

# City & Guilds Level 3 NVQ Diploma in Engineering Maintenance (1788)

Qualification handbook for centres  
501/0458/5



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# 1 About this document

This document contains the information that centres need to offer the following qualifications:

<b>Qualification titles and levels</b>	<b>City &amp; Guilds qualification numbers</b>	<b>Ofqual accreditation numbers</b>	<b>Last registration and certification dates</b>	<b>GLH</b>	<b>TQT</b>
City & Guilds Level 3 NVQ Diploma in Engineering Maintenance	1788	501/0458/5	Consult the Walled Garden/Online Catalogue for last dates	324	1520

This document includes details and guidance on:

- centre requirements
- candidate entry requirements
- course design and delivery
- qualification standards and specifications
- assessment requirements

<b>Version and date</b>	<b>Change detail</b>	<b>Section</b>
1.2 May 2013	Added assessment criteria 11-17 to unit 001 outcome 2	<b>Units</b>
1.3 July 2013	Corrected UAN and numbering of AC's – Unit 104	<b>Units</b>
2.0 Sept 2013	Added missing UAN's on multiple units	<b>Units</b>
2.1 July 2014	Corrected unit content – Unit 101	<b>Units</b>
2.2 October 2014	Formatting correction to Unit 124 LO1, AC8	<b>Units</b>
2.3 April 2015	Referred to the Walled Garden for last registration/certification	<b>About this document</b>
2.4 September 2018	Changed from seven to nine – assessment criteria 3	<b>Unit 101</b>
2.5 February 2022	TQT and GLH clarified and highlighted	<b>About this document</b>
2.6 Nov. 2022	GLH updated	<b>About this document</b>

## 2 About the qualification

### 2.1 Accreditation details

This qualification is accredited by Ofqual

#### Qualifications and Credit Framework (QCF)

The QCF replaces the National Qualifications Framework (NQF) in England and Northern Ireland, and is intended to replace the regulated pillar within the Qualifications and Credit Framework for Wales (CQFW). It is also intended to align with the Scottish Credit and Qualifications Framework (SCQF). The QCF provides a way of recognising achievement through the award of credit for units and qualifications. Units within the framework are allocated a:

- level to indicate the level of difficulty
- credit value to indicate the size of the unit. 10 hours of **learning time** = 1 credit value.

Learning time is a notional measure of the amount of time a typical candidate might be expected to take to complete all the learning relevant to achievement of the learning outcomes. It differs from Guided Learning Hours (GLH) which represent only those hours a tutor/trainer or facilitator are present and contributing to the learning process because it takes into account all learning relevant to the learning outcomes regardless of where, when and how it has taken place.

The QCF recognises learning by awarding credit each time a candidate successfully completes a unit. Candidates can accumulate and transfer credit achievement over time.

A unit is the smallest part of learning for which credit is awarded. Candidates can also gain credit for full qualifications.

## **2 About the qualification**

### **2.2 Aims of the qualification**

The Level 3 NVQ Diploma in Engineering maintenance (QCF) has been designed to cover those learners who require specific knowledge within the maintenance sector of engineering. The aim of the qualification is to recognise the skills and competence required by those who work within engineering undertaking maintenance operations. Success in the qualification will recognise an ability to perform competently practical work and an understanding of the related technology. It will also demonstrate competence in communication, planning and quality control within the workplace.

There is clear progression both to and from this qualification. This qualification forms a component of SEMTA Apprenticeship framework and will allow progression to higher levels. This qualification allows progression onto other relevant Engineering qualifications.

- 7576 – Level 4 Business improvement techniques
- 2850 – Level 3 Diploma in Engineering



## **2 About the qualification**

### **2.3 Rules of combination**

Rules of combination are used to define the structure of qualifications. The rules of combination specify the credits which must be achieved through a particular combination of units to gain a full qualification.

Candidates must complete all mandatory units in Group A, and a number of optional / mandatory units from Group B (depending on their chosen pathway). The minimum credit value to achieve this qualification is 152 credits

City & Guilds Level 3 NVQ Diploma in Engineering Maintenance (QCF) Pathways are:

- Mechanical
- Electrical
- Electronic
- Fluid power
- Engineered Systems
- Services Maintenance
- Lift Servicing
- Lift Repair
- Escalator Repair and Service
- Communication Electronics
- Servicing Medical Equipment
- Instrumentation and Control

## 2 About the qualification

### 2.4 Structure

## Engineering Maintenance

### Suite 3 Qualification Structure

#### Mandatory units for all pathways

Unit 001: Complying with Statutory Regulations and Organisational Safety Requirements

Unit 002: Using Engineering Drawings and Documents in Maintenance Activities

Unit 103: Working Efficiently and Effectively in Engineering

Unit 104: Handing Over and Confirming Completion of Maintenance Activities

#### Pathways

##### Mechanical

###### ***Must cover the following units:***

Unit 105: Carrying Out Fault Diagnosis on Mechanical Equipment

Unit 106: Maintaining Mechanical Equipment

###### ***Plus two more units from the following:***

Unit 107: Restoring Mechanical Components to Usable Condition by Repair

Unit 108: Producing Replacement Components for Maintenance Activities

Unit 109: Carrying Out Preventative Planned Maintenance on Mechanical Equipment

Unit 110: Carrying Out Condition Monitoring of Plant and Equipment

Unit 180: Assisting in the Installation of Mechanical Equipment

##### Electrical

###### ***Must cover the following units:***

Unit 111: Carrying Out Fault Diagnosis on Electrical Equipment and Circuits

Unit 112: Maintaining Electrical Equipment

Unit 113: Modifying or Rewiring Electrical Circuits

###### ***Plus two more units from the following:***

Unit 114: Testing Electrical Equipment and Circuits

Unit 115: Carrying Out Preventative Planned Maintenance on Electrical Equipment

Unit 110: Carrying Out Condition Monitoring of Plant and Equipment

Unit 181: Assisting in the Installation of Electrical/Electronic Equipment

##### Electronic

###### ***Must cover all of the following units:***

Unit 116: Carrying Out Fault Diagnosis on Electronic Equipment and Circuits

Unit 117: Testing Electronic Equipment and Circuits

Unit 118: Repairing Electronic Equipment

## **Fluid power**

### ***Must cover the following units:***

Unit 119: Carrying Out Fault Diagnosis on Fluid Power Equipment and Circuits  
Unit 120: Maintaining Fluid Power Equipment

### ***Plus two more units from the following:***

Unit 121: Carrying Out Preventative Planned Maintenance on Fluid Power Equipment  
Unit 110: Carrying Out Condition Monitoring of Plant and Equipment  
Unit 122: Testing Fluid Power Equipment and Systems  
Unit 182: Assisting in the Installation of Fluid Power Equipment

## **Engineered Systems**

### ***Must cover the following unit:***

Unit 123: Carrying Out Fault Diagnosis on Engineered Systems

### ***Plus two more units from the following:***

Unit 124: Maintaining Mechanical Equipment within an Engineered System  
Unit 125: Maintaining Electrical Equipment within an Engineered System  
Unit 126: Maintaining Fluid Power Equipment within an Engineered System  
Unit 127: Maintaining Process Controller Equipment within an Engineered System

### ***Plus one more unit from the following:***

Unit 128: Carrying Out Preventative Planned Maintenance on Engineered Systems  
Unit 110: Carrying Out Condition Monitoring of Plant and Equipment  
Unit 183: Assisting in the Installation of Equipment to Produce an Engineered System

## **Services Maintenance**

### ***Must complete the following units:***

Unit 129: Reading and Extracting Information from Service Drawings and Specifications  
Unit 130: Carrying Out Fault Diagnosis on Services and Systems

### ***Plus two more units from the following:***

Unit 131: Maintaining Fresh Water Distribution Systems and Equipment  
Unit 132: Maintaining Workplace Environmental Control Systems  
Unit 133: Maintaining Waste/Foul Water Distribution Systems and Equipment  
Unit 134: Maintaining Emergency Power Generation Equipment  
Unit 135: Maintaining Heating and Ventilation Systems  
Unit 136: Maintaining Air Conditioning and Ventilation Systems  
Unit 137: Maintaining Gas Distribution Systems and Equipment  
Unit 138: Maintaining Compressed Air Systems and Equipment  
Unit 139: Maintaining Process Control Systems  
Unit 140: Maintaining Instrumentation and Control Systems  
Unit 141: Maintaining Industrial Refrigeration Equipment  
Unit 142: Maintaining Environmental Control Equipment  
Unit 172: Maintaining Medical Device and Surgical Instrument Decontamination Equipment  
Unit 173: Maintaining Medical Gas Pipeline Systems and Equipment

### ***Plus one more unit from the following:***

Unit 143: Carrying Out Preventative Planned Maintenance on Services Systems and Equipment  
Unit 110: Carrying Out Condition Monitoring of Plant and Equipment  
Unit 184: Assisting in the Installation of Engineering Services Equipment

## **Lift Servicing**

### ***Must complete all of the following units:***

- Unit 144: Carrying Out Fault Diagnosis on Lifts
- Unit 145: Inspecting and Servicing Lift Equipment
- Unit 146: Checking Lift Function
- Unit 147: Rectifying Faults in Lifts

## **Lift Repair**

### ***Must complete all of the following units:***

- Unit 144: Carrying Out Fault Diagnosis on Lifts
- Unit 146: Checking Lift function
- Unit 147: Rectifying Faults in Lifts
- Unit 148: Repairing/Replacing Lift Doors, Chains, Ropes and Equipment

## **Escalator Repair and Service**

### ***Must complete all of the following units:***

- Unit 149: Carrying Out Fault Diagnosis on Escalators
- Unit 150: Rectifying Faults in Escalators
- Unit 151: Inspecting and Servicing Escalators
- Unit 152: Testing and Reinstating Escalator Installations

## **Communication Electronics**

### ***Must cover one of the following units:***

- Unit 116: Carrying Out Fault Diagnosis on Electronic Equipment and Circuits
- Unit 153: Carrying Out Fault Diagnosis on Communication Electronic Systems

### ***Plus two more units from the following:***

- Unit 117: Testing Electronic Equipment and Circuits

#### ***OR (but not both)***

- Unit 154: Testing Communication-Electronic Systems

- Unit 118: Repairing Electronic Equipment

#### ***OR (but not both)***

- Unit 155: Repairing Communication-Electronic Systems

- Unit 156: Carrying Out Preventative Planned Maintenance on Communication-Electronic Systems

- Unit 157: Modifying Communication-Electronic Systems

- Unit 158: Configuring Communication-Electronic Systems

- Unit 159: Installing Communication-Electronic Systems

## **Servicing Medical Equipment**

### ***Must cover the following units:***

- Unit 160: Carrying Out Fault Diagnosis on Medical Equipment
- Unit 161: Testing Medical Equipment
- Unit 162: Carrying Out Scheduled Servicing on Medical Equipment

### ***Plus three units from the following:***

- Unit 163: Servicing Cardiovascular Equipment
- Unit 164: Servicing Physiological Monitoring and Infusion Equipment
- Unit 165: Servicing Anaesthetic and Ventilation Equipment
- Unit 166: Servicing Operating Theatre and Surgical Equipment
- Unit 167: Servicing Medical Imaging Equipment
- Unit 168: Servicing Laboratory Equipment
- Unit 169: Servicing Dental Equipment
- Unit 170: Servicing Medical Therapeutic Equipment
- Unit 171: Servicing Mechanical and Electromechanical Assistive Technology Equipment

## **Instrumentation and Control**

### ***Must cover the following units:***

- Unit 174: Carrying Out Fault Diagnosis on Instrumentation and Control Equipment and Circuits
- Unit 175: Maintaining Instrumentation and Control Equipment and Circuits

### ***Plus two units from the following:***

- Unit 176: Carrying Out Preventative Planned Maintenance on Instrumentation and Control Equipment
- Unit 177: Repairing/Overhauling Instrumentation and Control Equipment
- Unit 178: Testing and Calibrating Instrumentation and Control Equipment and Circuits
- Unit 185: Assisting in the Installation of Instrumentation and Control Equipment

## 2 About the qualification

### 2.5 Relevant sources of information

#### Related publications

City & Guilds also provides the following documents specifically for these qualifications:

<b>Publication</b>	<b>Available from</b>
Centre Guides	Website
FAQ	website
Fast track approval form/generic fast track approval form	website

#### Other essential City & Guilds documents

There are other City & Guilds documents which contain general information on City & Guilds qualifications:

***Providing City & Guilds qualifications – a guide to centre and qualification approval***

contains detailed information about the processes which must be followed and requirements which must be met for a centre to achieve 'approved centre' status, or to offer a particular qualification.

***Ensuring quality***

contains updates on City & Guilds assessment and policy issues.

***Centre toolkit***

contains additional information on *Providing City & Guilds qualifications*, in a CD-ROM, which links to the internet for access to the latest documents, reference materials and templates. The *Centre Toolkit* is sent to centres when they receive approved centre status. It is also available from to order at an additional cost.

***Online catalogue/shop***

contains details of general regulations, registration and certification procedures and fees.

For the latest updates on our publications and details of how to obtain them and other City & Guilds resources, please refer to the City & Guilds website.

## City & Guilds websites

Website	Address	Purpose and content
City & Guilds main website	<a href="http://www.cityandguilds.com">www.cityandguilds.com</a>	This is the main website for finding out about the City & Guilds group, accessing qualification information and publications.
Walled Garden	<a href="http://www.walled-garden.com">www.walled-garden.com</a>	The Walled Garden is a qualification administration portal for approved centres, enabling them to register candidates and claim certification online.

