance of making visual checks before proving the equipment with the electrical supply on
29. The generation of documentation and/or reports following the servicing activity
30. The equipment operating and control procedures to be applied during the servicing activity
31. The problems that can occur during the servicing activity, and how they can be overcome
32. The organisational procedure(s) to be adopted for the safe disposal of waste of all types of materials
33. The extent of your own authority and whom you should report to if you have a problem that you cannot resolve
### Unit 67:
Servicing Medical Imaging Equipment

<table>
<thead>
<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
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<th>additional performance evidence (if required)</th>
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**Carry out all of the following during the servicing activities (ALL)**

- plan servicing to minimise disruption to working
- use correct documentation
- adhere to risk assessment and safety standards
- ensure correct decontamination procedure
- ensure safe isolation
- provide safe access
- use approved techniques and procedures
- return equipment to service on completion
- correctly dispose of waste & leave work area safe

**Carry out servicing on both of the following types of medical imaging equipment (ALL)**

- x-ray
- ultrasound

**PLUS two more of the following (TWO)**

- digital imaging
- x-ray processing
- imaging table

**Carry out all of the following activities as applicable to the equipment being serviced (ALL)**

- isolating the equipment
- applying ESD precautions
- dismantling equipment to the appropriate level
- disconnecting and reconnecting wires/cables
- attaching suitable cable identification markers
- remove/replacement electrical units/components
- remove/replacement mechanical units/components
- soldering and desoldering
**Unit 67:**
Servicing Medical Imaging Equipment

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<td>replace damaged/defective components</td>
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<td>replacing all ‘lifed’ items</td>
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<td>tightening fastenings to the required torque</td>
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<td>functionally testing the serviced equipment</td>
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</table>

**Replace a range of components to include twelve of the following (TWELVE)**
- cables and connectors
- printed circuit boards
- overload protection devices
- switches
- locking/retaining devices
- power supplies
- analogue or digital integrated circuits
- potentiometers
- diaphragms
- rectifiers
- filters
- sensors
- thermistors
- transformers
- transducers
- regulators
- timers
- seals
- batteries
- gears
- bearings
- lighting bulbs
- gauges
- display units
## Unit 67:
Servicing Medical Imaging Equipment

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<td>structural components</td>
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**Service laboratory equipment, in compliance with all of the following quality and accuracy standards and/or advisory documentation (ALL)**

- organisational guidelines and codes of practice
- equipment manufacturer's operation range
- relevant and current HTM documentation
- equipment & associated BSEN standards, CE marking, BS7671/IEE Wiring Regulations
- the equipment functions to specification
- all potential defects are identified and reported for future action

**Complete the relevant paperwork to include one of the following and pass to the appropriate people (ONE)**

- job cards
- servicing logs or reports
- other specific documentation

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Knowledge and understanding reference:

Candidate: ____________________________ Date: __________
Assessor: ___________________________ Date: __________
Unit 68: Servicing Laboratory Equipment

Unit Summary
This unit identifies the competences you need to carry out servicing activities on laboratory equipment, in accordance with approved procedures. You will be required to service a range of laboratory equipment, such as centrifuges, coulter counters, blood and gas analysers, flame photometers, chloride meters, roller beds, colorimeters, spectrophotometers, particle counters, ion selective analysers, pH meters and blood co-oximetry equipment. This will involve dismantling, removing and replacing faulty items, at component or unit level, on a variety of different types of laboratory equipment. You will be expected to apply a range of dismantling and reassembly methods and techniques, which are appropriate to the equipment being serviced and the type of components being removed/replaced, and which will include electrical, electronic and mechanical units and components.

Your responsibilities will require you to comply with organisational policy and procedures for the servicing activities undertaken, and to report any problems with the activities that you cannot personally resolve, or are outside your permitted authority, to the relevant people. You must ensure that all tools, equipment and materials used in the servicing 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 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 the correct servicing procedures. You will understand the dismantling and reassembly methods and procedures used, and their application. You will know about the laboratory equipment being worked on, and component properties, functions and associated defects, in adequate depth to provide a sound basis for carrying out the servicing activities, correcting faults and ensuring that the serviced equipment functions to the required specification.

You will understand the safety precautions required when carrying out the servicing 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.
Unit 68: Servicing Laboratory Equipment

Performance statements:
You must:

a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Follow the relevant servicing schedules to carry out the required work
c. Carry out the servicing activities within the limits of your personal authority
d. Carry out the servicing activities in the specified sequence and in an agreed time scale
e. Report any instances where the servicing activities cannot be fully met or where there are identified defects outside the planned schedule
f. Complete relevant servicing records accurately and pass them on to the appropriate person
g. Dispose of waste materials in accordance with safe working practices and approved procedures

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:
1. Carry out all of the following during the servicing activities:
   - plan the servicing activities so as to minimise disruption to normal working
   - use the correct issue of company and/or manufacturers’ drawings and servicing documentation
   - adhere to risk assessment, COSHH and other relevant safety standards
   - ensure that the correct equipment decontamination procedure has been adhered to before and after the servicing activities
   - ensure the safe isolation of equipment (such as electricity, mechanical, gas, air or fluids)
   - provide safe access and working arrangements for the servicing area
   - carry out the servicing activities, using appropriate techniques and procedures
   - return the equipment to service on completion of the activities
   - dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition

2. Carry out servicing on seven of the following types of laboratory equipment:
   - ion selective analysers
   - centrifuges
   - coulter counters
   - blood and gas analysers
   - flame photometers
   - chloride meters
   - roller beds
   - colorimeters
   - particle counters
   - pH meters
   - spectrophotometers
3. Carry out all of the following activities, as applicable to the equipment being serviced:
   • isolating and locking off equipment
   • applying electrostatic discharge (ESD) precautions
   • dismantling equipment to the appropriate level
   • disconnecting and reconnecting wires and cables
   • attaching suitable cable identification markers
   • removing and replacing electrical units/components
   • removing and replacing mechanical units/components
   • soldering and de-soldering
   • checking components for serviceability
   • replacing damaged/defective components
   • replacing all ‘lifed’ items
   • tightening fastenings to the required torque
   • setting and adjusting replaced components
   • making visual checks before powering up
   • checking equipment operating parameters
   • re-calibrating and/or adjusting equipment
   • carrying out electrical safety tests
   • functionally testing the serviced equipment

4. Replace a range of components, to include fourteen of the following:
   • cables and connectors
   • printed circuit boards
   • overload protection devices
   • switches
   • locking and retaining devices
   • power supplies
   • analog or digital integrated circuits
   • potentiometers
   • photo therapy lighting tubes
   • regulators
   • rectifiers
   • sensors
   • thermistors
   • transformers
   • transducers
   • timers
   • seals
   • batteries
   • heater elements
   • oxygen cells
   • display units/meters
   • indicators (lamps, LEDs)
   • valves
   • pumps
   • motors
   • hoses/pipework
   • structural components (such as hinges, covers and wheels)
5. Service laboratory equipment, in compliance with **all** of the following quality and accuracy standards and/or advisory documentation:
   - organisational guidelines and codes of practice
   - equipment manufacturer’s operation range
   - relevant and current HTM documentation
   - equipment and associated BSEN standards, CE marking and where appropriate BS7671/IEE wiring regulations
   - the equipment functions to specification
   - all potential defects are identified and reported for future action

6. Complete the relevant paperwork, to include **one** of the following, and pass it to the appropriate people:
   - job cards
   - servicing logs or reports
   - other specific documentation
Knowledge statements:

You must have knowledge and understanding of:

1. The health and safety, infection control and de-contamination requirements of the work area and equipment being serviced, and the responsibility these requirements place on you
2. The statutory and advisory documentation relating to laboratory equipment (such as warnings and guidance from the regulatory authority and British and European standards)
3. The isolation procedure that applies to servicing activities (such as electrical isolation, removal of fuses, placing of maintenance warning notices)
4. The importance of reporting any equipment adverse incidents to the regulatory authority
5. How to recognise and deal with victims of electric shock (to include methods of safely removing the victim from the power source, isolating the power source, and methods of first aid resuscitation)
6. The importance of wearing protective clothing and other appropriate safety equipment during the servicing activities
7. How to obtain and interpret documents needed in the servicing activities (such as drawings, circuit and physical layouts, charts, specifications, manufacturers’ manuals, history/maintenance reports, graphical electronic/electrical symbols and BS7671/IEE wiring regulations)
8. The working practices of, and the need to respect the laboratory environment
9. The basic principles of operation of the laboratory equipment being serviced, and the function of individual components
10. The human physiology directly associated with the laboratory equipment being serviced
11. The application and functions of a range of components used in the equipment (such as switches, sensors, overload protection devices, transformers, thermistors, rectifiers, printed circuit boards, valves, pumps)
12. The care, handling and application of ohmmeters, multimeters and other electrical measuring instruments (including dedicated test equipment)
13. Company policy on the repair/replacement of components, and the procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance activities
14. How to check that the replacement components meet the required specification/operating conditions (such as values, tolerance, current carrying capacity, voltage rating, power rating, working temperature range)
15. The techniques used to dismantle/assemble laboratory equipment (such as unplugging, desoldering, removal of screwed, clamped and crimped connections, removal of pipes, hoses and mechanical components)
16. Methods of removing and replacing components without causing damage to the equipment or other components
17. The procedures and precautions to be adopted to eliminate/protect against electrostatic discharge (ESD) when working on sensitive equipment or devices
18. The different types of cabling (such as multicore cables, single core cables, steel wire armoured (SWA), mineral insulated (MI), screened cables), and their application
19. The use of BS7671/IEE wiring, and other, regulations when replacing wires and cables
20. Methods of attaching identification markers/labels to removed components or cables to assist with re-assembly
21. The tools and equipment used in the servicing activities (including the use of cable stripping tools, crimping tools, soldering irons)
22. Methods of checking that components are fit for purpose, and the need to replace ‘lifed’ items
23. How to make adjustments to components/assemblies to ensure that they function correctly
24. 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
25. The importance of carrying out electrical safety tests on laboratory equipment, and the implications if this is not carried out
26. The importance of making visual checks before proving the equipment with the electrical supply
on
27. The generation of documentation and/or reports following the servicing activity
28. The equipment operating and control procedures to be applied during the servicing activity
29. The problems that can occur during the servicing activity, and how they can be overcome
30. The organisational procedure(s) to be adopted for the safe disposal of waste of all types of materials
31. The extent of your own authority and whom you should report to if you have a problem that you cannot resolve
### Unit 68: Servicing Laboratory Equipment

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</table>

#### evidence type
#### date

**Carry out all of the following during the servicing activities (ALL)**

- plan servicing to minimise disruption to working
- use correct documentation
- adhere to risk assessment and safety standards
- ensure correct decontamination procedure
- ensure safe isolation
- provide safe access
- use approved techniques and procedures
- return equipment to service on completion
- correctly dispose of waste & leave work area safe

**Carry out servicing on seven of the following types of laboratory equipment (SEVEN)**

- ion selective analysers
- centrifuges
- coulter counters
- blood and gas analysers
- flame photometers
- chloride meters
- roller beds
- colorimeters
- particle counters
- pH meters
- spectrophotometers

**Carry out all of the following activities as applicable to the equipment being serviced (ALL)**

- isolating the equipment
- applying ESD precautions
- dismantling equipment to the appropriate level
- disconnecting and reconnecting wires/cables
- attaching suitable cable identification markers
- remove/replace electrical units/components
### Unit 68: Servicing Laboratory Equipment

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<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
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<th>additional performance evidence (if required)</th>
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<td>remove/replace mechanical units/components</td>
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Unit 68: Servicing Laboratory Equipment

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Service physiological monitoring and infusion equipment, in compliance with all of the following quality and accuracy standards and/or advisory documentation (ALL)

- organisational guidelines and codes of practice
- equipment manufacturer's operation range
- relevant and current HTM documentation
- equipment & associated BSEN standards, CE marking, BS7671/IEE Wiring Regulations
- the equipment functions to specification
- all potential defects are identified and reported for future action

Complete relevant paperwork to include one of the following & pass to the appropriate people (ONE)

- job cards
- servicing logs or reports
- other specific documentation

Knowledge and understanding reference:

Candidate: ___________________________ Date: ___________________________
Assessor: ___________________________ Date: ___________________________
Unit 69: Servicing Dental Equipment

Unit Summary
This unit identifies the competences you need to carry out servicing activities on dental equipment, in accordance with approved procedures. You will be required to service a range of dental equipment, such as drilling units, suction units, dental hand pieces, amalgamators, floor service units, dental lighting, dental air compressors, de-scalers and polymerisation equipment. This will involve dismantling, removing and replacing faulty items, at component or unit level, on a variety of different types of dental equipment. You will be expected to apply a range of dismantling and reassembly methods and techniques, which are appropriate to the equipment being serviced and the type of components being removed/replaced, and which will include electrical, electronic and mechanical units and components.

Your responsibilities will require you to comply with organisational policy and procedures for the servicing activities undertaken, and to report any problems with the activities that you cannot personally resolve, or are outside your permitted authority, to the relevant people. You must ensure that all tools, equipment and materials used in the servicing 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 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 the correct servicing procedures. You will understand the dismantling and reassembly methods and procedures used, and their application. You will know about dental equipment being worked on, and component properties, functions and associated defects, in adequate depth to provide a sound basis for carrying out the servicing activities, correcting faults and ensuring that the serviced equipment functions to the required specification.

You will understand the safety precautions required when carrying out the servicing 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.
Unit 69:
Servicing Dental Equipment

Performance statements:
You must:

a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Follow the relevant servicing schedules to carry out the required work
c. Carry out the servicing activities within the limits of your personal authority
d. Carry out the servicing activities in the specified sequence and in an agreed timescale
e. Report any instances where the servicing activities cannot be fully met or where there are identified defects outside the planned schedule
f. Complete the relevant servicing records accurately and pass them on to the appropriate person
g. Dispose of waste materials in accordance with safe working practices and approved procedures

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:

1. Carry out all of the following during the servicing activities:
   - plan the servicing activities so as to minimise disruption to normal working
   - use the correct issue of company and/or manufacturers’ drawings and servicing documentation
   - adhere to risk assessment, COSHH and other relevant safety standards
   - ensure that the correct equipment decontamination procedure has been adhered to before and after the servicing activities
   - ensure the safe isolation of equipment (such as electricity, mechanical, gas, air or fluids)
   - provide safe access and working arrangements for the servicing area
   - carry out the servicing activities, using appropriate techniques and procedures
   - return the equipment to service on completion of the activities
   - dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition

2. Carry out servicing on seven of the following types of dental equipment:
   - suction unit
   - drilling unit
   - de-scalers
   - floor utility service units
   - polymerisation unit
   - dental lighting
   - amalgamators
   - dental hand pieces
   - amalgam separators
   - dental air compressors
3. Carry out all of the following activities, as applicable to the equipment being serviced:
   • isolating and locking off equipment
   • applying electrostatic discharge (ESD) precautions
   • dismantling equipment to the appropriate level
   • disconnecting and reconnecting wires and cables
   • attaching suitable cable identification markers
   • removing and replacing electrical units/components
   • removing and replacing mechanical units/components
   • soldering and de-soldering
   • checking components for serviceability
   • replacing damaged/defective components
   • replacing all 'lifed' items
   • tightening fastenings to the required torque
   • setting and adjusting replaced components
   • making visual checks before powering up
   • carrying out electrical safety tests
   • checking equipment operating parameters
   • re-calibrating and/or adjusting equipment
   • functionally testing the serviced equipment

4. Replace a range of components, to include fourteen of the following:
   • cables and connectors
   • printed circuit boards
   • overload protection devices
   • switches
   • locking and retaining devices
   • power supplies
   • analog or digital integrated circuits
   • potentiometers
   • phototherapy lighting tubes
   • regulators
   • rectifiers
   • sensors
   • thermistors
   • transformers
   • transducers
   • timers
   • seals
   • batteries
   • heater elements
   • oxygen cells
   • display units/meters
   • indicators (such as lamps, LEDs)
   • valves
   • pumps
   • motors
   • hoses/pipework
   • structural components (such as hinges, covers and wheels)
5. Service dental equipment, in compliance with all of the following quality and accuracy standards and/or advisory documentation:
   - organisational guidelines and codes of practice
   - equipment manufacturer’s operation range
   - relevant and current HTM documentation
   - equipment and associated BSEN standards, CE marking and where appropriate BS7671/IEE wiring regulations
   - the equipment functions to specification
   - all potential defects are identified and reported for future action