## Contacting City & Guilds by e-mail

The following e-mail addresses give direct access to our Customer Relations team.

e-mail	Query types
<a href="mailto:learnersupport@cityandguilds.com">learnersupport@cityandguilds.com</a>	all learner enquiries, including <ul style="list-style-type: none"><li>• requesting a replacement certificate</li><li>• information about our qualification</li><li>• finding a centre.</li></ul>
<a href="mailto:centresupport@cityandguilds.com">centresupport@cityandguilds.com</a>	all centre enquiries
<a href="mailto:walledgarden@cityandguilds.com">walledgarden@cityandguilds.com</a>	all enquiries relating to the Walled Garden, including <ul style="list-style-type: none"><li>• setting up an account</li><li>• resetting passwords.</li></ul>

## 3 Centre requirements

### 3.1 Obtaining centre and qualification approval

Only approved organisations can offer City & Guilds qualifications. Organisations approved by City & Guilds are referred to as **centres**.

Centres must meet a set of quality criteria including:

- provision of adequate resources, both physical and human
- clear management information systems
- effective assessment and quality assurance procedures including candidate support and reliable recording systems.

An organisation that has not previously offered City & Guilds qualifications must apply for approval to become a centre. This is known as the **centre approval process (CAP)**. Centres also need approval to offer a specific qualification. This is known as the **qualification approval process (QAP)**. In order to offer these qualifications, organisations which are not already City & Guilds centres must apply for centre and qualification approval at the same time.

Existing City & Guilds centres who already offer the qualification 1688 NVQ in Engineering Maintenance will be given automatic approval to run the new Level 3 Engineering Maintenance (1788).

Full details of the procedures and forms for applying for centre and qualification approval are given

City and Guilds branch offices will support new centres through the approval process. They will appoint an External Verifier. They will also provide details of fees applicable for approvals. The local office will be the point of contact for all enquiries for these qualifications and will be responsible for monitoring the delivery and assessments through reports submitted by External Verifiers. They will be the first point of contact for any enquiries regarding the multiple choice examination.

Assessments must not be undertaken until qualification approval has been obtained and candidates have been registered.

City & Guilds reserves the right to withdraw qualification or centre approval for reasons of debt, malpractice or non-compliance with City & Guilds' policies, regulations, requirements, procedures and guidelines, or for any reason that may be detrimental to the maintenance of authentic, reliable and valid qualifications or that may prejudice the name of City & Guilds.



### **3 Centre requirements**

#### 3.2 Candidate entry requirement

Candidates should not be entered for a qualification of the same type, content and level as that of a qualification they already hold.

There are no formal entry requirements for candidates undertaking this qualification. However, centres must ensure that candidates have the potential and opportunity to gain the qualification successfully.

## 3 Centre requirements

### 3.3 Fast Track Approval

This section outlines the approval processes for Centres to offer this qualification and any resources that Centres will need in place to offer the qualifications including qualification-specific requirements for Centre staff.

#### **Centres already offering City & Guilds qualifications in this subject area**

Centres approved to offer the qualification Level 3 NVQ in Engineering maintenance (1688) may apply for approval for the new Level 3 NVQ Diploma in Engineering maintenance (1788) using the **fast track approval form**, available from the City & Guilds website.

Centres may apply to offer the new qualification using the fast track form

- providing there have been no changes to the way the qualifications are delivered, and
- if they meet all of the approval criteria specified in the fast track form guidance notes.

Fast track approval is available for 12 months from the launch of the qualification. After this time, the qualification is subject to the **standard** Qualification Approval Process. It is the centre's responsibility to check that fast track approval is still current at the time of application.

## **3 Centre requirements**

### **3.4 Resource requirements**

#### **Physical resources**

Centres must have an adequate learning environment. Resources should be accessible and reflect the nature of the qualification. They must also ensure that they have the staff and access to sufficient equipment so that candidates have the opportunity to cover all of the activities of the qualification.

#### **Centre staff**

Centre staff must satisfy the requirements for occupational expertise for these qualifications. Staff should be technically competent and experienced in the units for which they are delivering, teaching, training and assessing learning

## 3 Centre requirements

### 3.5 Registration and Certification

Candidates must be registered at the beginning of their course. Centres should submit registrations using the Walled Garden, or Form S (Registration), under qualification and complex number 1788. Candidates achieving the required Rules of Combination will be issued with the full Level 3 NVQ Diploma in Engineering maintenance (1788). For information on the registration and certification periods for the qualification, centre should refer to the City & Guilds Directory of qualifications.

Full details of City & Guilds' administrative procedures for this qualification are provided in the *Directory of qualifications*, provided online to City & Guilds registered centres. This information includes details on:

- registration procedures
- enrolment numbers
- fees
- claiming certification.

These details are also available on the **[www.cityandguilds.com](http://www.cityandguilds.com)**

## 3 Centre requirements

### 3.6 Quality Assurance

#### Internal quality assurance

Approved centres must have effective quality assurance systems to ensure optimum delivery and assessment of qualifications.

Quality assurance includes initial centre approval, qualification approval and the centre's own internal procedures for standardising and monitoring quality. Centres are responsible for internal quality assurance, ensuring that there are appropriate opportunities for open communication between the course team, scheme co-ordinator and external verifier. City & Guilds is responsible for external quality assurance.

Full details and guidance on the internal and external quality assurance requirements and procedures, are provided in *Providing City & Guilds Qualifications* and in the centre toolkit. This document also explains the tasks, activities and responsibilities of quality assurance staff.

All candidates' evidence must be available for external verification; Centres are also required to retain copies of candidates' assessment and internal verification records for three years after certification.

National standards and rigorous quality assurance are maintained by use of:

- City & Guilds assignment, marked by the centres according to externally set marking criteria
- Portfolio evidence assessed against set criteria
- Internal (centre) quality assurance
- City & Guilds external verification.

To meet the quality assurance criteria for this qualification, the centre must ensure that the following internal roles are undertaken:

- quality assurance co-ordinator
- primary assessor
- independent assessor
- internal verifier.

#### External quality assurance

External verifiers are appointed by City & Guilds to approve centres, and to monitor the assessment and internal quality assurance carried out by centres. External verification is carried out to ensure that assessment is valid and reliable, and that there is good assessment practice in centres.

To carry out their quality assurance role, external verifiers must have appropriate occupational and verifying knowledge and expertise. City & Guilds external verifiers attend training and development designed to keep them up-to-date, to facilitate standardisation between verifiers and to share good practice.

Further details of the role of external verifiers are given in *Providing City & Guilds qualifications*.

## 4 Course design and delivery

### Recommended delivery strategies

Centre staff should familiarise themselves with the structure, content and assessment requirements of the qualifications before designing a course programme.

Provided that the requirements for the qualifications are met, centres may design course programmes of study in any way that they feel best meets the needs and capabilities of their candidates.

Centres may wish to include topics as part of the course programme which will not be assessed through the qualifications for example to address local, organisational or government needs.

Provided the aims, outcomes and knowledge requirements are met, centres have the flexibility to deliver the qualification in as many hours as they deem appropriate.

### Data protection and confidentiality

Centres offering these qualifications may need to provide City & Guilds with personal data for staff and candidates. Centres will need to abide by the legal requirements of the country that they operate in. Centres and staff will be expected to maintain the confidentiality required by the laws and policies of national governments and the centres that offer the qualifications.

### Health and safety

The requirement to follow safe working practices is an integral part of all City & Guilds qualifications and assessments, and it is the responsibility of centres to ensure that all relevant health and safety requirements are in place before candidates commence the programme.

Should a candidate fail to follow health and safety practice and procedures during an assessment, the assessment must be stopped. The candidate should be informed that they have not reached the standard required to successfully pass the assessment and told the reason why. Candidates may retake the assessment at a later date, at the discretion of the centre. In case of any doubt, guidance should be sought from the external verifier.

### Initial assessment and induction

Centres will need to make an initial assessment of each candidate prior to the start of their programme. Candidates should have a reasonable level of English language and literacy skills.

The initial assessment should identify any specific training needs the candidate has, and the support and guidance they may require when working towards their qualification. The results of initial assessment will assist centres and tutors with the design and delivery of the courses to meet the particular needs of their candidates for both the class based and practical aspects of the course.

Centres should provide an induction programme to ensure the candidate fully understands the requirements of the qualifications they will work towards, their responsibilities as a candidate, and the responsibilities of the centre. It may be helpful to record the information as part of the learning contract/individual learning plan.

## **Equal opportunities**

It is a requirement of centre approval that centres have an equal opportunities policy (see *Providing City & Guilds qualifications*).

The regulatory authorities require City & Guilds to monitor centres to ensure that equal opportunity policies are being followed.

The City & Guilds equal opportunities policy is set out on the City & Guilds website, in *Providing City & Guilds qualifications*, in the *Directory of qualifications*, and is also available from the City & Guilds Customer Relations department.

## **Access to assessment**

City & Guilds' guidance and regulations on access to assessment are designed to facilitate access for assessments and qualifications for candidates who are eligible for adjustments to assessment arrangements. Access arrangements are designed to allow attainment to be demonstrated. For further information, please see Access to assessment and qualifications, available on the City & Guilds website.

## **Results and certification**

All candidates for City & Guilds qualifications receive a Notification of Candidates Results giving details of their performance.

Centres will also receive a consolidated results list detailing the performance of all candidates they enter, whether they are successful or not.

Further information about the issue of results and certification for centres is available online at [www.cityandguilds.com](http://www.cityandguilds.com) or by contacting the City & Guilds Operations Support Service enquiries team

## **Appeals**

Centres must have their own, auditable, appeals procedure that must be explained to candidates during their induction. Appeals must be fully documented by the quality assurance co-ordinator and made available to the external verifier or City & Guilds.

Further information on appeals is given in *Providing City & Guilds qualifications*. There is also information on appeals for centres and learners on the City & Guilds website or available from the Customer Relations department.

## 5 Assessment

### Summary of assessment methods

For this qualification, candidates will be required to complete a portfolio of evidence for **each** unit. The minimum level of evidence required is determined by Semta.

### External quality control

External quality control is provided by the usual City & Guilds external verification process which includes the use of the electronically scannable report form which is designed to provide an objective risk analysis of individual centre assessment and verification practice.

### Assessment environment

The evidence put forward for this unit can only be regarded valid, reliable, sufficient and authentic if achieved and obtained in the working environment and be clearly attributable to the learner. However, in certain circumstances, simulation/replication of work activities may be acceptable.

- The use of high quality, realistic simulations/replication, which impose pressures which are consistent with workplace expectations, should only be used in relation to the assessment of the following:-
  - rare or dangerous occurrences, such as those associated with health, safety and the environment issues, emergency scenarios and rare operations at work;
  - the response to faults and problems for which no opportunity has presented for the use of naturally occurring workplace evidence of learners competence;
  - aspects of working relationships and communications for which no opportunity has presented for the use of naturally occurring workplace evidence of learners competence.
  - Simulations/replications will require prior approval from the specific Awarding Organisation and should be designed in relation to the following parameters: -
  - the environment in which simulations take place must be designed to match the characteristics of the working environment ;
  - competencies achieved via simulation/replication must be transferable to the working environment
  - simulations which are designed to assess competence in dealing with emergencies, accidents and incidents must be verified as complying with relevant health, safety and environmental legislation by a competent health and safety/environmental control officer before being used;
  - simulated activities should place learners under the same pressures of time, access to resources and access to information as would be expected if the activity was real;
  - simulated activities should require learners to demonstrate their competence using plant and/or equipment used in the working environment;
  - simulated activities which require interaction with colleagues and contacts should require the learner to use the communication media that would be expected at the workplace;
  - for health and safety reason simulations need not involve the use of genuine substances/materials. Any simulations which require the learner to handle or otherwise deal with materials substances/should ensure that the substitute take the same form as in the workplace



## Carrying Out Assessment

The NVQ units were specifically developed to cover a wide range of activities. The evidence produced for the units will, therefore, depend on the learners choice of “bulleted items” listed in the unit assessment criteria.

Where the assessment criteria gives a choice of bulleted items (for example ‘any three from five’), assessors should note that learners do not need to provide evidence of the other items to complete the unit (in this example, two) items, particularly where these additional items may relate to other activities or methods that are not part of the learners normal workplace activity or area of expertise.

## Minimum 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 examples of performance must be provided, and must be sufficient to show that the assessment criteria have been achieved to the prescribed standards. It is possible that some of the bulleted items in the assessment criteria may be covered more than once. The assessor and learner need to devise an assessment plan to ensure that performance evidence is sufficient to cover all the specified assessment criteria and which maximises the opportunities to gather evidence. Where applicable, performance evidence maybe used for more than one unit.

The most effective way of assessing competence, is through direct observation of the learner. Assessors must make sure that the evidence provided reflects the learner’s competence and not just the achievement of a training programme.

Evidence that has been produced from team activities, for example, maintenance or installation activities is only valid when it clearly relates to the learners specific and individual contribution to the activity, and not to the general outcome(s).

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

Performance evidence must be a combination of:

- outputs of the learner’s work, such as items that have been manufactured, installed, maintained, designed, planned or quality assured, and documents produced as part of a work activity

together with:

- evidence of the way the learner carried out the activities such as witness testimonies, assessor observations or authenticated learner reports, records or photographs of the work/activity carried out, etc.

Competent performance is more than just carrying out a series of individual set tasks. Many of the units contain statements that require the learner 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 valid, authentic and reliable evidence, the internal and/or 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 learners 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. Semta expects oral questioning and practical demonstrations to be used, as these are considered the most appropriate for these units. Assessors should ask enough questions to make sure that the learner has an appropriate level of knowledge and understanding, as required by the unit.

Evidence of knowledge and understanding will **not** be required for those bulleted items in the assessment criteria that have not been selected by the learner.

The achievement of the specific knowledge and understanding requirements of the units cannot simply be inferred by the results of tests or assignments from other units, qualifications or training programmes. Where evidence is submitted from these sources, the assessor must, as with any assessment, make sure the evidence is valid, reliable, authentic, directly attributable to the learner, and meets the full knowledge and understanding requirements of the unit.

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

## Witness testimony

Where 'observation is used to obtain performance evidence, this must be carried out against the unit assessment criteria. 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 assessment criteria by someone else that is in close contact with the learner. This could be a team leader, supervisor, mentor or line manager who may be regarded as a suitable witness to the learners 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 learner. It will be the responsibility of the assessor to make sure that any witness testimonies accepted as evidence of the learner's competency are reliable, auditable and technically valid.

## Recording forms

Candidates and centres may decide to use a paper-based or electronic method of recording evidence.

City & Guilds has developed a set of *Recording forms* including examples of completed forms, for new and existing centres to use as appropriate. **N/SVQ Recording forms** are available on the City & Guilds website.

Although it is expected that new centres will use these forms, centres may devise or customise alternative forms, which must be approved for use by the external verifier, before they are used by candidates and assessors at the centre.

City & Guilds endorses several ePortfolio systems. Further details are available at:  
**[www.cityandguilds.com/eportfolios](http://www.cityandguilds.com/eportfolios)**.

## 6 Units

### Structure of units

The units in this qualification are written in a standard format and comprise the following:

- City & Guilds reference number
- unit accreditation number
- title
- level
- credit value
- unit aim
- relationship to NOS, other qualifications and frameworks
- endorsement by a sector or other appropriate body
- information on assessment
- learning outcomes which are comprised of a number of assessment criteria
- notes for guidance.

### Summary of units

City & Guilds unit number	Title	QCF unit number	Credit Value	GLH	Level
001	Complying with statutory regulations and organisational safety requirements	A/601/5013	5	35	2
002	Using and interpreting engineering data and documentation	Y/601/5102	5	25	2
103	Working efficiently and effectively in engineering	K/601/5055	5	25	3
104	Handing Over and Confirming Completion of Maintenance Activities	T/600/5516	20	35	3
105	Carrying Out Fault Diagnosis on Mechanical Equipment	T/600/5533	50	60	3
106	Maintaining Mechanical Equipment	H/600/5544	70	119	3
107	Restoring Mechanical Components to Usable Condition by Repair	A/600/5551	47	91	3
108	Producing Replacement Components for Maintenance Activities	H/600/5558	47	91	3
109	Carrying Out Preventative Planned Maintenance on Mechanical Equipment	A/600/5565	38	74	3
110	Carrying Out Condition Monitoring of Plant and Equipment	A/600/5582	39	81	3
111	Carrying Out Fault Diagnosis on Electrical Equipment and Circuits	H/600/5592	50	60	3
112	Maintaining Electrical Equipment	Y/600/5606	70	119	3

113	Modifying or Rewiring Electrical Circuits	D/600/5610	35	63	3
114	Testing Electrical Equipment and Circuits	H/600/5656	50	60	3
115	Carrying Out Preventative Planned Maintenance on Electrical Equipment	F/600/5664	38	74	3
116	Carrying Out Fault Diagnosis on Electronic Equipment and Circuits	Y/600/5671	50	60	3
117	Testing Electronic Equipment and Circuits	A/600/5677	50	60	3
118	Repairing Electronic Equipment	D/600/5946	62	81	3
119	Carrying Out Fault Diagnosis on Fluid Power Equipment and Circuits	T/600/5953	50	60	3
120	Maintaining Fluid Power Equipment	M/600/5983	70	119	3
121	Carrying Out Preventative Planned Maintenance on Fluid Power Equipment	J/600/5990	38	74	3
122	Testing Fluid Power Equipment and Systems	D/600/6000	46	56	3
123	Carrying Out Fault Diagnosis on Engineered Systems	L/600/6011	53	95	3
124	Maintaining Mechanical Equipment within an Engineered System	Y/600/5413	81	161	3
125	Maintaining Electrical Equipment within an Engineered System	M/600/5417	81	161	3
126	Maintaining Fluid Power Equipment within an Engineered System	A/600/5422	81	161	3
127	Maintaining Process Controller Equipment within an Engineered System	Y/600/5427	81	161	3
128	Carrying Out Preventative Planned Maintenance on Engineered Systems	F/600/5440	38	74	3
129	Reading and Extracting Information from Service Drawings and Specifications	J/600/5469	5	25	3
130	Carrying Out Fault Diagnosis on Services and Systems	R/600/5474	50	60	3
131	Maintaining Fresh Water Distribution Systems and Equipment	K/600/5481	70	119	3
132	Maintaining Waste/Foul Water Distribution Systems and Equipment	H/600/5494	70	119	3
133	Maintaining Workplace Environmental Control Systems	T/600/5497	70	119	3
134	Maintaining Emergency Power Generation Equipment	T/600/5502	70	119	3
135	Maintaining Heating and Ventilation Systems	L/600/5506	70	119	3
136	Maintaining Air Conditioning and Ventilation Systems	H/600/5513	70	119	3

137	Maintaining Gas Distribution Systems and Equipment	J/600/5519	70	119	3
138	Maintaining Compressed Air Systems and Equipment	Y/600/5525	70	119	3
139	Maintaining Process Control Systems	H/600/5530	70	119	3
140	Maintaining Instrumentation and Control Systems	J/600/5536	70	119	3
141	Maintaining Industrial Refrigeration Equipment	L/600/5540	70	119	3
142	Maintaining Environmental Control Equipment	M/600/5546	70	119	3
143	Carrying Out Preventative Planned Maintenance on Services Systems and Equipment	F/600/5552	38	74	3
144	Carrying Out Fault Diagnosis on Lifts	T/601/2224	50	60	3
145	Inspecting and Servicing Lift Equipment	K/600/5495	38	74	3
146	Checking Lift Function	R/600/5507	50	60	3
147	Rectifying Faults in Lifts	A/600/5520	47	91	3
148	Repairing/Replacing Lift Doors, Chains, Ropes and Equipment	A/600/5534	47	91	3
149	Carrying Out Fault Diagnosis on Escalators	R/600/5541	50	60	3
150	Rectifying Faults in Escalators	R/600/5555	47	91	3
151	Inspecting and Servicing Escalators	R/600/5457	38	74	3
152	Testing and Reinstating Escalator Installations	T/600/5564	46	56	3
153	Carrying Out Fault Diagnosis on Communication-Electronic Systems	Y/600/5573	50	60	3
154	Testing Communication-Electronic Systems	A/600/5579	50	60	3
155	Repairing Communication-Electronic Systems	M/600/5465	62	81	3
156	Carrying Out Preventative Planned Maintenance on Communication	D/600/5476	38	74	3
157	Modifying Communication-Electronic Systems	L/600/5585	35	63	3
158	Configure Communication-Electronic Systems	Y/600/5590	51	77	3
159	Installing Communication-Electronic Systems	J/600/5598	32	81	3
160	Carrying Out Fault Diagnosis on Medical Equipment	A/600/5601	50	60	3
161	Testing Medical Equipment	H/600/5608	50	60	3
162	Carrying Out Scheduled Servicing on Medical Equipment	A/600/5484	38	74	3
163	Servicing Cardiovascular Equipment	R/600/5491	70	119	3
164	Servicing Physiological Monitoring and Infusion Equipment	F/600/5499	70	119	3

165	Servicing Anaesthetic and Ventilation Equipment	Y/600/5508	70	119	3
166	Servicing Operating Theatre and Surgical Equipment	F/600/5518	70	119	3
167	Servicing Medical Imaging Equipment	T/600/5581	70	119	3
168	Servicing Laboratory Equipment	R/600/5586	70	119	3
169	Servicing Dental Equipment	D/600/5591	70	119	3
170	Servicing Medical Therapeutic Equipment	F/600/5597	70	119	3
171	Servicing Mechanical and Electromechanical Assistive Technology Equipment	F/600/5602	70	119	3
172	Maintaining Medical Device and Surgical Instrument Decontamination Equipment	K/600/5609	70	119	3
173	Maintaining Medical Gas Pipeline Systems and Equipment	J/600/5617	70	119	3
174	Carrying Out Fault Diagnosis on Instrumentation and Control Equipment and Circuits	Y/600/5637	50	60	3
175	Maintaining Instrumentation and Control Equipment and Circuits	L/600/5621	70	119	3
176	Carrying Out Preventative Planned Maintenance on Instrumentation and Control Equipment	T/600/5628	38	74	3
177	Repairing/Overhauling Instrumentation and Control Equipment	M/600/5644	47	91	3
178	Testing and Calibrating Instrumentation and Control Equipment and Circuits	J/600/5651	50	60	3
179	Assisting in the Installation of Mechanical Equipment	J/600/5634	48	161	3
180	Assisting in the Installation of Electrical/Electronic Equipment	H/600/5642	48	161	3
181	Assisting in the Installation of Fluid Power Equipment	L/600/5649	48	161	3
182	Assisting in the Installation of Equipment to Produce an Engineered System	T/600/5659	48	161	3
183	Assisting in the Installation of Engineering Services Equipment	R/600/5667	48	161	3
184	Assisting in the Installation of Instrumentation and Control Equipment	F/600/6068	48	161	3

## Unit 101

# Complying with statutory regulations and organisational safety requirements

**Level: 2**

**Credit value: 5**

**UAN number: A/601/5013**

### Unit aim

This unit covers the skills and knowledge needed to prove the competences required to deal with statutory regulations and organisational safety requirements. It does not deal with specific safety regulations or detailed requirements, it does, however, cover the more general health and safety requirements that apply to working in an industrial environment.

The learner will be expected to comply with all relevant regulations that apply to their area of work, as well as their general responsibilities as defined in the Health and Safety at Work Act. The learner will need to be able to identify the relevant qualified first aiders and know the location of the first aid facilities. The learner will have a knowledge and 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. The learner will also need to be fully conversant with their organisation's procedures for fire alerts and the evacuation of premises.

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

The learner's responsibilities will require them to comply with all relevant statutory and organisational policy and procedures for health and safety in the workplace. The learner must act in a responsible and safe manner at all times, and present themselves in the workplace suitably prepared for the activities to be undertaken. The learner will be expected to report any problems with health and safety issues, to the relevant authority.

The learner's knowledge will provide a good understanding of the relevant statutory regulations and organisational requirements associated with their work, and will provide an informed approach to the procedures used. The learner will need to understand their organisation's health and safety requirements and their application, in adequate depth to provide a sound basis for carrying out their activities in a safe and competent manner.

### Learning outcomes

There are **two** learning outcomes to this unit. The learner will be able to:

1. Comply with statutory regulations and organisational safety requirements
2. Know how to comply with statutory regulations and organisational safety requirements.

### Guided learning hours

It is recommended that **35** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from national occupational standard: Complying with statutory regulations and organisational safety requirements (Suite 2)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's unit assessment strategies which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**



## Unit 101

# Complying with statutory regulations and organisational safety requirements

## Outcome 1

### Comply with statutory regulations and organisational safety requirements

#### Assessment Criteria

The learner will be able to:

1. comply with their duties and obligations as defined in the health and safety at work act
2. demonstrate their understanding of their duties and obligations to health and safety by:
  - applying in principle their duties and responsibilities as an individual under the Health and Safety at Work Act
  - identifying, within their organisation, appropriate sources of information and guidance on health and safety issues, such as:
    - eye protection and personal protective equipment (PPE)
    - 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
3. present themselves in the workplace suitably prepared for the activities to be undertaken
4. follow organisational accident and emergency procedures
5. comply with emergency requirements, to include:
  - identifying the appropriate qualified first aiders and the location of first aid facilities
  - identifying the procedures to be followed in the event of injury to themselves 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 of equipment
6. recognise and control hazards in the workplace
7. identify the hazards and risks that are associated with the following:
  - their working environment
  - the equipment that they use
  - materials and substances (where appropriate) that they use
  - working practices that do not follow laid-down procedures
8. use correct manual lifting and carrying techniques
9. demonstrate one of the following methods of manual lifting and carrying:
  - lifting alone
  - with assistance of others
  - with mechanical assistance
10. apply safe working practices and procedures to include:
  - maintaining a tidy workplace, with exits and gangways free from obstruction
  - using equipment safely and only for the purpose intended
  - observing organisational safety rules, signs and hazard warnings
  - taking measures to protect others from any harm resulting from the work that they are carrying out

## Unit 101

# Complying with statutory regulations and organisational safety requirements

## Outcome 2

Know how to comply with statutory regulations and organisational safety requirements

### Assessment Criteria

The learner will be able to:

1. describe the roles and responsibilities of themselves and others under the Health and Safety at Work Act, and other current legislation (such as 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, Reporting of Injuries, Diseases and Dangerous Occurrences Regulations)
2. describe the specific regulations and safe working practices and procedures that apply to their work activities
3. describe the warning signs for the nine main groups of hazardous substances defined by classification, packaging and labelling of dangerous substances regulations
4. explain how to locate relevant health and safety information for their tasks, and the sources of expert assistance when help is needed
5. explain what constitutes a hazard in the workplace (such as moving parts of machinery, electricity, slippery and uneven surfaces, poorly placed equipment, dust and fumes, handling and transporting, contaminants and irritants, material ejection, fire, working at height, environment, pressure/stored energy systems, volatile, flammable or toxic materials, unshielded processes, working in confined spaces)
6. describe their responsibilities for identifying and dealing with hazards and reducing risks in the workplace
7. describe the risks associated with their working environment (such as the tools, materials and equipment that they use, spillages of oil, chemicals and other substances, not reporting accidental breakages of tools or equipment and not following laid-down working practices and procedures)
8. describe the processes and procedures that are used to identify and rate the level of risk (such as safety inspections, the use of hazard checklists, carrying out risk assessments, coshh assessments)
9. describe the first aid facilities that exist within their work area and within the organisation in general; the procedures to be followed in the case of accidents involving injury
10. explain what constitute dangerous occurrences and hazardous malfunctions, and why these must be reported even if no-one is injured
11. describe the procedures for sounding the emergency alarms, evacuation procedures and escape routes to be used, and the need to report their presence at the appropriate assembly point
12. describe the organisational policy with regard to fire fighting procedures; the common causes of fire and what they can do to help prevent them
13. describe the protective clothing and equipment that is available for their areas of activity
14. explain how to safely lift and carry loads, and the manual and mechanical aids available
15. explain how to prepare and maintain safe working areas; the standards and procedures to ensure good housekeeping
16. describe the importance of safe storage of tools, equipment, materials and products
17. describe the extent of their own authority, and to whom they should report in the event of problems that they cannot resolve

## Unit 102

# Using and interpreting engineering data and documentation

**Level:** 2  
**Credit value:** 5  
**UAN number:** Y/601/5102

### Unit aim

This unit covers the skills and knowledge needed to prove the competences required to make effective use of text, numeric and graphical information, by interpreting and using technical information extracted from documents such as engineering drawings, technical manuals, reference tables, specifications, technical sales/marketing documentation, charts or electronic displays, in accordance with approved procedures. The learner will be required to extract the necessary information from the various documents, in order to establish and carry out the work requirements, and to make valid decisions about the work activities based on the information extracted.