6. Complete the relevant paperwork, to include one of the following, and pass it to the appropriate people:
   - job cards
   - servicing logs or reports
   - other specific documentation
Unit 69: Servicing Dental Equipment

Knowledge statements:
You must have knowledge and understanding of:
1. The health and safety, infection control and de-contamination requirements of the work area and equipment being serviced, and the responsibility these requirements place on you
2. The statutory and advisory documentation relating to dental equipment (such as warnings and guidance from the regulatory authority and British and European standards)
3. The importance of reporting any equipment adverse incidents to the regulatory authority
4. The isolation procedure that applies to the servicing activities (such as electrical isolation, removal of fuses, placing of maintenance warning notices)
5. How to recognise and deal with victims of electric shock (to include methods of safely removing the victim from the power source, isolating the power source, and methods of first aid resuscitation)
6. The importance of wearing protective clothing and other appropriate safety equipment during the servicing activities
7. How to obtain and interpret documents needed in the servicing activities (such as drawings, circuit and physical layouts, charts, specifications, manufacturers' manuals, history/maintenance reports, graphical electronic/electrical symbols and BS7671/IEE wiring regulations)
8. The working practices of, and the need to respect the dental department environment
9. The basic principles of operation of the dental equipment being serviced, and the function of individual components
10. The application and functions of a range of components used in the equipment (such as switches, sensors, overload protection devices, transformers, thermistors, rectifiers, printed circuit boards, valves, pumps)
11. The care, handling and application of ohmmeters, multimeters and other electrical measuring instruments (including dedicated test equipment)
12. Company policy on the repair/replacement of components, and the procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance activities
13. How to check that the replacement components meet the required specification/operating conditions (such as values, tolerance, current carrying capacity, voltage rating, power rating, working temperature range)
14. The techniques used to dismantle/reassemble dental equipment (such as unplugging, desoldering, removal of screwed, clamped and crimped connections, removal of pipes, hoses and mechanical components)
15. Methods of removing and replacing components without causing damage to the equipment or other components
16. The procedures and precautions to be adopted to eliminate/protect against electrostatic discharge (ESD) when working on sensitive equipment or devices
17. The different types of cabling (such as multicore cables, single core cables, steel wire armoured (SWA), mineral insulated (MI), screened cables), and their application
18. The use of BS7671/IEE wiring, and other, regulations when replacing wires and cables
19. Methods of attaching identification markers/labels to removed components or cables to assist with re-assembly
20. The tools and equipment used in the servicing activities (including the use of cable stripping tools, crimping tools, soldering irons)
21. Methods of checking that components are fit for purpose, and the need to replace ‘lifed’ items
22. How to make adjustments to components/assemblies to ensure that they function correctly
23. 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
24. The importance of carrying out electrical safety tests on dental equipment, and the implications if this is not carried out
25. The importance of making visual checks before proving the equipment with the electrical supply on
26. The generation of documentation and/or reports following the servicing activity
27. The equipment operating and control procedures to be applied during the servicing activity
28. The problems that can occur during the servicing activity, and how they can be overcome
29. The organisational procedure(s) to be adopted for the safe disposal of waste of all types of materials
### Unit 69: Servicing Dental Equipment

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**Carry out all of the following during the servicing activities (ALL)**

- Plan servicing to minimise disruption to working
- Use correct documentation
- Adhere to risk assessment and safety standards
- Ensure correct decontamination procedure
- Ensure safe isolation
- Provide safe access
- Use approved techniques and procedures
- Return equipment to service on completion
- Correctly dispose of waste & leave work area safe

**Carry out servicing on seven of the following types of dental equipment (SEVEN)**

- Suction unit
- Drilling unit
- De-scalers
- Floor utility service units
- Polymerisation unit
- Dental lighting
- Amalgamators
- Dental hand pieces
- Amalgam separators
- Dental air compressors

**Carry out all of the following activities as applicable to the equipment being serviced (ALL)**

- Isolating the equipment
- Applying ESD precautions
- Dismantling equipment to the appropriate level
- Disconnecting and reconnecting wires/cables
- Attaching suitable cable identification markers
- Remove/replace electrical units/components
Unit 69: Servicing Dental Equipment

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**Replace a range of components to include fourteen of the following (FOURTEEN)**

- cables and connectors
- printed circuit boards
- overload protection devices
- switches
- locking/retaining devices
- power supplies
- analogue or digital integrated circuits
- potentiometers
- phototherapy lighting tubes
- regulators
- diaphragms
- rectifiers
- sensors
- thermistors
- transformers
- transducers
- timers
- seals
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**Service dental equipment, in compliance with all of the following quality and accuracy standards and/or advisory documentation (ALL)**

- organisational guidelines and codes of practice
- equipment manufacturer's operation range
- relevant and current HTM documentation
- equipment & associated BSEN standards, CE marking, BS7671/IEE Wiring Regulations
- the equipment functions to specification
- all potential defects are identified and reported for future action

**Complete the relevant paperwork to include one of the following and pass to the appropriate people (ONE)**

- job cards
- servicing logs or reports
- other specific documentation

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Knowledge and understanding reference:

Candidate: _____________________________ Date: ____________

Assessor: _____________________________ Date: ____________
Unit 70:
Servicing Medical Therapeutic Equipment

Unit Summary
This unit identifies the competences you need to carry out servicing activities on medical therapeutic equipment, in accordance with approved procedures. You will be required to service a range of medical therapeutic equipment, such as nerve stimulating devices, interferential therapy devices, therapeutic ultrasound devices, therapeutic diathermy devices, traction devices, exercise equipment and hydrotherapy equipment. This will involve dismantling, removing and replacing faulty items, at component or unit level, on a variety of different types of medical therapeutic equipment. You will be expected to apply a range of dismantling and reassembly methods and techniques, which are appropriate to the equipment being serviced and the type of components being removed/replaced, and which will include electrical, electronic and mechanical units and components.

Your responsibilities will require you to comply with organisational policy and procedures for the servicing activities undertaken, and to report any problems with the activities that you cannot personally resolve, or are outside your permitted authority, to the relevant people. You must ensure that all tools, equipment and materials used in the servicing 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 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 the correct servicing procedures. You will understand the dismantling and reassembly methods and procedures used, and their application. You will know about the medical therapeutic equipment being worked on, and component properties, functions and associated defects, in adequate depth to provide a sound basis for carrying out the servicing activities, correcting faults and ensuring that the serviced equipment functions to the required specification.

You will understand the safety precautions required when carrying out the servicing 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.
Unit 70:
Servicing Medical Therapeutic Equipment

Performance statements:
You must:
a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Follow the relevant servicing schedules to carry out the required work
c. Carry out the servicing activities within the limits of your personal authority
d. Carry out the servicing activities in the specified sequence and in an agreed timescale
e. Report any instances where the servicing activities cannot be fully met or where there are identified defects outside the planned schedule
f. Complete the relevant servicing records accurately and pass them on to the appropriate person
g. Dispose of waste materials in accordance with safe working practices and approved procedures

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:
1. Carry out all of the following during the servicing activities:
   a. plan the servicing activities so as to minimise disruption to normal working
   b. use the correct issue of company and/or manufacturers' drawings and servicing documentation
   c. adhere to risk assessment, COSHH and other relevant safety standards
   d. ensure that the correct equipment decontamination procedure has been adhered to before and after the servicing activities
   e. ensure the safe isolation of equipment (such as electricity, mechanical, gas, air or fluids)
   f. provide safe access and working arrangements for the servicing area
   g. carry out the servicing activities, using appropriate techniques and procedures
   h. return the equipment to service on completion of the activities
   i. dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition

2. Carry out servicing on five of the following types of medical therapeutic equipment:
   a. nerve stimulating devices
   b. interferential therapy devices
   c. therapeutic ultrasound devices
   d. therapeutic diathermy devices
   e. traction devices
   f. heater lamps
   g. hydrotherapy equipment
   h. exercise equipment
3. Carry out all of the following activities, as applicable to the equipment being serviced:
   - isolating the equipment
   - applying electrostatic discharge (ESD) precautions
   - dismantling equipment to the appropriate level
   - disconnecting and reconnecting wires and cables
   - attaching suitable cable identification markers
   - removing and replacing electrical units/components
   - removing and replacing mechanical units/components
   - soldering and de-soldering
   - checking components for serviceability
   - replacing damaged/defective components
   - replacing all ‘lifed’ items
   - tightening fastenings to the required torque
   - setting and adjusting replaced components
   - making visual checks before powering up
   - carrying out electrical safety tests
   - checking equipment operating parameters
   - re-calibrating and/or adjusting equipment
   - functionally testing the serviced equipment

4. Replace a range of components, to include twelve of the following:
   - cables and connectors
   - printed circuit boards
   - overload protection devices
   - locking and retaining devices
   - power supplies
   - analog or digital integrated circuits
   - heater lamps/elements
   - indicators (such as lamps, LEDs)
   - rectifiers
   - sensors
   - thermistors
   - transformers
   - transducers
   - inductors
   - motors
   - pulleys
   - belts
   - timers
   - seals
   - batteries
   - gears
   - bearings
   - gauges
   - potentiometers
   - switches
   - display units
   - valves
   - pumps
   - hoses/pipework
   - structural components (such as hinges, covers and wheels)
5. Service medical therapeutic equipment, in compliance with **all** of the following quality and accuracy standards and/or advisory documentation:
   - organisational guidelines and codes of practice
   - equipment manufacturer’s operation range
   - relevant and current HTM documentation
   - equipment and associated BSEN standards, CE marking and where appropriate BS7671/IEE wiring regulations
   - the equipment functions to specification
   - all potential defects are identified and reported for future action

6. Complete the relevant paperwork, to include **one** of the following, and pass it to the appropriate people:
   - job cards
   - servicing logs or reports
   - other specific documentation
Unit 70: 
Servicing Medical Therapeutic Equipment

Knowledge statements:
You must have knowledge and understanding of:
1. The health and safety, infection control and de-contamination requirements of the work area and equipment being serviced, and the responsibility these requirements place on you
2. The statutory and advisory documentation relating to medical therapeutic equipment (such as warnings and guidance from the regulatory authority and British and European standards)
3. The importance of reporting any equipment adverse incidents to the regulatory authority
4. The isolation procedure that applies to the servicing activities (such as electrical isolation, removal of fuses, placing of maintenance warning notices)
5. How to recognise and deal with victims of electric shock (to include methods of safely removing the victim from the power source, isolating the power source, and methods of first aid resuscitation)
6. The importance of wearing protective clothing and other appropriate safety equipment during the servicing activities
7. How to obtain and interpret documents needed in the servicing activities (such as drawings, circuit and physical layouts, charts, specifications, manufacturers' manuals, history/maintenance reports, graphical electronic/electrical symbols and BS7671/IEE wiring regulations)
8. The working practices of, and the need to respect the hospital ward and/or patient environment
9. The basic principles of operation of the medical therapeutic equipment being serviced, and the function of individual components
10. The human physiology directly associated with the medical therapeutic equipment being serviced
11. The risks to the human body from external energy sources associated with the therapeutic equipment
12. The application and functions of a range of components used in the equipment (such as switches, sensors, overload protection devices, transformers, thermistors, rectifiers, printed circuit boards, valves, pumps)
13. The care, handling and application of ohmmeters, multimeters and other electrical measuring instruments (including dedicated test equipment)
14. Company policy on the repair/replacement of components, and the procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance activities
15. How to check that the replacement components meet the required specification/operating conditions (such as values, tolerance, current carrying capacity, voltage rating, power rating, working temperature range)
16. The techniques used to dismantle/reassemble medical therapeutic equipment (such as unplugging, de-soldering, removal of screwed, clamped and crimped connections, removal of pipes, hoses and mechanical components)
17. Methods of removing and replacing components without causing damage to the equipment or other components
18. The procedures and precautions to be adopted to eliminate/protect against electrostatic discharge (ESD) when working on sensitive equipment or devices
19. The different types of cabling (such as multicore cables, single core cables, steel wire armoured (SWA), mineral insulated (MI), screened cables), and their application
20. The use of BS7671/IEE wiring, and other, regulations when replacing wires and cables
21. Methods of attaching identification markers/labels to removed components or cables to assist with re-assembly
22. The tools and equipment used in the servicing activities (including the use of cable stripping tools, crimping tools, soldering irons)
23. Methods of checking that components are fit for purpose, and the need to replace 'lifed' items
24. How to make adjustments to components/assemblies to ensure that they function correctly
25. 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
26. The importance of carrying out electrical safety tests on medical therapeutic equipment, and the
implications if this is not carried out

27. The importance of making visual checks before proving the equipment with the electrical supply on
28. The generation of documentation and/or reports following the servicing activity
29. The equipment operating and control procedures to be applied during the servicing activity
30. The problems that can occur during the servicing activity, and how they can be overcome
31. The organisational procedure(s) to be adopted for the safe disposal of waste of all types of materials
32. The extent of your own authority and whom you should report to if you have a problem that you cannot resolve
Unit 70: Servicing Medical Therapeutic Equipment

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<thead>
<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
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**Carry out all of the following during the servicing activities (ALL)**

- plan servicing to minimise disruption to working
- use correct documentation
- adhere to risk assessment and safety standards
- ensure correct decontamination procedure
- ensure safe isolation
- provide safe access
- use approved techniques and procedures
- return equipment to service on completion
- correctly dispose of waste & leave work area safe

**Carry out servicing on five of the following types of medical therapeutic equipment (FIVE)**

- nerve stimulating devices
- interferential therapy devices
- therapeutic ultrasound devices
- therapeutic diathermy devices
- traction devices
- heater lamps
- hydrotherapy equipment
- exercise equipment

**Carry out all of the following activities as applicable to the equipment being serviced (ALL)**

- isolating the equipment
- applying ESD precautions
- dismantling equipment to the appropriate level
- disconnecting and reconnecting wires/cables
- attaching suitable cable identification markers
- remove/replace electrical units/components
### Unit 70: Servicing Medical Therapeutic Equipment

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**Replace a range of components to include twelve of the following (TWELVE)**

- cables and connectors
- printed circuit boards
- overload protection devices
- locking/retaining devices
- power supplies
- analogue or digital integrated circuits
- heater lamps/elements
- indicators
- rectifiers
- sensors
- thermistors
- transducers
- transformers
- inductors
- motors
- pulleys
- belts
- timers
- seals
# Unit 70:
Servicing Medical Therapeutic Equipment

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**Service medical therapeutic equipment, in compliance with all of the following quality and accuracy standards and/or advisory documentation (ALL)**

- organisational guidelines and codes of practice
- equipment manufacturer’s operation range
- relevant and current HTM documentation
- equipment & associated BSEN standards, CE marking, BS7671/IEE Wiring Regulations
- the equipment functions to specification
- all potential defects are identified and reported for future action

**Complete the relevant paperwork to include one of the following and pass to the appropriate people (ONE)**

- job cards
- servicing logs or reports
- other specific documentation

Knowledge and understanding reference:

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Unit 71: Servicing Mechanical and Electromechanical Assistive Technology Equipment

Unit Summary

This unit identifies the competences you need to carry out servicing activities on mechanical and electromechanical assistive technology equipment, in accordance with approved procedures. You will be required to service a range of mechanical/electromechanical assistive technology equipment such as, wheelchairs, hoists, stair lifts, seating, walking aids, adjustable beds, pressure redistribution cushions, ramps, and aids to daily living. This will involve dismantling, removing and replacing faulty equipment, at component or unit level, on a variety of different types of assistive technology equipment. You will be expected to apply a range of dismantling and reassembly methods and techniques, such as mechanical fitting, fixing, fastening, soldering, crimping, harnessing, and securing cables and components.