The learner's responsibilities will require them to comply with organisational policy and procedures for obtaining and using the documentation applicable to the activity. They will be expected to report any problems with the use and interpretation of the documents that they cannot personally resolve, or are outside their permitted authority, to the relevant people. They will be expected to work to instructions if necessary, with an appropriate level of supervision or as a member of a team, and take personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's underpinning knowledge will provide a good understanding of the types of documentation used, and will provide an informed approach to applying instructions and procedures. They will be able to read and interpret the documentation used and will know about the conventions, symbols and abbreviations, in adequate depth to provide a sound basis for carrying out the activities to the required specification.

### Learning outcomes

There are **two** learning outcomes to this unit. The learner will be able to:

1. Use and interpret engineering data and documentation
2. Know how to use and interpret engineering data and documentation

### Guided learning hours

It is recommended that **25** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### Details of the relationship between the unit and relevant national standards

This unit has been derived from national occupational standard: Using and interpreting engineering data and documentation (Suite 2)

### Support of the unit by a sector or other appropriate body

This unit is endorsed by Semta.

## **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's unit assessment strategies which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

## Unit 102

# Using and interpreting engineering data and documentation

### Outcome 1

Use and interpret engineering data and documentation

#### Assessment Criteria

The learner will be able to:

1. use the approved source to obtain the required data and documentation
2. use the data and documentation and carry out all of the following:
  - check the currency and validity of the data and documentation 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
  - deal with or report any problems found with the data and documentation
  - make valid decisions based on the evaluation of the engineering information extracted from the documents
  - return all documents to the approved location on completion of the work
  - complete all necessary work related documentation such as production documentation, installation documentation, maintenance documentation, planning documentation
3. correctly identify, interpret and extract the required information
4. extract information that includes three of the following:
  - materials or components required
  - dimensions
  - tolerances
  - build quality
  - installation requirements
  - customer requirements
  - time scales
  - financial information
  - operating parameters
  - surface texture requirements
  - location/orientation of parts
  - process or treatments required
  - dismantling/assembly sequence
  - inspection/testing requirements
  - number/volumes required
  - repair/service methods
  - method of manufacture
  - weld type and size
  - operations required
  - connections to be made
  - surface finish required
  - shape or profiles

- fault finding procedures
  - safety/risk factors
  - environmental controls
  - specific data (such as component data, maintenance data, electrical data, fluid data)
  - resources (such as tools, equipment, personnel)
  - utility supply details (such as electricity, water, gas, air)
  - location of services, including standby and emergency backup systems
  - circuit characteristics (such as pressure, flow, current, voltage, speed)
  - protective arrangements and equipment (such as containment, environmental controls, warning and evacuation systems and equipment)
  - other specific related information
5. use the information obtained to ensure that work output meets the specification
  6. use information extracted from documents to include one from the following:
    - drawings (such as component drawings, assembly drawings, modification drawings, repair drawings, welding/fabrication drawings, distribution and installation drawings)
    - diagrams (such as schematic, fluid power diagrams, piping, wiring/circuit diagrams)
    - manufacturers manuals/drawings
    - approved sketches
    - technical illustrations
    - photographic representations
    - visual display screen information
    - technical sales/marketing documentation
    - contractual documentation
    - other specific drawings/documents
  7. use information extracted from related documentation, to include two from the following:
    - instructions (such as job instructions, drawing instructions, manufacturers instructions)
    - specifications (such as material, finish, process, contractual, calibration)
    - reference materials (such as manuals, tables, charts, guides, notes)
    - schedules
    - operation sheets
    - service/test information
    - planning documentation
    - quality control documents
    - company specific technical instructions
    - national, international and organisational standards
    - health and safety standards relating to the activity (such as coshh)
    - other specific related documentation
  8. deal promptly and effectively with any problems within their control and report those which cannot be solved
  9. report any inaccuracies or discrepancies in documentation and specifications

## Unit 102

# Using and interpreting engineering data and documentation

### Outcome 2

Know how to use and interpret engineering data and documentation

#### Assessment Criteria

The learner will be able to:

1. explain what information sources are used for the data and documentation that they use in their work activities
2. explain how documents are obtained, and how to check that they are current and valid
3. explain the basic principles of confidentiality (including what information should be available and to whom)
4. describe the different ways/formats that data and documentation can be presented (such as such as drawings, job instructions product data sheets, manufacturers' manuals, financial spreadsheets, production schedules, inspection and calibration requirements, customer information)
5. explain how to use other sources of information to support the data (such as electronic component pin configuration specifications, reference charts, standards, bend allowances required for material thickness, electrical conditions required for specific welding rods, mixing ratios for bonding and finishing materials, metal specifications and inspection requirements, health and safety documentation)
6. describe the importance of differentiating fact from opinion when reviewing data and documentation
7. describe the importance of analysing all available data and documentation before decisions are made
8. describe the different ways of storing and organising data and documentation to ensure easy access
9. describe the procedures for reporting discrepancies in the data or documentation, and for reporting lost or damaged documents
10. describe the importance of keeping all data and documentation up to date during the work activity, and the implications of this not being done
11. explain the care and control procedures for the documents, and how damage or graffiti on documents can lead to scrapped work
12. explain the importance of returning documents to the designated location on completion of the work activities
13. explain what basic drawing conventions are used and why there needs to be different types of drawings (such as isometric and orthographic, first and third angle, assembly drawings, circuit and wiring diagrams, block and schematic diagrams)
14. explain what types of documentation are used and how they interrelate (such as production drawings, assembly drawings, circuit and wiring diagrams, block and schematic diagrams)
15. explain the imperial and metric systems of measurement; tolerancing and fixed reference points
16. describe the meaning of the different symbols and abbreviations found on the documents that they use (such as surface finish, electronic components, weld symbols, linear and geometric tolerances, pressure and flow characteristics)
17. describe the extent of their own responsibility, when to act on their own initiative to find, clarify and evaluate information, and to whom they should report if they have problems that they cannot resolve

**Level:** 3  
**Credit value:** 5  
**UAN number:** K/601/5055

**Unit aim**

This unit covers the skills and knowledge needed to prove the competences required to work efficiently and effectively in the workplace, in accordance with approved procedures and practices. Prior to undertaking the engineering activity, the learner will be required to carry out all necessary preparations within the scope of their responsibility. This may include preparing the work area and ensuring that it is in a safe condition to carry out the intended activities, ensuring they 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, the learner will be required to return their 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, the learner will also be required to demonstrate that they can create and maintain effective working relationships with colleagues and line management. The learner will also be expected to review objectives and targets for their personal development and make recommendations to, and communicate any opportunities for, improvements that could be made to working practices and procedures.

The learner's responsibilities will require them to comply with organisational policy and procedures for the engineering activities undertaken, and to report any problems with the activities, or the tools and equipment that are used that they cannot personally resolve, or are outside their permitted authority, to the relevant people. The learner will be expected to take personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to working efficiently and effectively in an engineering environment. The learner will understand the need to work efficiently and effectively, and will know about the areas they 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 their development objectives and targets, in adequate depth to provide a sound basis for carrying out the activities safely and correctly.

The learner will understand the safety precautions required when carrying out engineering activities. The learner will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace.



### **Learning outcomes**

There are **two** learning outcomes to this unit. The learner will be able to:

1. Work efficiently and effectively in engineering
2. Know how to work efficiently and effectively in engineering

### **Guided learning hours**

It is recommended that **25** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from national occupational standard: Working efficiently and effectively in engineering (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard\\_qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard_qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's unit assessment strategies which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard\\_qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard_qca_assessment_requirements.aspx)**

## Unit 103

# Working efficiently and effectively in engineering

## Outcome 1

### Work efficiently and effectively in engineering

#### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. prepare the work area to carry out the engineering activity
3. prepare to carry out the engineering activity, taking into consideration all of the following, as applicable to the work to be undertaken:
  - the work area is free from hazards and is 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
4. check that there are sufficient supplies of materials and/or consumables and that they meet work requirements
5. ensure that completed products or resources are stored in the appropriate location on completion of the activities
6. 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 or components
  - arranging for disposal of waste materials
7. tidy up the work area on completion of the engineering activity
8. deal promptly and effectively with problems within their control and report those that cannot be resolved
9. 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

10. contribute to and communicate opportunities for improvement to working practices and procedures
11. make recommendations for improving to two of the following:
  - working practices
  - working methods
  - quality
  - safety
  - tools and equipment
  - supplier relationships
  - internal communication
  - customer service
  - training and development
  - teamwork
  - other
12. maintain effective working relationships with colleagues to include two of the following:
  - colleagues within own working group
  - colleagues outside normal working group
  - line management
  - external contacts
13. review personal training and development as appropriate to the job role
14. 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

## Unit 103

## Working efficiently and effectively in engineering

### Outcome 2

Know how to work efficiently and effectively in engineering

#### Assessment Criteria

The learner will be able to:

1. describe the safe working practices and procedures to be followed whilst preparing and tidying up their work area
2. describe the correct use of any equipment used to protect the health and safety of themselves and their colleagues
3. describe the procedure for ensuring that all documentation relating to the work being carried out is available and current, prior to starting the activity
4. describe the action that should be taken if documentation received is incomplete and/or incorrect
5. describe the procedure for ensuring that all tools and equipment are available prior to undertaking the activity
6. describe the checks to be carried out to ensure that tools and equipment are in full working order, prior to undertaking the activity
7. describe the action that should be taken if tools and equipment are not in full working order
8. describe the checks to be carried out to ensure that all materials required are correct and complete, prior to undertaking the activity
9. describe the action that should be taken if materials do not meet the requirements of the activity
10. explain whom to inform when the work activity has been completed
11. describe the information and/or documentation required to confirm that the activity has been completed
12. explain what materials, equipment and tools can be reused
13. explain how any waste materials and/or products are transferred, stored and disposed of
14. explain where tools and equipment should be stored and located
15. describe the importance of making recommendations for improving working practices
16. describe the procedure and format for making suggestions for improvements
17. describe the benefits to organisations if improvements can be identified
18. describe the importance of maintaining effective working relationships within the workplace
19. describe the procedures to deal with and report any problems that can affect working relationships
20. describe the difficulties that can occur in working relationships
21. describe the regulations that affect how they should be treated at work (such as equal opportunities act, race and sex discrimination, working time directive)
22. describe the benefits of continuous personal development
23. describe the training opportunities that are available in the workplace
24. describe the importance of reviewing their training and development
25. explain with whom to discuss training and development issues
26. describe the extent of their own responsibility and to whom they should report if they have any problems that they cannot resolve

**Level:** 3  
**Credit value:** 20  
**UAN number:** T/600/5516

**Unit aim**

This unit covers the skills and knowledge needed to prove the competences required 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, the learner 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 themselves, 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, the learner will be expected to highlight any new, current or changed operating features of the equipment, and to inform the appropriate person of any future maintenance requirements. The learner must also ensure that they receive confirmation that everyone involved in the handover accepts that the maintained equipment is in a satisfactory condition to return to service.

The learner's responsibilities will require them to comply with organisational policy and procedures for the handover activities undertaken, and to report any problems with the handing over procedure that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work with minimal supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying maintenance handover procedures. The learner 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.