Your responsibilities will require you to comply with organisational policy and procedures for the servicing activities undertaken, and to report any problems with the activities that you cannot personally resolve, or are outside your permitted authority, to the relevant people. You must ensure that all tools, equipment and materials used in the servicing 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 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 the correct servicing procedures. You will understand the dismantling and reassembly methods and procedures used, and their application. You will know about the assistive technology equipment being worked on, component properties, functions and associated defects, in adequate depth to provide a sound basis for carrying out the servicing activities, correcting faults and ensuring that the serviced equipment functions to the required specification.

You will understand the safety precautions required when carrying out the servicing 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.
Unit 71:
Servicing Mechanical and Electromechanical Assistive Technology Equipment

Performance statements:
You must:

a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Follow the relevant servicing schedules to carry out the required work
c. Carry out the servicing activities within the limits of your personal authority
d. Carry out the servicing activities in the specified sequence and in an agreed timescale
e. Report any instances where the servicing activities cannot be fully met or where there are identified defects outside the planned schedule
f. Complete the relevant servicing records accurately, and pass them on to the appropriate person
g. Dispose of waste materials in accordance with safe working practices and approved procedures

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:
1. Carry out all of the following servicing activities:
   - plan the servicing activities so as to minimise disruption to normal working
   - use the correct issue of company and/or manufacturers’ drawings and servicing documentation
   - adhere to risk assessment, COSHH and other relevant safety standards
   - ensure that the correct equipment decontamination procedure has been adhered to before and after the servicing activities
   - ensure the safe isolation of equipment (such as electricity, mechanical, gas, air or fluids)
   - provide safe access and working arrangements for the servicing area
   - carry out the servicing activities, using appropriate techniques and procedures
   - return the equipment to service on completion of the servicing activities
   - dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition

2. Carry out servicing activities on six of the following types of assistive technology equipment:
   - wheelchairs (including buggies, scooters)
   - hoists
   - seating systems
   - walking aids
   - pressure redistribution and relief devices
   - adjustable beds
   - stair lifts
   - commodes
   - bathing equipment
   - other specific AT equipment
3. Carry out all of the following servicing activities, as applicable to the equipment being maintained:
   - isolating the equipment
   - initial inspection and identification of items for servicing
   - disconnecting and reconnecting wires and cables
   - dismantling equipment to the appropriate level
   - removing electrical units/components
   - soldering and de-soldering
   - checking components for serviceability
   - replacing damaged/defective components
   - setting and adjusting replaced components
   - replacing all 'lifed' items
   - replacing fasteners
   - tightening fastenings to the required torque
   - replacing or checking lubricants
   - welding/brazing of mountings or support structures
   - repairing or replacing upholstery
   - non-destructive crack detecting
   - attaching suitable cable identification markers
   - making visual checks before functional test or powering up
   - carrying out electrical safety tests
   - functionally testing the serviced equipment

4. Replace a range of components, to include fifteen of the following:
   - cables and connectors
   - printed circuit boards/control unit
   - overload protection devices
   - locking and retaining devices
   - power supplies
   - actuators
   - hydraulic units
   - posture supports/belts
   - lifting slings
   - seating/support surface
   - rectifiers
   - sensors
   - thermistors
   - transformers
   - transducers
   - inductors
   - motors
   - pulleys
   - belts
   - timers
   - seals
   - valves
   - pumps
   - gears
   - wheels
   - bearings
   - gauges
   - switches
   - display/indication units
   - hoses/pipework
   - structural components
   - upholstery
   - battery chargers
5. Service assistive technology equipment to **one or more** of the following quality and accuracy standards:
   - organisational guidelines and codes of practice
   - equipment manufacturer’s instructions
   - equipment meets BS EN 12182, CE marking and, where appropriate, BSEN 60601 and BS 7671/IEE wiring regulations

6. Complete **all** relevant paperwork from the following, and pass it to the appropriate people:
   - job cards
   - servicing logs or reports
   - other specific documentation
Unit 71:
Servicing Mechanical and Electromechanical Assistive Technology Equipment

Knowledge statements:
You must have knowledge and understanding of:
1. The health and safety, infection control and de-contamination requirements of the work area and equipment being serviced, and the responsibility these requirements place on you
2. The statutory and advisory documentation relating to medical devices (such as Medical Devices Regulations, British and European standards, regulatory agency guidance and safety warnings)
3. The importance of reporting any equipment adverse incidents to the regulatory authority.
4. The isolation procedure that applies to the servicing activities (such as electrical isolation, removal of fuses, placing of maintenance warning notices)
5. How to recognise and deal with victims of electric shock (to include methods of safely removing the victim from the power source, isolating the power source, and methods of first aid resuscitation)
6. The importance of wearing protective clothing and other appropriate safety equipment during the servicing activities
7. How to obtain and interpret drawings, circuit and physical layouts, charts, specifications, manufacturers' information, history/maintenance reports, graphical electrical symbols, and BS7671/IEE wiring regulations, and other documents needed for the servicing activities
8. The appropriate working practices, and the need to respect the patient and carer in the patient environment, at home or in the community
9. The basic principle of operation of the assistive technology equipment being serviced, and the function of individual components
10. The human physiology directly associated with the assistive technology equipment being serviced
11. The application and functions of a range of components used in the equipment (such as switches, sensors, overload protection devices, printed circuit boards, mechanical components, control units, valves, pumps, batteries and chargers)
12. The care, handling and application of multimeters and other measuring instruments (including dedicated test equipment)
13. Organisational policy on the repair/replacement of components, and the procedure for obtaining replacement parts, materials and other consumables necessary for the servicing activities
14. How to check that the replacement components meet the required specification/operating conditions (such as type, size, tolerance, current carrying capacity, voltage rating, power rating)
15. The techniques used to dismantle/reassemble AT mechanical/electromechanical equipment (such as mechanical fittings, unplugging, de-soldering, removal of crimped connections)
16. Methods of removing and replacing components without causing damage to the equipment or other components
17. The different types of cabling, and their application (such as multicore cables, single core cables, steel wire armoured (SWA), mineral insulated (MI), screened cables)
18. Methods of attaching identification markers/labels to removed components or cables to assist with re-assembly
19. The use of BS7671/IEE wiring, and other, regulations when replacing wires and cables
20. The tools and equipment used in the servicing activities
21. Methods of checking that components are fit for purpose, and the need to replace ‘lifed’ items
22. How to make adjustments to components/assemblies to ensure that they function correctly
23. 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
24. The importance of carrying out electrical safety tests on medical equipment, and the implications if this is not carried out
25. The importance of making visual checks before functional testing or proving the equipment with the electrical supply on
26. Procedures for the generation of documentation and/or reports following the servicing activity
28. The equipment operating and control procedures to be applied during the servicing activity
29. The problems that can occur during the servicing activity, and how they can be overcome
30. The organisational procedure(s) to be adopted for the safe disposal of waste of all types of materials
31. The extent of your own authority and whom you should report to if you have a problem that you cannot resolve
## Unit 71: Servicing Mechanical and Electromechanical Assistive Technology Equipment

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**Carry out all of the following during the servicing activities (ALL)**

- plan servicing to minimise disruption to working
- use correct documentation
- adhere to risk assessment and safety standards
- ensure correct decontamination procedure
- ensure safe isolation
- provide safe access
- use approved techniques and procedures
- return equipment to service on completion
- correctly dispose of waste & leave work area safe

**Carry out servicing on six of the following types of assistive technology equipment (SIX)**

- wheelchairs
- hoists
- seating systems
- walking aids
- pressure redistribution and relief devices
- adjustable beds
- stair lifts
- commodes
- bathing equipment
- other specific AT equipment

**Carry out all of the following activities as applicable to the equipment being serviced (ALL)**

- isolating the equipment
- initial inspection and identification of items for servicing
- disconnecting and reconnecting wires/cables
- dismantling equipment to the appropriate level
## Unit 71:
Servicing Mechanical and Electromechanical Assistive Technology Equipment

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**Replace a range of components to include fifteen of the following (FIFTEEN)**

- cables and connectors
- printed circuit boards
- overload protection devices
- locking/retaining devices
- power supplies
- actuators
- hydraulic units
- posture supports/belts
- lifting slings
- seating/support surface
**Unit 71:**
Servicing Mechanical and Electromechanical Assistive Technology Equipment

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<td>battery chargers</td>
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**Service mechanical and electromechanical assistive technology equipment, in compliance with all of the following quality and accuracy standards and/or advisory documentation (ALL)**