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

**Learning outcomes**

There are **two** learning outcomes to this unit. The learner will be able to:

1. Hand over and confirm completion of maintenance activities
2. Know how to hand over and confirm completion of maintenance activities

### **Guided learning hours**

It is recommended that **35** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 4: Handing Over and Confirming Completion of Maintenance Activities (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

## Unit 104

# Handing Over and Confirming Completion of Maintenance Activities

### Outcome 1

Hand over and confirm completion of maintenance activities

#### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
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
  - medical equipment
  - other specific equipment
3. carry out the handover following two of the following maintenance activities:
  - breakdown
  - preventative maintenance activity
  - scheduled servicing
  - modification to equipment
4. 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 or features are functioning correctly
  - any waste materials, safety barriers and warning signs have been removed (where appropriate)
  - any auxiliary systems or equipment involved are connected and operable
  - any environmental controls are operable (where appropriate)
  - others involved in using the equipment are aware that the equipment is about to be operated/used
5. confirm that everyone involved accepts the product or asset is in a satisfactory condition for handover to take place
6. clearly identify any unusual features of the condition of the product or asset
7. make the handover and obtain agreement between everyone involved on the precise moment of transfer of responsibility

8. carry out all of the following during the handover procedures:
  - operate/use 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 that would result in 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
  
9. carry out handover procedures to one of the following:
  - production/process operator
  - supervisor of production/process
  - maintenance supervisor
  - other specific person
  
10. deal promptly and effectively with problems within their control and report those that they cannot solve
  
11. make sure that clear, accurate and complete records of the handover are made
  
12. complete the relevant paperwork from one of the following, and pass it to the appropriate people:
  - job card
  - maintenance log or report
  - company-specific documentation
  - other handover paperwork



## Unit 104

# Handing Over and Confirming Completion of Maintenance Activities

### Outcome 2

Know how to hand over and confirm completion of maintenance activities

#### Assessment Criteria

The learner will be able to:

1. describe the health and safety requirements of the area in which the handover is to take place, and the responsibility they place on the learner
2. describe the isolation and lock-off procedure or permit-to-work procedure that applies to the equipment being maintained
3. describe the specific health and safety precautions to be applied during the handover procedure, and their effects on others
4. describe the importance of wearing protective clothing and other appropriate safety equipment whilst operating/using the equipment during the handover operations and where it may be obtained
5. describe the checking process to be followed before handing over the equipment (such as are the safety and quality systems operable, does the equipment function to specification)
6. describe the appropriate handover procedure, depending on the maintenance activity carried out (repair, modification, preventative maintenance, scheduled servicing)
7. describe the procedure for involving the appropriate people when operating/using the equipment
8. describe the need to highlight, where appropriate, any new, current or changed operating features of the maintained or installed equipment
9. describe the importance of informing the appropriate person of any future maintenance requirements
10. describe the need to confirm that the other person understands how to use/operate the equipment before handing the equipment over to them
11. describe the need to ensure that the person they are handing over the equipment to accepts that it is in a satisfactory condition
12. describe the organisational documentation procedures to be used with regard to the handover
13. explain how to create and maintain effective working relationships with appropriate people (such as encouraging, helping, politeness, open discussions both ways)
14. describe the problems that can occur during handover, and how they can be overcome
15. describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve

**Level:** 3  
**Credit value:** 50  
**UAN number:** T/600/5533

**Unit aim**

This unit covers the skills and knowledge needed to prove the competences required to carry out efficient and effective fault diagnosis on mechanical equipment, in accordance with approved procedures. The learner 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. The learner 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, the learner will be expected to identify the fault and its probable cause, and to suggest action to remedy the problem.

The learner's responsibilities will require them 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 they cannot personally resolve or that are outside their permitted authority, to the relevant people. The learner will be expected to work with minimal supervision, taking full responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying fault diagnosis procedures on mechanical equipment. The learner will understand the various fault diagnosis methods and techniques used, and their application. The learner 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.

The learner will understand the safety precautions required when carrying out the maintenance activities, especially those for isolating the equipment. The learner will also understand their responsibilities for safety and the importance of taking the necessary safeguards to protect themselves and others in the workplace.

**Learning outcomes**

There are **two** learning outcomes to this unit. The learner will be able to:

1. Carry out fault diagnosis on mechanical equipment
2. Know how to carry out fault diagnosis on mechanical equipment

**Guided learning hours**

It is recommended that **60** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 5: Carrying Out Fault Diagnosis on Mechanical Equipment (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

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Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

## Unit 105

# Carrying Out Fault Diagnosis on Mechanical Equipment

### Outcome 1

Carry out fault diagnosis on mechanical equipment

#### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the fault diagnostic activity:
  - plan the fault diagnosis prior to beginning the work
  - obtain and use the correct issue of company and/or manufacturer's drawings and maintenance documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
  - provide and maintain 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
3. carry out fault diagnosis on three 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
4. find faults that have resulted in two of the following breakdown categories:
  - intermittent problem
  - partial failure/out-of-specification output
  - complete breakdowns
5. review and use all relevant information on the symptoms and problems associated with the products or assets
6. 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

7. investigate and establish the most likely causes of the faults
8. select, use and apply diagnostic techniques, tools and aids to locate faults
9. use a range of fault diagnostic techniques, to include two of the following:
  - half-split technique
  - emergent sequence
  - input/output
  - six point technique
  - equipment self diagnostics
  - unit substitution
  - function/performance testing
  - injection and sampling
10. 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
11. use two of the following types of test equipment to aid fault diagnosis:
  - measuring instruments/devices
  - dial test indicators
  - torque measuring devices
  - thermal indicators
  - audio test devices
  - self-diagnostic equipment
  - other specific test equipment
12. 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)
13. complete the fault diagnosis within the agreed time and inform the appropriate people when this cannot be achieved
14. determine the implications of the fault for other work and for safety considerations
15. use the evidence gained to draw valid conclusions about the nature and probable cause of the fault
16. record details on the extent and location of the faults in an appropriate format
17. 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 105

# Carrying Out Fault Diagnosis on Mechanical Equipment

### Outcome 2

Know how to carry out fault diagnosis on mechanical equipment

#### Assessment Criteria

The learner will be able to:

1. describe the health and safety requirements of the area in which they are carrying out the fault diagnosis activities, and the responsibility these requirements place on the learner
2. describe the specific safety precautions to be taken when carrying out fault diagnosis of the specific piece of equipment
3. describe the isolation and lock-off procedure or permit-to-work procedure that applies
4. describe the importance of wearing protective clothing and other appropriate safety equipment during the fault diagnosis activities
5. describe the hazards associated with carrying out fault diagnosis on mechanical equipment (such as 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 to minimise these and reduce any risks
6. explain where to obtain, and how to interpret drawings, specifications, manufacturers' manuals and other documents needed in the fault diagnosis process
7. describe the procedure to be adopted to establish the background of the fault
8. explain 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. describe the various fault finding techniques that can be used, and how they are applied (such as half-split, input/output put, emergent problem sequence, six point technique, function testing, unit substitution, injection and sampling techniques, and equipment self diagnostics)
10. explain how to use a range of fault diagnostic equipment to investigate the problem (such as measuring devices, torque and run-out devices)
11. explain how to use various items of test equipment, and how to calibrate it and check that it is free from damage and defects
12. explain how to evaluate sensory information (sight, sound, smell, touch)
13. describe the procedure(s) to be followed for investigating the faults, and how to deal with intermittent faults
14. explain how to analyse and evaluate possible characteristics and causes of specific faults/problems
15. explain how to relate previous reports/records of similar fault conditions
16. explain 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. explain how to prepare and produce a risk analysis report (where appropriate)
18. explain how to prepare a report and take follow-up action which satisfies the company policy on concluding fault diagnosis
19. describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve

**Level:** 3  
**Credit value:** 70  
**UAN number:** H/600/5544

## Unit aim

This unit covers the skills and knowledge needed to prove the competences required to carry out corrective maintenance activities on mechanical equipment, in accordance with approved procedures. The learner 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.

The learner 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.

The learner's responsibilities will require them 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 they cannot personally resolve or that are outside their permitted authority, to the relevant people. The learner 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. The learner will be expected to work with minimal supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying mechanical maintenance procedures. The learner will understand the dismantling and reassembly methods and procedures, and their application. The learner will know how the equipment functions, and the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the maintenance activities, correcting faults and ensuring the repaired equipment functions to the required specification and remains compliant with all standards and regulations. In addition, the learner will have sufficient in-depth knowledge of these components to ensure that they are fit for purpose and meet the specifications, thus providing a sound basis for carrying out reassembly.

The learner will understand the safety precautions required when carrying out the maintenance activities, especially those for isolating the equipment. The learner will also understand their responsibilities for safety and the importance of taking the necessary safeguards to protect themselves and others in the workplace.

## Learning outcomes

There are **two** learning outcomes to this unit. The learner will be able to:

1. Maintain mechanical equipment
2. Know how to maintain mechanical equipment

### **Guided learning hours**

It is recommended that **119** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 6: Maintaining Mechanical Equipment (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**



**Assessment Criteria**

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the maintenance activity:
  - plan and communicate the maintenance activities to cause minimal disruption to normal working
  - obtain and use the correct issue of company and/or manufacturer's drawings and maintenance documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
  - provide and maintain 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
3. carry out maintenance activities on three 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
4. follow the relevant maintenance schedules to carry out the required work
5. maintain mechanical equipment which complies with one of the following:
  - organisational guidelines and codes of practice
  - equipment manufacturer's operation range
  - BS, ISO and/or BSEN standards
6. carry out the maintenance activities within the limits of their personal authority
7. carry out the maintenance activities in the specified sequence and in an agreed timescale

8. 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 lified 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
  - safety system checks
  - functionally testing the completed system
  
9. replace/refit a range of mechanical components, to include ten of the following:
  - shafts
  - couplings
  - gears
  - clutches
  - valves and seats
  - pistons
  - splined components
  - brakes
  - bearing and seals
  - fitting keys
  - springs
  - diaphragms
  - cams and followers
  - chains & sprockets
  - pulleys and belts
  - levers and links
  - slides
  - rollers
  - wire ropes/cables
  - housings
  - actuating mechanisms
  - structural components
  - locking & retaining devices (such as circlips, pins, lift nuts)
  - other specific components
  
10. report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
11. complete relevant maintenance records accurately, to include one from the following, and pass them on to the appropriate person:
  - job cards
  - permit to work/formal risk assessment and/or sign-on/off procedures
  - maintenance log or report
  - company-specific documentation
  
12. dispose of waste materials in accordance with safe working practices and approved procedures

**Assessment Criteria**

The learner will be able to:

1. describe the health and safety requirements of the area in which the maintenance activity is to take place, and the responsibility these requirements place on the learner
2. describe the isolation and lock-off procedures or permit-to-work procedure that applies
3. describe the specific health and safety precautions to be applied during the maintenance procedure, and their effects on others
4. describe the hazards associated with carrying out mechanical maintenance activities (such as handling oils, greases, stored pressure/force, misuse of tools, using damaged or badly maintained tools and equipment, not following laid-down maintenance procedures), and how to minimise these and reduce any risks
5. describe the importance of wearing protective clothing and other appropriate safety equipment during maintenance process
6. explain how to obtain and interpret drawings, specifications, manufacturers' manuals and other documents needed in the maintenance process
7. describe the procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance activities
8. describe company policy on repair/replacement of components during the maintenance process
9. describe the sequence to be adopted for the dismantling/re-assembly of various types of assemblies
10. describe the methods and techniques used to dismantle/assemble mechanical equipment (such as release of pressures/force, proof marking, extraction, pressing, alignment)
11. describe the methods of checking components are fit for purpose, and how to identify defects and wear characteristics
12. describe the basic principles of how the equipment functions, operation sequence, the working purpose of individual units/components and how they interact
13. describe the identification, application, fitting and removal of different types of bearings (such as roller, ring, thrust)
14. describe the methods and techniques of fitting keys and splined components
15. describe the identification, application, fitting and removal of different types of gears
16. explain how to correctly tension belts and chains
17. describe the identification and application of different types of locking devices
18. describe the methods of checking that removed components are fit for purpose, and the need to replace 'lived' items (such as seals and gaskets)
19. describe the uses of measuring equipment (such as micrometers, verniers, run-out devices and other measuring devices)
20. explain how to make adjustments to components/assemblies to ensure they function correctly (such as setting working clearance, setting travel, setting backlash in gears, preloading bearings)
21. describe the importance of making 'off-load' checks before running the equipment under power
22. explain 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. describe the importance of maintenance documentation and/or reports following the maintenance activity, and how to generate them
24. describe the equipment operating and control procedures to be applied during the maintenance activity
25. explain how to use lifting and handling equipment in the maintenance activity

26. describe the problems associated with the maintenance activity, and how they can be overcome
27. describe the organisational procedure(s) to be adopted for the safe disposal of waste of all types of materials
28. describe the extent of their own authority and to whom they should report if they have a problem that they cannot resolve

**Level:** 3  
**Credit value:** 47  
**UAN number:** A/600/5551

**Unit aim**

This unit covers the skills and knowledge needed to prove the competences required to restore mechanical components to usable condition by repair, in accordance with approved procedures. The learner 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. The learner 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, the learner 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, scrapping 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.

The learner's responsibilities will require them 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 they cannot personally resolve or that are outside their permitted authority, to the relevant people. The learner will be expected to work with minimal supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying component repair procedures. The learner 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. The learner will also understand the organisational policy on repairing components, and its application.

The learner will understand the safety precautions required when carrying out the maintenance activities, especially those for isolating the equipment. The learner will also understand their responsibilities for safety and the importance of taking the necessary safeguards to protect themselves and others in the workplace.