- Organisational guidelines and codes of practice
- Equipment manufacturer’s instructions
- Equipment meets BS EN 12182, CE marking and, where appropriate, BSEN 60601 and BS 7671/IEE wiring regulations

**Complete the relevant paperwork to include one of the following and pass to the appropriate people (ONE)**

- Job cards
- Servicing logs or reports
- Other specific documentation

Knowledge and understanding reference:

Candidate:  
Assessor:  
Date:  
Date:  
Unit 72: 
Maintaining Medical Device and Surgical Instrument Decontamination Equipment

Unit Summary
This unit identifies the competences you need to carry out maintenance activities on medical device and surgical instrument decontamination equipment, in accordance with approved procedures. You will be required to maintain a range of decontamination equipment, such as surgical instrument washers, human waste washers, endoscope washers, laboratory equipment washers, ultrasonic washers, bench top sterilisers, large porous load sterilisers, fluid sterilisers, ethylene oxide sterilisers and gas plasma sterilisers. This will involve dismantling, removing and replacing faulty items, at component or unit level, on a variety of different types of sterilisation and washer disinfecting equipment, and will involve depressurising the system and removing, replacing and repairing components, as applicable.

Your responsibilities will require you to comply with organisational policy and procedures for the maintenance activities undertaken, and to report any problems with the activities that you cannot personally resolve, or 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 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 the correct maintenance procedures. You will understand the dismantling and reassembly methods and procedures used, and their application. You will know about the decontamination equipment being worked on, its component properties, functions and associated defects, in adequate depth to provide a sound basis for carrying out the maintenance activities, correcting faults and ensuring that the maintained equipment functions to the required specification.

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.
Unit 72: Maintaining Medical Device and Surgical Instrument Decontamination Equipment

Performance statements:
You must:

a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Follow the relevant maintenance schedules to carry out the required work
c. Carry out the maintenance activities within the limits of your personal authority
d. Carry out the maintenance activities in the specified sequence and in an agreed timescale
e. Report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
f. Complete relevant maintenance records accurately and pass them on to the appropriate person
g. Dispose of waste materials in accordance with safe working practices and approved procedures

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:

1. Carry out all of the following during the maintenance activities:
   • plan the maintenance activities so as to minimise disruption to normal working
   • use the correct issue of company and/or manufacturers’ drawings and maintenance documentation
   • adhere to risk assessment, COSHH, relevant health technical memorandums (HTM) and other relevant safety standards
   • ensure that the correct equipment decontamination procedure has been adhered to before and after carrying out the maintenance activities (where appropriate)
   • ensure the safe isolation of equipment and services (such as electricity, mechanical, gas, air or fluids)
   • provide safe access and working arrangements for the maintenance area
   • carry out the maintenance activities, using appropriate techniques and procedures
   • hand over the equipment the appropriate person on completion of the maintenance activities
   • dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition

2. Carry out maintenance on three of the following types of washer disinfecting equipment:
   • surgical instrument washers (including hollow-ware and anaesthetic accessories)
   • human waste washers
   • endoscope washers
   • laboratory equipment washers
   • ultrasonic washers

Plus two more of the following types of sterilisation equipment:
   • bench top sterilisers
   • large porous load sterilisers
   • fluid sterilisers
   • ethylene oxide sterilisers
   • gas plasma sterilisers
   • other specific sterilisers (such as low temperature steam)
3. Carry out all of the following activities, as applicable to the equipment being maintained:
   - releasing stored pressure
   - dismantling equipment to the appropriate level
   - replacing damaged/defective components
   - soldering and de-soldering
   - removing and replacing units/components (such as pumps, cylinders, valves, actuators)
   - disconnecting/removing hoses and pipes
   - proof marking/labelling of removed components
   - checking components for serviceability
   - replacing all 'lifed' items (such as seals, filters, gaskets)
   - removing and replacing electrical units/components
   - disconnecting and re-connecting cables and wires
   - setting, aligning and adjusting replaced components
   - tightening fastenings to the required torque
   - making 'off-load' checks before running the equipment
   - functional testing of the maintained system
   - identifying and reporting any potential equipment problems that may require action in the future

4. Remove and replace a range of components, to include fifteen of the following:
   - pumps
   - motors
   - pneumatic rams
   - manifolds/flanges
   - protection devices
   - pressure transducers
   - steam separators
   - steam traps
   - condenser units
   - couplings
   - locking and retaining devices
   - seals and gaskets
   - gauges
   - fans
   - valves
   - calorfiers
   - drive belts and/or chains
   - receivers
   - pipework
   - filters
   - drain flasks
   - indicator lamps/LEDs
   - switches
   - cables and wires
   - electrical connectors
   - printed circuit boards
   - sensors
   - power supplies
   - batteries
   - heater elements
5. Maintain medical decontamination equipment, in compliance with **all** of the following quality and accuracy standards and/or advisory documentation:
   - organisational guidelines and codes of practice
   - equipment manufacturer’s operation range
   - relevant and current HTM documentation
   - pressure systems safety regulations (PSSR)
   - equipment and associated BSEN standards, CE marking and where appropriate BS7671/IEE wiring regulations

6. Complete the relevant paperwork, to include **one** of the following, and pass it to the appropriate people:
   - job cards
   - servicing logs or reports
   - permit to work
   - other specific documentation
Unit 72: Maintaining Medical Device and Surgical Instrument Decontamination Equipment

Knowledge statements:
You must have knowledge and understanding of:
1. The health and safety, infection control and de-contamination requirements of the work area and equipment being maintained, and the responsibility these requirements place on you
2. The statutory and advisory documentation relating to decontamination, sterilisation and washer disinfecting equipment (such as warnings and guidance from the regulatory authority and British and European standards, Pressure Systems Safety Regulations and HTM documentation)
3. The importance of reporting any equipment adverse incidents to the regulatory authority
4. The isolation and lock-off procedures or permit-to-work procedure that applies to the decontamination equipment being maintained
5. How to recognise and deal with victims of electric shock (to include methods of safely removing the victim from the power source, isolating the power source, and methods of first aid resuscitation)
6. The importance of wearing protective clothing and other appropriate safety equipment
7. Hazards associated with carrying out maintenance activities on decontamination equipment, and how these can be minimised
8. The importance of working safely with steam supply systems
9. How to obtain and interpret documents needed in the maintenance activities (such as drawings, circuit and physical layouts, charts, specifications, manufacturers’ manuals, history/maintenance reports, graphical electronic/electrical symbols and BS7671/IEE wiring regulations)
10. The working practices of, and the need to respect the department where the maintenance is being carried out
11. The basic principles of operation of the decontamination equipment being maintained, and the function of individual components
12. The basic principles of the different types of decontamination process, and how this effects the selection of decontamination equipment
13. The basic understanding of reverse osmosis (RO) water systems, and its importance for the decontamination process
14. How to use and interpret equipment performance against steam tables
15. The sequence to be adopted for the dismantling/reassembly of various types of decontamination equipment
16. The care, handling and application of appropriate measuring instruments and test equipment
17. The organisational policy on the repair/replacement of components, and the procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance activities
18. How to check that replacement components meet the required specification/operating conditions
19. The techniques used to dismantle/reassemble decontamination equipment
20. Methods of removing and replacing components without causing damage to the equipment or other components
21. Methods of attaching identification markers/labels to removed components or cables to assist with re-assembly
22. The tools and equipment used in the maintenance activities
23. Methods of checking that components are fit for purpose, and the need to replace ‘lifed’ items
24. How to make adjustments to components/assemblies to ensure that they function correctly
25. 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
26. The importance of making visual checks before proving the equipment
27. The generation of documentation and/or reports following the maintenance activity
28. The equipment operating and control procedures to be applied during the maintenance activity
29. The problems that can occur during the maintenance activity, and how they can be overcome
30. The organisational procedure(s) to be adopted for the safe disposal of waste of all types of
31. The extent of your own authority and whom you should report to if you have a problem that you cannot resolve
## Unit 72:
Maintaining Medical Device and Surgical Instrument Decontamination Equipment

<table>
<thead>
<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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**Carry out all of the following during the maintenance activities (ALL)**