**Learning outcomes**

There are **two** learning outcomes to this unit. The learner will be able to:

1. Restore mechanical components to usable condition by repair
2. Know how to restore mechanical components to usable condition by repair

### **Guided learning hours**

It is recommended that **91** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 7: Restoring Mechanical Components to Usable Condition by Repair (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

## Unit 107

# Restoring Mechanical Components to Usable Condition by Repair

### Outcome 1

Restore mechanical components to usable condition by repair

#### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following activities during the maintenance activity:
  - plan the repair activities to cause minimal disruption to normal working
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
  - provide and maintain 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
3. 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
4. follow the relevant specifications for the component to be repaired
5. prepare the component for repair
6. carry out the repairs within agreed timescale using approved materials and components and methods and procedures

7. 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)
8. 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
9. ensure that the repaired component meets the specified operating conditions
10. carry out repairs to mechanical equipment which complies with one of the following:
  - organisational guidelines and codes of practice
  - equipment manufacturer's operation range
  - BS, ISO and/or BSEN standards
11. produce accurate and complete records of all repair work carried out



## Unit 107

# Restoring Mechanical Components to Usable Condition by Repair

### Outcome 2

Know how to restore mechanical components to usable condition by repair

#### Assessment Criteria

The learner will be able to:

1. describe the health and safety requirements of the area in which the repairing activity is to take place, and the responsibility these requirements place on the learner
2. describe the isolation procedures or permit-to-work procedure that applies
3. describe the specific health and safety precautions needed to be applied during the repairing procedure, and their effects on others
4. describe the importance of wearing protective clothing and other appropriate safety equipment during maintenance activities
5. describe the hazards associated with the repair/restoration operations being carried out (such as sawing (hand, band), drilling, reaming, grinding (hand or machine), filing, scraping or lapping, threading (internal or external), turning, milling and thermal processes), and how to minimise these and reduce any risks
6. explain where to obtain, and how to interpret drawings, specifications, manufacturers' manuals, maintenance schedules and other relevant documents
7. describe the methods, techniques and company procedures to be followed for repairing mechanical equipment
8. describe 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. describe the factors to be taken into account when deciding if a repair is practical and possible (such as is a replacement component available, cost of replacing, safety of repair, age and condition of equipment)
10. describe 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. explain how to use filing, scraping and lapping to achieve the required surface finish (such as various types of files/scrapers, checking that file/scrapper handles are in good condition, the range of lapping mediums)
12. explain how to cut internal and external threads (such as using hand dies and taps, machine cutting)
13. explain how to produce a sliding or mating fit, and the techniques to be adopted
14. explain how to select saw blades for different materials and different operations
15. describe the types and application of portable power tools that can be used for the fitting operations
16. explain how to check that portable power tools and extension cables are in a safe usable condition
17. explain how to use hand power tools and specialist equipment correctly (such as electrical, pneumatic, lifting equipment)
18. describe the operating requirements of the machine tools and accessories being used (such as guards, workholding devices, taper turning attachments, steadies, dividing heads, specific statutory regulations such as abrasive wheels regulations)
19. describe the various shapes and types of tooling that can be used (such as solid high-speed tooling, brazed tip tooling, interchangeable tipped tooling)
20. explain how to handle and store tools and equipment safely and correctly
21. describe the factors which affect the selection of cutting feeds and speeds, and the depth of cut that can be taken (such as workpiece rigidity, machine condition, type of tooling being used, material type, finish and tolerance required)

22. describe the application of cutting fluids with regard to a range of different materials and processes
23. describe the techniques and implications of clamping of a workpiece in a chuck/work holding device (such as safely secured for the process, causing distortion in the finished components)
24. explain how to recognise machining faults, and how to identify when tools need re-sharpening/dressing
25. describe the operating requirements of the thermal processes and accessories being used (such as any statutory regulations and quality standards to be observed, guards, workholding devices, fume extraction, gas storage)
26. describe the methods that can be used to position the workpiece in relation to the cutting tools
27. describe the effects of backlash in the machine slides and how this can be overcome
28. describe the company recording procedures to be used following repair, and how to apply them
29. describe the problems associated with repair, and how to resolve them
30. describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve

**Level:** 3  
**Credit value:** 47  
**UAN number:** H/600/5558

**Unit aim**

This unit covers the skills and knowledge needed to prove the competences required to produce replacement components resulting from maintenance activities, in accordance with approved procedures. The learner will produce these components using manual machining techniques, such as milling, turning, grinding, shaping/slotting, drilling/boring, combined with hand fitting techniques. The learner will be expected to produce components that require them to use a range of different machines, and this will involve setting up the workholding arrangements, workpiece and machine tooling.

The learner 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.

The learner's responsibilities will require them 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 they cannot personally resolve, or that are outside their personal responsibilities, to the relevant people. The learner will be expected to work with minimal supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying replacement component manufacturing procedures and instructions. The learner 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.

The learner will understand the safety precautions required when working with the machines and their associated tools and equipment. The learner will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace.

**Learning outcomes**

There are **two** learning outcomes to this unit. The learner will be able to:

1. Produce replacement components for maintenance activities
2. Know how to produce replacement components for maintenance activities

### **Guided learning hours**

It is recommended that **91** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 8: Producing Replacement Components for Maintenance Activities (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

## Unit 108

# Producing Replacement Components for Maintenance Activities

### Outcome 1

Produce replacement components for maintenance activities

#### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the manufacturing activities:
  - obtain and use the correct drawing, sketch or sample/damaged component to be replaced
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - 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
3. follow instructions and any relevant specifications to produce the component
4. produce the required components using appropriate manufacturing methods and techniques
5. 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
6. produce replacement components using two of the following machining processes:
  - turning
  - drilling
  - milling
  - spark/wire erosion
  - grinding
  - shaping or slotting

7. 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
  
8. 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
  
9. check that the finished component meets the requirements and make any necessary adjustments
  
10. 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
  
11. deal promptly and effectively with problems within their control and report those that cannot be solved

## Unit 108

# Producing Replacement Components for Maintenance Activities

### Outcome 2

Know how to produce replacement components for maintenance activities

#### Assessment Criteria

The learner will be able to:

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

26. describe the problems that can occur with the machining and fitting activities, and how these can be overcome
27. describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve



## Unit 109

# Carrying Out Preventative Planned Maintenance on Mechanical Equipment

**Level:** 3  
**Credit value:** 38  
**UAN number:** A/600/5565

### Unit aim

This unit covers the skills and knowledge needed to prove the competences required to carry out preventative planned maintenance activities on mechanical equipment, in accordance with approved procedures. The learner 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.

The learner's responsibilities will require them 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 they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner 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. The learner will be expected to work with minimal supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying planned maintenance procedures to mechanical equipment. The learner 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 that the system is maintained to the required specification and remains compliant with all standards and regulations. In addition, the learner will be expected to report where the outcome identifies further investigation or maintenance work.

The learner will understand the safety precautions required when carrying out the maintenance activities, especially those for isolating the equipment. The learner will also understand their responsibilities for safety and the importance of taking the necessary safeguards to protect themselves and others in the workplace.

### Learning outcomes

There are **two** learning outcomes to this unit. The learner will be able to:

1. Carry out preventative planned maintenance on mechanical equipment
2. Know how to carry out preventative planned maintenance on mechanical equipment

### Guided learning hours

It is recommended that **74** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 9: Carrying Out Preventative Planned Maintenance on Mechanical Equipment (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

## Unit 109

# Carrying Out Preventative Planned Maintenance on Mechanical Equipment

### Outcome 1

Carry out preventative planned maintenance on mechanical equipment

#### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the planned maintenance activities:
  - plan and communicate the maintenance activities to cause minimal disruption to normal working
  - obtain and use the correct issue of company and/or manufacturers' drawings and maintenance documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
  - provide and maintain 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
3. carry out planned maintenance activities on three 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
4. follow the relevant maintenance schedules to carry out the required work
5. follow planned maintenance activities using one of the following types of maintenance schedules:
  - condition based maintenance
  - preventative planned maintenance
  - scheduled maintenance
  - total preventative maintenance
6. carry out the maintenance activities within the limits of their personal authority
7. carry out the maintenance activities in the specified sequence and in an agreed timescale

8. carry out all of the following planned maintenance activities:
  - visual examination and testing of equipment against maintenance schedule
  - replacing 'lived' consumables (such as oils, grease, belts, gaskets and seals)
  - 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
  
9. ensure that the maintained equipment meets all of the following:
  - all maintenance activities have been completed to the required schedule
  - equipment operates within acceptable limits for successful continuous operation to meet output specification
  - equipment remains compliant with appropriate regulations and safety requirements
  - any potential defects are identified and reported for future action
  
10. report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
11. complete relevant maintenance records accurately, to include one of the following, and pass them on to the appropriate person:
  - job cards
  - maintenance log or report
  - permit to work/formal risk assessment and/or sign-on/off procedures
  - company-specific documentation
  
12. dispose of waste materials in accordance with safe working practices and approved procedures

## Unit 109

# Carrying Out Preventative Planned Maintenance on Mechanical Equipment

## Outcome 2

Know how to carry out preventative planned maintenance on mechanical equipment

### Assessment Criteria

The learner will be able to:

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

**Level:** 3  
**Credit value:** 39  
**UAN number:** A/600/5582

**Unit aim**

This unit covers the skills and knowledge needed to prove the competences required to carry out condition monitoring of plant and equipment, in accordance with approved procedures. The learner will be required to select the appropriate monitoring equipment to use, based on the type of plant or equipment being monitored and the conditions they wish to check. The learner 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. The learner 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.

The learner's responsibilities will require them 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 they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work with minimal supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying condition monitoring techniques. The learner 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.

The learner will understand the safety precautions required when carrying out the monitoring activities, especially those for isolating the equipment. The learner will also understand their responsibilities for safety, and the importance of taking the necessary safeguards to protect themselves and others in the workplace.

**Learning outcomes**

There are **two** learning outcomes to this unit. The learner will be able to:

1. Carry out condition monitoring of plant and equipment
2. Know how to carry out condition monitoring of plant and equipment

**Guided learning hours**

It is recommended that **81** hours should be allocated for this unit, although patterns of delivery are likely to vary.

**Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 10: Carrying Out Condition Monitoring of Plant and Equipment (Suite 3)

## **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

## Unit 110

# Carrying Out Condition Monitoring of Plant and Equipment

### Outcome 1

Carry out condition monitoring of plant and equipment

#### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the monitoring activities:
  - plan and communicate the condition monitoring activities so as to minimise disruption to normal working
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - 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
3. use appropriate monitoring techniques to set up equipment 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 and actuators and pumps)
  - process controller (such as program controller, input/output interfacing, wiring/cabling, monitoring sensors)
  - electrical components (such as power supplies, switchgear and distribution panels, control systems)
  - environmental systems (such as air conditioning, fume extraction)
4. correctly set up and check-calibrate the equipment required for the monitoring being carried out
5. carry out the monitoring activities with the minimum disruption to normal activities
6. 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)



7. 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
  
8. 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
  
9. record and review the outcomes and take appropriate actions
10. complete the relevant paperwork from one of the following, and pass it to the appropriate people:
  - job cards
  - predictive maintenance log or report
  - permit to work/formal risk assessment and/or sign on/off procedures
  - company-specific documentation

## Unit 110

# Carrying Out Condition Monitoring of Plant and Equipment

### Outcome 2

Know how to carry out condition monitoring of plant and equipment

#### Assessment Criteria

The learner will be able to:

1. describe the specific health and safety precautions to be applied during the monitoring procedure, and their effects on others
2. describe the health and safety requirements of the area in which the monitoring activity is to take place, and the responsibility these requirements place on the learner
3. describe the hazards associated with carrying out monitoring activities on plant and equipment (such as electrical supplies, moving machinery, process controller interface, using damaged or badly maintained tools and equipment, not following laid-down procedures), and how to minimise these and reduce any risks
4. explain 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. describe the basic principles of how the plant or equipment to be monitored functions, its operating sequence, the working purpose of individual units/components and how they interact
6. describe the basic principles of condition monitoring, and how it helps prevent equipment failure
7. describe the different types of monitoring component or sensor (such as temperature, force, pressure, vibration, rotational, voltage, current), their fittings, and their application
8. describe 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. describe the methods of attaching monitoring components to different parts of the plant, equipment or system
10. describe the need to check that monitoring instruments are fit for purpose, undamaged, and have a suitable monitoring range and value
11. describe the importance of monitoring equipment calibration and authorisation procedures
12. describe the need to set up and operate condition monitoring equipment correctly
13. describe the care and control procedures for condition monitoring equipment
14. describe the problems that can occur during the monitoring activity, and how they can be overcome
15. explain how to record the results from conditioning monitoring, and the documentation to be used
16. describe the control procedures for reporting the results from condition monitoring
17. describe the organisational procedure(s) to be adopted for the safe disposal of waste of all types of materials
18. describe the extent of their own authority and to whom they should report if they have a problem that they cannot resolve

**Level:** 3  
**Credit value:** 50  
**UAN number:** H/600/5592

### Unit aim

This unit covers the skills and knowledge needed to prove the competences required to carry out efficient and effective fault diagnosis on electrical equipment and circuits, in accordance with approved procedures. The learner 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. The learner 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, the learner will be expected to identify the fault and its probable cause, and to suggest action to remedy the problem.

The learner's responsibilities will require them 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 they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work with minimal supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying fault diagnosis procedures on electrical equipment and circuits. The learner will understand the various fault diagnosis methods and techniques used, and their application. The learner 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.

The learner will understand the safety precautions required when carrying out the fault diagnosis activities, especially those for isolating the equipment. The learner will also understand their responsibilities for safety and the importance of taking the necessary safeguards to protect themselves and others in the workplace.

### Learning outcomes

There are **two** learning outcomes to this unit. The learner will be able to:

1. Carry out fault diagnosis on electrical equipment and circuits
2. Know how to carry out fault diagnosis on electrical equipment and circuits

### **Guided learning hours**

It is recommended that **60** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 11: Carrying Out Fault Diagnosis on Electrical Equipment and Circuits (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

## Unit 111

# Carrying Out Fault Diagnosis on Electrical Equipment and Circuits

### Outcome 1

Carry out fault diagnosis on electrical equipment and circuits

#### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the fault diagnostic activity:
  - plan the fault diagnosis, based on the available information about the fault
  - obtain and use the correct issue of company and/or manufacturers drawings and maintenance documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - ensure the safe isolation of equipment (such as electricity, mechanical, gas, air or fluids)
  - provide and maintain 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
3. 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
4. find faults that have resulted in two of the following breakdown categories:
  - intermittent action or circuit failure
  - partial failure or reduced performance
  - complete breakdown
5. review and use all relevant information on the symptoms and problems associated with the products or assets
6. investigate and establish the most likely causes of the faults
7. select, use and apply diagnostic techniques, tools and aids to locate faults

8. 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
  
9. use a range of fault diagnostic techniques, to include two of the following:
  - half-split technique
  - input/output technique
  - injection and sampling
  - six point technique
  - equipment self-diagnostics
  - emergent sequence
  - unit substitution
  - function/performance testing
  
10. 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
  
11. 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)
  
12. 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
  
13. complete the fault diagnosis within the agreed time and inform the appropriate people when this cannot be achieved
14. determine the implications of the fault for other work and for safety considerations
15. use the evidence gained to draw valid conclusions about the nature and probable cause of the fault
16. record details on the extent and location of the faults in an appropriate format
17. 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 111

# Carrying Out Fault Diagnosis on Electrical Equipment and Circuits

### Outcome 2

Know how to carry out fault diagnosis on electrical equipment and circuits

#### Assessment Criteria

The learner will be able to:

1. describe 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 the learner
2. describe the isolation and lock-off procedure or permit-to-work procedure that applies
3. explain 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. describe the importance of wearing protective clothing and other appropriate safety equipment during fault diagnosis activities
5. describe the hazards associated with carrying out fault diagnosis on electrical equipment (such as live electrical components, stored energy, misuse of tools), and how to minimise these and reduce any risks
6. describe the procedure to be adopted to establish the background of the fault
7. explain how to evaluate the various types of information available for fault diagnosis
8. explain how to use the various aids and reports available for fault diagnosis
9. explain how to use various items of fault diagnostic equipment to investigate the problem
10. describe 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. explain how to evaluate sensory information (sight, sound, smell, touch)
12. explain how to analyse evidence and evaluate possible characteristics and causes of specific faults/problems
13. explain how to relate previous reports/records of similar fault conditions
14. describe the care, handling and application of electrical test instruments (such as multimeters, insulation resistance testers)
15. explain how to calibrate electrical test instruments and check that they are free from damage and defects
16. explain how to obtain and interpret drawings, circuit and physical layouts, charts, specifications, manufacturers' manuals, history/maintenance reports, graphical electrical symbols, bs7671/iee wiring regulations, and other documents needed in the maintenance process
17. describe the basic principles of how the circuit functions, the operating sequence, the purpose of individual units/components and how they interact
18. describe the different types of cabling (such as multi-core cables, single-core cables, swa cables, mi cables, screened cables), their associated fittings, and their application
19. describe the different types of motors and starters, and their operation
20. describe the different types of control systems and components, and their operation
21. describe the different types of electrical components (such as plugs, switches, lighting and fittings, junction boxes, consumer units), and their operation
22. explain how to evaluate the likely risk to themselves and others, and the effects the fault could have on the overall process or system
23. explain how to prepare and produce a risk analysis report, where appropriate
24. explain how to prepare a report or take follow-up action which satisfies the company policy on concluding fault diagnosis
25. describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve

**Level:** 3  
**Credit value:** 70  
**UAN number:** Y/600/5606

## Unit aim

This unit covers the skills and knowledge needed to prove the competences required to carry out corrective maintenance activities on electrical equipment, in accordance with approved procedures. The learner 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. The learner will be expected to apply a range of dismantling and reassembly methods and techniques, such as soldering, crimping, harnessing and securing cables and components.

The learner's responsibilities will require them to comply with organisational policy and procedures for the maintenance activities undertaken, and to report any problems with the maintenance activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner 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. The learner will be expected to work with minimal supervision, taking personal responsibility for their actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying electrical maintenance procedures. The learner will understand the dismantling and reassembly methods and procedures used, and their application. The learner 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 that the repaired equipment functions to the required specification and remains compliant with all standards and regulations.

The learner will understand the safety precautions required when carrying out the maintenance activities, especially those for isolating the equipment. The learner will also understand their responsibilities for safety and the importance of taking the necessary safeguards to protect themselves and others in the workplace.

## Learning outcomes

There are **two** learning outcomes to this unit. The learner will be able to:

1. Maintain electrical equipment
2. Know how to maintain electrical equipment

## Guided learning hours

It is recommended that **119** hours should be allocated for this unit, although patterns of delivery are likely to vary.



### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 12: Maintaining Electrical Equipment (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

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**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

**Assessment Criteria**

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following maintenance activities:
  - plan and communicate the maintenance activities to cause minimal disruption to normal working
  - obtain and use the correct issue of company and/or manufacturers' drawings and maintenance documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - ensure the safe isolation of equipment (such as electricity, mechanical, gas, air or fluids)
  - provide and maintain 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
3. 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
4. follow the relevant maintenance schedules to carry out the required work
5. maintain electrical equipment to one of the following:
  - organisational guidelines and codes of practice
  - equipment manufacturers operation range
  - BS7671/IEE wiring regulations
  - BS, ISO and/or BSEN standards
6. carry out the maintenance activities within the limits of their personal authority
7. carry out the maintenance activities in the specified sequence and in an agreed time scale

8. 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
  
9. replace/refit a range of electrical components, to include ten of the following groups of components:
  - cables and connectors
  - contactors
  - relay components
  - overload protection devices
  - locking and 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
  
10. report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
11. complete relevant maintenance records accurately, to include one of the following, and pass them on to the appropriate person:
  - job cards
  - maintenance logs or reports
  - permits to work/formal risk assessment and/or sign on/off procedures
  - company specific documentation
  
12. dispose of waste materials in accordance with safe working practices and approved procedures

**Assessment Criteria**

The learner will be able to:

1. describe the health and safety requirements of the area in which the maintenance activity is to take place, and the responsibility these requirements place on the learner
2. describe the isolation and lock-off procedure or permit-to-work procedure that applies to maintenance activities (such as electrical isolation, locking off switchgear, removal of fuses, placing of maintenance warning notices, proving the isolation has been achieved and secured)
3. explain 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. describe the hazards associated with carrying out electrical maintenance activities (such as contact with live electrical components, misuse of tools, using damaged or badly maintained tools and equipment, not following laid-down maintenance procedures), and how to minimise these and reduce any risk
5. describe the importance of wearing protective clothing and other appropriate safety equipment during the maintenance activities
6. explain how to obtain and interpret drawings, circuit and physical layouts, charts, specifications, manufacturers' manuals, history/maintenance reports, graphical electrical symbols, BS7671/IEE wiring regulations, and other documents needed for the maintenance activities
7. describe the purpose of the components which have been replaced/maintained
8. describe the different types of cabling and their application (such as multicore cables, single core cables, steel wire armoured (swa), mineral insulated (mi), screened cables)
9. describe the different types of electric motors and motor starters
10. describe the different types of control system, and their various components
11. describe the application and use of a range of electrical components (such as plugs, switches, sockets, lighting and fittings, junction boxes, consumer units)
12. describe the various lighting systems used (including tungsten, sodium, mercury vapour and fluorescent)
13. describe the different types of wiring enclosures that are used (to include conduit, trunking and traywork systems)
14. describe the care, handling and application of ohmmeters, multimeters and other electrical measuring instruments
15. describe the company policy on the repair/replacement of components, and the procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance activities
16. explain 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)
17. describe the techniques used to dismantle/assemble electrical equipment (such as unplugging, de-soldering, removal of screwed, clamped and crimped connections)
18. describe the methods of removing and replacing cables and wires in wiring enclosures without causing damage to existing cables
19. describe the use of BS7671/IEE wiring, and other, regulations when selecting wires and cables and when carrying out tests on systems
20. describe the methods of attaching identification markers/labels to removed components or cables to assist with re-assembly
21. describe 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)

22. describe the methods of checking that components are fit for purpose, and the need to replace 'lived' items (such as motor brushes, seals and gaskets overload protection devices)
23. explain how to make adjustments to components/assemblies to ensure they function correctly
24. explain 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
25. describe the importance of making 'off-load' checks before proving the equipment with the electrical supply on
26. describe the generation of maintenance documentation and/or reports following the maintenance activity
27. describe the equipment operating and control procedures to be applied during the maintenance activity
28. explain how to use appropriate lifting and handling equipment in the maintenance activity
29. describe the problems that can occur during the electrical maintenance activity, and how they can be overcome
30. describe the organisational procedure(s) to be adopted for the safe disposal of waste of all types of materials
31. describe the extent of their own authority and to whom they should report if they have a problem that they cannot resolve

**Level:** 3  
**Credit value:** 35  
**UAN number:** D/600/5610

## Unit aim

This unit covers the skills and knowledge needed to prove the competences required to modify electrical circuits, in accordance with approved procedures. The learner will be required to modify, rewire and update circuits in accordance with specifications and latest issue drawings and standards. The learner will be expected to remove and replace cables, add new cables, change breakout points and change the routing of cables. The learner will also be expected to change components, units and trays. The learner 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.

The learner's responsibilities will require them 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 they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner 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. The learner will be expected to work with minimal supervision, taking full responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying modification or rewiring procedures. The learner 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 that the modification is carried out to the required specification and remains compliant with all standards and regulations.

The learner will understand the safety precautions required when carrying out the modification activities. The learner will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace.

## Learning outcomes

There are **two** learning outcomes to this unit. The learner will be able to:

1. Modify or rewire electrical circuits
2. Know how to modify or rewire electrical circuits

## Guided learning hours

It is recommended that **63** hours should be allocated for this unit, although patterns of delivery are likely to vary.

## Details of the relationship between the unit and relevant national standards

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 13: Modifying or Rewiring Electrical Circuits (Suite 3)

## **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

**Assessment Criteria**

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the modification and rewiring activities:
  - obtain and use the correct issue of company and/or manufacturers' drawings and planning documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - ensure the safe isolation of equipment (such as electricity, mechanical, gas, air or fluids)
  - provide and maintain 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
3. 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 (such as conduit, trunking or tray work)
  - luminaires
  - other specific electrical equipment
4. obtain and follow the relevant modification specifications and job instructions
5. confirm and agree what modifications are to be carried out to meet the specification
6. prepare the electrical system for the required modification
7. carry out the system modification using approved materials, methods and procedures
8. 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



9. 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
10. complete the modification within the agreed timescale
11. ensure that the modified electrical system meets the specified operating conditions
12. produce modified or rewired electrical systems in accordance with one of the following:
  - organisational guidelines and codes of practice
  - equipment manufacturers' operation range
  - BS7671/IEE wiring regulations
  - BS, ISO and/or BSEN standards
13. produce accurate and complete records of all modification work carried out
14. complete the relevant paperwork, from one of the following, and pass it to the appropriate people:
  - job cards
  - maintenance log or report
  - company-specific documentation
  - permits to work/formal risk assessment and/or sign-on/off procedures
15. deal promptly and effectively with problems within their control and report those that cannot be solved

**Assessment Criteria**

The learner will be able to:

1. describe 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. describe the health and safety requirements of the work area in which they are carrying out the modification or rewiring activities, and the responsibility these requirements place on the learner
3. describe the hazards associated with carrying out modifications or rewiring of electrical systems, and how to minimise these and reduce any risks
4. explain 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. describe the personal protective equipment and clothing to be worn during the modification or rewiring activities
6. explain how to obtain and interpret drawings, circuit and physical layouts, charts, specifications, manufacturers' manuals, graphical electrical symbols, BS7671/IEE wiring regulations, and other documentation used during the modification or rewiring activities
7. describe the basic principles of how the system functions, the operating sequence, the working purpose of individual units/components, and how they interact
8. describe the different types of cabling (such as multicore cables, single core cables, swa cables, mi cables, screened cables), their fittings and their application
9. describe the different types of electrical component (such as plugs, switches, lighting and fittings, junction boxes, consumer units)
10. describe the preparations to be undertaken prior to the modification or rewiring of the system
11. explain 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. describe the methods and techniques to be used for soldering and de-soldering, and the importance of adhering to these procedures
13. describe the methods and techniques to be used for crimping and heat shrinking, and the importance of adhering to these procedures
14. describe the various mechanical fasteners that can be used, and their methods of installation or removal
15. describe the procedure for obtaining replacement parts, materials and other consumables necessary for the modification or rewiring activities
16. describe 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. explain how to conduct any necessary checks to ensure that the completed modification or rewiring complies with all appropriate standards
18. describe 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. explain 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. describe the problems that can occur with the modification or rewiring operations, and how these can be overcome
21. describe the recording documentation to be completed for the activities undertaken
22. describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve

**Level:** 3  
**Credit value:** 50  
**UAN number:** H/600/5656

## Unit aim

This unit covers the skills and knowledge needed to prove the competences required 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. The learner 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.