- plan maintenance to minimise disruption to working
- use correct documentation
- adhere to risk assessment and safety standards
- ensure correct decontamination procedure
- ensure safe isolation
- provide safe access
- carry out maintenance using approved techniques and procedures
- hand over equipment on completion
- correctly dispose of waste and leave work area safe

**Carry out maintenance on three of the following types of washer disinfecting equipment (THREE)**

- surgical instrument washers
- human waste washers
- endoscope washers
- laboratory equipment washers
- ultrasonic washers

**PLUS two more of the following types of sterilisation equipment (TWO)**

- bench top sterilisers
- large porous load sterilisers
- fluid sterilisers
- ethylene oxide sterilisers
- gas plasma sterilisers
- other specific sterilisers
## Unit 72:
Maintaining Medical Device and Surgical Instrument Decontamination Equipment

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<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
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<tbody>
<tr>
<td><strong>Carry out all of the following activities as applicable to the equipment being maintained (ALL)</strong></td>
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<td>releasing stored pressure</td>
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<td>dismantling equipment to the appropriate level</td>
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<td>removing and replacing units/components</td>
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<td>replace damaged/defective components</td>
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<td>soldering and desoldering</td>
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<td>disconnecting/removing hoses and pipes</td>
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<td>proof marking/labelling of removed components</td>
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<td>checking components for serviceability</td>
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<td>replacing all ‘lifed’ items</td>
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<td>removing/replacing electrical units/components</td>
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<td>disconnecting and reconnecting wires/cables</td>
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<td>setting/aligning/adjusting replaced components</td>
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<td>tightening fastenings to the required torque</td>
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<td>making ‘off-load’ checks before running</td>
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<tr>
<td>functional testing the maintained system</td>
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<td>identifying and reporting problems for action</td>
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<tr>
<td><strong>Remove and replace a range of components to include fifteen of the following (FIFTEEN)</strong></td>
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<td>motors</td>
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<td>pneumatic rams</td>
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<td>manifolds/flanges</td>
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<td>protection devices</td>
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<td>pressure transducers</td>
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<td>steam separators</td>
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<td>steam traps</td>
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<td>condenser units</td>
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<td>couplings</td>
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<td>locking/retaining devices</td>
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## Unit 72:
Maintaining Medical Device and Surgical Instrument Decontamination Equipment

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<th>additional performance evidence (if required)</th>
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<td>calorifiers</td>
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<td>drain flasks</td>
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<td>heater elements</td>
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**Maintain medical decontamination equipment, in compliance with all of the following quality and accuracy standards and/or advisory documentation (ALL)**

- organisational guidelines and codes of practice
- equipment manufacturer's operation range
- relevant and current HTM documentation
- pressure systems safety regulations
- equipment & associated BSEN standards, CE marking, BS7671/IEE Wiring Regulations

**Complete the relevant paperwork to include one of the following and pass to the appropriate people (ONE)**

- job cards
- servicing logs or reports
- permit to work
- other specific documentation

Knowledge and understanding reference:

Candidate: ___________________________ Date: ____________
Assessor: ___________________________ Date: ____________
Unit 73:
Maintaining Medical Gas Pipeline Systems and Equipment

Unit Summary
This unit identifies the competences you need to carry out maintenance activities on medical gas pipeline systems and equipment, in accordance with approved procedures. You will be required to maintain a range of piped medical gas systems and equipment, such as medical/surgical compressed air systems, cylinder manifold systems, terminal supply units, medical vacuum systems, anaesthetic gas scavenging systems, dental compressed air and vacuum systems, primary, secondary and tertiary supply systems. This will involve dismantling, removing and replacing faulty items, at component or unit level, on a variety of different types of medical gas pipeline systems and equipment and, where appropriate, this will involve depressurising the system and removing, replacing and repairing system components, as applicable.

Your responsibilities will require you to comply with organisational policy and procedures for the maintenance activities undertaken, and to report any problems with the activities that you cannot personally resolve, or 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 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 the correct maintenance procedures. You will understand the dismantling and reassembly methods and procedures used, and their application. You will know about the medical gas pipeline system and equipment being worked on, its component properties, functions and associated defects, in adequate depth to provide a sound basis for carrying out the maintenance activities, correcting faults and ensuring that the maintained equipment functions to the required specification.

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.
Unit 73:
Maintaining Medical Gas Pipeline Systems and Equipment

Performance statements:
You must:

a. Work safely at all times, complying with health and safety and other relevant regulations and guidelines
b. Follow the relevant maintenance schedules to carry out the required work
c. Carry out the maintenance activities within the limits of your personal authority
d. Carry out the maintenance activities in the specified sequence and in an agreed timescale
e. Report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
f. Complete the relevant maintenance records accurately and pass them on to the appropriate person
g. Dispose of waste materials in accordance with safe working practices and approved procedures

Scope of the unit:
The numbers of scope items specified (below) indicate the minimum requirements for this Occupational Standard.

You must:
1. Carry out all of the following during the maintenance activities:
   - plan the maintenance activities so as to minimise disruption to normal working
   - use the correct issue of company and/or manufacturers’ drawings and maintenance documentation
   - adhere to risk assessment, COSHH, relevant health technical memorandums (HTM) and other relevant safety standards
   - comply with permit-to-work procedures at all times
   - ensure the safe isolation of equipment (such as electricity, mechanical, gas, air or fluids)
   - ensure that there are safe access and working arrangements for the maintenance area
   - carry out the maintenance activities, using appropriate techniques and procedures
   - return the system/equipment to service on completion of the maintenance activities
   - hand over the maintained system/equipment to the appropriate person to authorise that the system can be returned to service
   - dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition

2. Carry out maintenance on six of the following medical gas pipeline systems and equipment:
   - medical vacuum system
   - medical/surgical compressed air system
   - dental compressed air and vacuum system
   - anaesthetic gas scavenging system
   - cylinder manifold system
   - terminal supply units
   - monitoring and alarm systems
   - primary, secondary and tertiary supply systems
3. Carry out all of the following activities, as applicable to the equipment being maintained:
   - using appropriate techniques to release stored pressure safely
   - supporting equipment components
   - disconnecting/removing hoses and pipes
   - removing and replacing units/components (such as pumps, cylinders, valves, actuators)
   - proof marking/labelling of removed components
   - visually checking components for serviceability
   - replacing all ‘lifed’ items (such as seals, filters, gaskets)
   - disconnecting and re-connecting cables and wires
   - removing and replacing electrical/electronic units/components (such as switches, circuit boards)
   - setting, aligning and adjusting replaced components
   - tightening fastenings to the required torque
   - making ‘off-load’ checks before re-pressurising the system
   - carrying out emergency repairs
   - testing the system for leaks
   - functional testing of the maintained system

4. Remove and replace a range of components, to include eighteen of the following:
   - protection devices
   - switches
   - electrical connectors
   - locking and retaining devices
   - seals and gaskets
   - sensors
   - pumps
   - valves
   - motors
   - pistons
   - regulators
   - power supplies
   - batteries
   - heater elements
   - drain flasks
   - display meter units
   - printed circuit boards
   - reservoirs
   - receivers
   - compressors
   - cylinders
   - actuators
   - manifolds
   - pipework
   - gauges
   - filters and filtration components
   - inspection ports
   - drains
   - medical gas cylinders
   - separators
   - indicator lamps/LEDs
   - identification markers
5. Maintain medical gas pipeline systems, in compliance with all of the following quality and accuracy standards and/or advisory documentation:
   - organisational guidelines and codes of practice
   - equipment manufacturer’s operation range
   - relevant and current HTM documentation
   - equipment and associated BSEN standards, CE marking and where appropriate BS7671/IEE wiring regulations
   - the equipment functions to specification
   - all potential defects are identified and reported for future action

6. Complete the relevant paperwork, to include one of the following, and pass it to the appropriate people:
   - job cards
   - servicing logs or reports
   - permit to work
   - other specific documentation
Unit 73:  
Maintaining Medical Gas Pipeline Systems and Equipment

Knowledge statements:  
You must have knowledge and understanding of:
1. The health and safety, infection control and de-contamination requirements of the work area and equipment being maintained, and the responsibility these requirements place on you
2. The statutory and advisory documentation relating to medical gas pipeline systems and equipment (such as warnings and guidance from the regulatory authority and British and European standards and HTM documentation)
3. The importance of reporting any equipment adverse incidents to the regulatory authority
4. The permit-to-work procedure that applies to the gas pipeline system being maintained
5. How to recognise and deal with victims of electric shock (to include methods of safely removing the victim from the power source, isolating the power source, and methods of first aid resuscitation)
6. The importance of wearing protective clothing and other appropriate safety equipment
7. Hazards associated with carrying out maintenance activities on medical gas pipeline systems and equipment, and how these can be minimised
8. How to obtain and interpret documents needed in the maintenance activities (such as drawings, circuit and physical layouts, charts, specifications, manufacturers’ manuals, history/maintenance reports, graphical electronic/electrical symbols and BS7671/IEE wiring regulations)
9. The working practices of, and the need to respect the hospital ward and/or patient environment
10. The basic principles of operation of the medical gas pipeline system and equipment being maintained, and the function of individual components
11. The identification and application of different types of valves (such as poppet, spool, piston, disc, ball)
12. The identification and application of different types of sensors and actuators (such as rotary, linear, mechanical, electrical)
13. The identification and application of different types of compressors (such as single acting, double acting)
14. The identification and application of different types of pumps (such as positive and dynamic, reciprocating, screw and claw)
15. The sequence to be adopted for the dismantling/reassembly of various types of medical gas pipeline systems
16. The care, calibration, handling and application of appropriate measuring instruments and test equipment
17. The organisational policy on the repair/replacement of components, and the procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance activities
18. How to check that replacement components meet the required specification/operating conditions
19. The techniques used to dismantle/reassemble medical gas pipeline systems and equipment
20. Methods of removing and replacing components without causing damage to the equipment or other components
21. Methods of attaching identification markers/labels to removed components or cables to assist with re-assembly
22. The tools and equipment used in the maintenance activities
23. Methods of checking that components are fit for purpose, and the need to replace ‘lifed’ items
24. How to make adjustments to components/assemblies to ensure that they function correctly
25. The methods used to label and identify different pipework systems (including colour coding/warning signs)
26. 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
27. The importance of ensuring that sampling and testing of medical gases is carried out on completion of the maintenance activities, and the implications if this is not carried out
28. The importance of making visual checks before proving the equipment
29. The generation of documentation and/or reports following the maintenance activity
30. The equipment operating and control procedures to be applied during the maintenance activity
31. The problems that can occur during the maintenance activity, and how they can be overcome
32. The organisational procedure(s) to be adopted for the safe disposal of waste of all types of materials
33. The extent of your own authority and whom you should report to if you have a problem that you cannot resolve
<table>
<thead>
<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
</tr>
</thead>
<tbody>
<tr>
<td>evidence type</td>
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<td>date</td>
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</table>

**Carry out all of the following during the maintenance activities (ALL)**

- plan maintenance to minimise disruption to working
- use correct documentation
- adhere to risk assessment and safety standards
- comply with permit to work
- ensure safe isolation
- provide safe access
- carry out maintenance using approved techniques and procedures
- return system to service
- hand over equipment on completion
- correctly dispose of waste and leave work area safe

**Carry out maintenance on six of the following medical gas pipeline systems and equipment (SIX)**

- medical vacuum system
- medical/surgical compressed air system
- dental compressed air and vacuum system
- anaesthetic gas scavenging system
- cylinder manifold system
- terminal supply units
- monitoring and alarm systems
- primary, secondary and tertiary supply systems

**Carry out all of the following activities as applicable to the equipment being maintained (ALL)**

- releasing stored pressure
- supporting equipment components
- disconnecting/removing hoses and pipes
- removing/replacing units/components
## Unit 73:
Maintaining Medical Gas Pipeline Systems and Equipment

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<thead>
<tr>
<th>evidence record sheet</th>
<th>performance evidence 1</th>
<th>performance evidence 2</th>
<th>performance evidence 3</th>
<th>additional performance evidence (if required)</th>
</tr>
</thead>
<tbody>
<tr>
<td>proof marking/labelling of removed components</td>
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<tr>
<td>checking components for serviceability</td>
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<tr>
<td>replacing all 'lifed' items</td>
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<tr>
<td>disconnecting and reconnecting wires/cables</td>
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<tr>
<td>removing/replacing electrical/electronic units/components</td>
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<tr>
<td>setting/aligning/adjusting replaced components</td>
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<tr>
<td>tightening fastenings to the required torque</td>
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<td>making 'off-load' checks before running</td>
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<tr>
<td>carrying out emergency repairs</td>
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<tr>
<td>testing system for leaks</td>
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<tr>
<td>functional testing the maintained system</td>
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</tbody>
</table>

**Remove and replace a range of components to include fifteen of the following (FIFTEEN)**
- protection devices
- switches
- electrical connectors
- locking/retaining devices
- seals and gaskets
- sensors
- pumps
- valves
- motors
- pistons
- regulators
- power supplies
- batteries
- heater elements
- drain flasks
- display meter units
- printed circuit boards
- reservoirs
- receivers
- compressors
- cylinders
- actuators
- manifolds
- pipework
- gauges
### Unit 73:
Maintaining Medical Gas Pipeline Systems and Equipment

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<td>drains</td>
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<tr>
<td>medical gas cylinders</td>
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<tr>
<td>separators</td>
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<tr>
<td>indicator lamps/LEDs</td>
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<tr>
<td>identification markers</td>
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</table>

**Maintain medical gas pipeline systems and equipment in compliance with all of the following quality and accuracy standards and/or advisory documentation (ALL)**

- organisational guidelines and codes of practice
- equipment manufacturer's operation range
- relevant and current HTM documentation
- equipment & associated BSEN standards, CE marking, BS7671/IEE Wiring Regulations
- equipment functions to specification
- all potential defects are identified and reported for future action

**Complete the relevant paperwork to include one of the following and pass to the appropriate people (ONE)**

- job cards
- servicing logs or reports
- permit to work
- other specific documentation

Knowledge and understanding reference:

Candidate: ____________________________ Date: ____________________________

Assessor: ____________________________ Date: ____________________________
Level 3 NVQ in Engineering Maintenance
Opportunities for generation of Key Skills evidence

The Level 3 award in Engineering Maintenance has been contextualised by SEMTA from the National Engineering Competency Standards (ECS). The following table lists the opportunities for generation of Key Skills evidence for each unit in the award and also gives reference to the ECS unit it has been derived from.

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<th>ECS Unit</th>
<th>Key Skills Reference</th>
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<td>Communication</td>
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<tr>
<td>Unit 1 Complying With Statutory Regulations And Organisational Safety Requirements</td>
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<tr>
<td>Unit 2 Using And Interpreting Engineering Drawings And Documents</td>
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<td>Unit 4: Handing Over And Confirming Completion Of Maintenance Activities</td>
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<td>Unit 5: Carrying Out Fault Diagnosis On Mechanical Equipment</td>
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<td>Unit 6: Maintaining Mechanical Equipment</td>
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<td>Unit 7: Restoring Mechanical Components To Usable Condition By Repair</td>
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<tr>
<td>Unit 8: Producing Replacement Components For Maintenance Activities</td>
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<tr>
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<tr>
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<tr>
<td>Unit 11: Carrying Out Fault Diagnosis On Electrical Equipment And Circuits</td>
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<td>Engineering Maintenance Unit</td>
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<td>Unit 18: Repairing Electronic Equipment</td>
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<td>Unit 19: Carrying Out Fault Diagnosis on Fluid Power Equipment and Circuits</td>
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<td>Unit 21: Carrying Out Planned Maintenance Activities on Fluid Power Equipment</td>
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<td>Unit 22: Testing Fluid Power Equipment and Systems</td>
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<td>Unit 23: Carrying Out Fault Diagnosis on Engineered Systems</td>
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<td>Unit 24: Maintaining Mechanical Equipment within an Engineered System</td>
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Opportunities for generation of Key Skills evidence

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<td><strong>Unit 29: Reading and Extracting Information from Service</strong></td>
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<td>C1.1 C1.3 C2.2 PS1.1 PS1.2</td>
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<td>ECS Unit</td>
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