The learner's responsibilities will require them 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 they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work with minimal supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a sound understanding of their work, and will provide an informed approach to applying test procedures to electrical equipment and circuits. The learner 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 safely and correctly and ensuring that the equipment remains compliant with all standards and regulations. In addition, the learner will be expected to review the outcome of the tests, compare the results with appropriate standards, determine the action required, and to record and report the results in the appropriate format.

The learner 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 themselves and others against direct and indirect electric shock. The learner will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace.

## Learning outcomes

There are **two** learning outcomes to this unit. The learner will be able to:

1. Test electrical equipment and circuits
2. Know how to test electrical equipment and circuits

## Guided learning hours

It is recommended that **60** hours should be allocated for this unit, although patterns of delivery are likely to vary.

## Details of the relationship between the unit and relevant national standards

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 14: Testing Electrical Equipment and Circuits (Suite 3)

## **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

**Assessment Criteria**

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the testing activities:
  - plan the inspection and testing activities to cause minimal disruption to normal working
  - obtain and use the correct issue of company and/or manufacturers' drawings and maintenance documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - ensure the safe isolation of equipment
  - provide and maintain 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
3. 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
4. follow the appropriate procedures for use of tools and equipment to carry out the required 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
  - test procedures used are as recommended in the appropriate electrical codes of practice (BS7671/IEE)
  - test equipment is operated within its specification range
6. set up and carry out the tests using the correct procedures and within agreed timescales

7. use appropriate test equipment to carry out five of the following tests, as applicable to the equipment being maintained:
  - protective conductor resistance values
  - insulation resistance values
  - load current
  - voltage levels
  - impedance
  - continuity
  - polarity
  - power rating
  - resistance
  - capacitance
  - frequency values
  - RCD disconnection time
  - specialised tests (such as speed, sound, light, temperature)
8. record the results of the tests in the appropriate format
9. 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
10. review the results and carry out further tests if necessary

**Assessment Criteria**

The learner will be able to:

1. describe the health and safety requirements of the work area where they are carrying out the testing activities, and the responsibility these requirements place on the learner
2. describe the equipment isolation and lock-off procedure or permit-to-work procedure that applies to the testing activities (such as electrical isolation, locking off switchgear, removal of fuses, placing of maintenance warning notices, proving the isolation has been achieved and secured)
3. describe the hazards associated with carrying out tests on electrical systems, and how to minimise these and reduce any risks
4. describe the specific safety precautions to be taken when carrying out formal inspection and testing of electrical equipment
5. explain 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)
6. describe the importance of wearing protective clothing and other appropriate safety equipment during the electrical testing activities
7. describe the protection techniques for electrical systems (to prevent burn or fire risk)
8. explain how to obtain and interpret drawings, circuit and physical layouts, charts, specifications, manufacturers' manuals, history/maintenance reports, graphical electrical symbols, bs7671/iee wiring regulations, and other documents needed in the testing activities
9. describe the types of test equipment to be used, and their selection for particular types of tests
10. explain how to ensure that the test equipment is maintained and correctly calibrated, in accordance with the appropriate organisational procedures
11. explain 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
12. describe the various testing methods and procedures, as recommended in approved electrical codes of practice, and how to apply them to different operating conditions
13. explain how to display/record test results, and the documentation to be used
14. explain how to interpret the value and significance of the test readings
15. explain how to analyse test results using tables in approved electrical codes of practice, and how to use comparison and sequential techniques
16. describe the importance of ensuring that test equipment is used only for its intended purpose and within its specified range and limits
17. describe the problems or errors that may occur and which could affect the test results, and how they can be avoided
18. describe the environmental control and company operating procedures relating to the testing activities
19. describe the documentation required and the procedures to be observed following the test
20. describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve

## Unit 115

# Carrying Out Preventative Planned Maintenance on Electrical Equipment

**Level:** 3  
**Credit value:** 38  
**UAN number:** F/600/5664

### Unit aim

This unit covers the skills and knowledge needed to prove the competences required to carry out preventative planned maintenance activities on electrical equipment, in accordance with approved procedures. The learner 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.

The learner's responsibilities will require them 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 they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner 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. The learner will be expected to work with minimal supervision, taking full responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying planned maintenance procedures to electrical equipment. The learner 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 that the system is maintained to the required specification and remains compliant with all standards and regulations. In addition, the learner will be expected to report where the outcome identifies the need for further investigation or maintenance work.

The learner will understand the safety precautions required when carrying out the maintenance activities, especially those for isolating the equipment. The learner will also understand their responsibilities for safety and the importance of taking the necessary safeguards to protect themselves and others in the workplace.

### Learning outcomes

There are **two** learning outcomes to this unit. The learner will be able to:

1. Carry out preventative planned maintenance on electrical equipment
2. Know how to carry out preventative planned maintenance on electrical equipment

### Guided learning hours

It is recommended that **74** hours should be allocated for this unit, although patterns of delivery are likely to vary.



### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 15: Carrying Out Preventative Planned Maintenance on Electrical Equipment (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

## Unit 115

# Carrying Out Preventative Planned Maintenance on Electrical Equipment

### Outcome 1

Carry out preventative planned maintenance on electrical equipment

#### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following planned maintenance activities:
  - plan and communicate the maintenance activities to cause minimal disruption to normal working
  - obtain and use the correct issue of company and/or manufacturers' drawings and maintenance documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
  - provide and maintain 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
3. 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
  - luminaries
4. follow the relevant maintenance schedules to carry out the required work
5. follow planned maintenance activities, using one of the following types of maintenance categories:
  - condition based maintenance
  - preventative planned maintenance
  - scheduled maintenance
  - total preventative maintenance (TPM)
6. carry out the maintenance activities within the limits of their personal authority
7. carry out the maintenance activities in the specified sequence and in an agreed time scale

8. carry out all of the following planned maintenance activities:
  - visual examination of condition and security of wiring enclosures (conduit, trunking, traywork)
  - checking and replacing 'lived' 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
  - carrying out portable appliance testing (PAT) or arranging for it to be completed
  - removing excessive dirt and dust from panels
  - checking the condition of cables
  - making routine adjustments
  - testing and reviewing system function
  - checking the integrity and security of earth bonding
  - recording the results of the maintenance and reporting any defects found
9. ensure that the maintained equipment meets all of the following:
  - equipment remains compliant with appropriate regulations and safety requirements
  - all components and sub-assemblies are fit for purpose
  - all connections are electrically and mechanically safe and sound
  - equipment and associated cabling meets bs7671/iee wiring regulations
  - equipment functions to specification
  - all potential defects are identified and reported for future action
10. report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
11. complete relevant maintenance records accurately, to include one of the following, and pass them on to the appropriate person:
  - job cards
  - maintenance log or report
  - company-specific documentation
  - permit to work/formal risk assessment and/or sign-on/off procedures
12. dispose of waste materials in accordance with safe working practices and approved procedures

## Unit 115

# Carrying Out Preventative Planned Maintenance on Electrical Equipment

### Outcome 2

Know how to carry out preventative planned maintenance on electrical equipment

#### Assessment Criteria

The learner will be able to:

1. describe 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 the learner
2. describe the isolation and lock-off procedure or permit-to-work procedure that applies to maintenance activities (such as electrical isolation, locking off switch gear, removal of fuses, placing of maintenance warning notices, proving the isolation has been achieved and secured)
3. describe the specific health and safety precautions to be applied during the planned maintenance activities, and their effects on others
4. describe the importance of wearing protective clothing and other appropriate safety equipment during the maintenance activities
5. explain 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. describe the hazards associated with carrying out planned maintenance activities on electrical equipment (such as exposure to live conductors, misuse of tools), and how to minimise these and reduce any risks
7. explain how to obtain and interpret drawings, circuit and physical layouts, charts, specifications, manufacturers' manuals, history/maintenance reports, graphical electrical symbols, bs7671/iee wiring regulations, and other documents needed in the maintenance activities
8. describe the maintenance schedules and methods to be followed in order to comply with company procedures for planned maintenance on electrical equipment
9. describe the basic principle of operation of the equipment/circuits being maintained, and the function/purpose of individual components within the circuit
10. describe 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. describe the different types of electric motors and motor starters, and their maintenance requirements
12. describe the different types of control system, their various components and maintenance requirements
13. describe 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 for each of them
14. describe the various lighting systems used (including tungsten, sodium, mercury vapour and fluorescent), and their maintenance requirements
15. describe the different types of wiring enclosure that are used (to include conduit, trunking and traywork systems), and what to check during the maintenance activities
16. describe the methods of checking that components are fit for purpose, and the need to replace 'lived' items (such as motor brushes, seals and gaskets, and overload protection devices)
17. explain how to make sensory checks (by sight, sound, smell, touch)
18. explain 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. describe the various planned maintenance categories that are generally used (such as condition based maintenance, scheduled maintenance and total preventative maintenance (tpm))
20. describe the procedure for obtaining the consumables to be used during the planned maintenance activity
21. describe the appropriate testing procedures to be adopted during the maintenance activity
22. explain how to compile planned maintenance records/logs/reports that comply with company policy and procedures
23. describe the equipment operating and control procedures, and how to apply them in order to carry out planned maintenance
24. describe the problems that can occur whilst carrying out the planned maintenance activities, and how they can be avoided
25. describe the organisational procedure to be adopted for the safe disposal of waste of all types of materials
26. describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve

**Level:** 3  
**Credit value:** 50  
**UAN number:** Y/600/5671

### Unit aim

This unit covers the skills and knowledge needed to prove the competences required to carry out efficient and effective fault diagnosis on electronic equipment/circuits, in accordance with approved procedures. The learner 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. The learner 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, the learner will be expected to identify the fault and its probable cause, and to suggest appropriate action to remedy the problem.

The learner's responsibilities will require them 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 they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work with minimal supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they produce.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying fault diagnosis procedures on electronic equipment and circuits. The learner will understand the various fault diagnosis methods and techniques used, and their application. The learner 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.

The learner will understand the safety precautions required when carrying out the fault diagnosis activities, especially those for isolating the equipment. The learner will also understand their responsibilities for safety and the importance of taking the necessary safeguards to protect themselves and others in the workplace.

### Learning outcomes

There are **two** learning outcomes to this unit. The learner will be able to:

1. Carry out fault diagnosis on electronic equipment and circuits
2. Know how to carry out fault diagnosis on electronic equipment and circuits

### Guided learning hours

It is recommended that **60** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 16: Carrying Out Fault Diagnosis on Electronic Equipment and Circuits (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

## Unit 116

# Carrying Out Fault Diagnosis on Electronic Equipment and Circuits

### Outcome 1

Carry out fault diagnosis on electronic equipment and circuits

#### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the fault diagnostic activity:
  - plan the fault diagnosis using available information about the fault
  - obtain and use the correct issue of company and/or manufacturers' drawings and maintenance documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - ensure the safe isolation of equipment
  - provide and maintain 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 diagnostic activities using appropriate procedures
  - collect equipment fault diagnostic 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
3. 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 (e.g. programmable controller, microprocessor, ROM/RAM, logic gates)
  - analogue circuits and systems (e.g. frequency modulation/demodulation, amplifiers, filters, oscillators)
  - hybrid circuits and systems (e.g. analogue to digital convertors [ADC], d-to-a convertors [DAC])
4. find faults that have resulted in two of the following breakdown categories:
  - intermittent action or circuit failure
  - partial failure or reduced performance
  - complete breakdown
5. review and use all relevant information on the symptoms and problems associated with the products or assets
6. investigate and establish the most likely causes of the faults
7. select, use and apply diagnostic techniques, tools and aids to locate faults



8. 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
9. use a range of fault diagnostic techniques to include two of the following
  - half-split technique
  - input/output technique
  - six point technique
  - unit substitution
  - equipment self-diagnostics
  - injection and sampling
  - emergent sequence
  - function/performance testing
10. 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
  - troubleshooting guides
  - electronic aids
11. 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)
12. 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
13. complete the fault diagnosis within the agreed time and inform the appropriate people when this cannot be achieved
14. determine the implications of the fault for other work and for safety considerations
15. use the evidence gained to draw valid conclusions about the nature and probable cause of the fault
16. record details on the extent and location of the faults in an appropriate format
17. 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 116

# Carrying Out Fault Diagnosis on Electronic Equipment and Circuits

### Outcome 2

Know how to carry out fault diagnosis on electronic equipment and circuits

#### Assessment Criteria

The learner will be able to:

1. describe 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 the learner
2. describe the isolation and lock-off procedure or permit-to-work procedure that applies
3. explain 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. describe the importance of wearing protective clothing and other appropriate safety equipment during the fault diagnosis activities
5. describe the hazards associated with carrying out fault diagnosis on electronic equipment (such as mains electricity, stored capacitive/inductive/electrostatic energy, misuse of tools), and how to minimise these and reduce any risks
6. describe the procedure to be adopted to establish the background of the fault
7. explain how to evaluate the various types of information available for fault diagnosis
8. explain how to use the various aids and reports available for fault diagnosis
9. explain how to use various types of fault diagnostic equipment needed to investigate the problem
10. describe digital circuits and their operation (including logic truth tables and Boolean algebra for AND, OR, NAND, NOR, NOT and EXCLUSIVE-OR gates)
11. describe 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. explain how to evaluate sensory conditions (by sight, sound, smell, touch)
13. explain how to analyse evidence and evaluate possible characteristics and causes of specific faults/problems
14. explain how to relate previous reports/records of similar fault conditions
15. describe the care, handling and application of electronic test instruments (such as multimeters, logic probes, oscilloscopes, signal tracers, signal generators)
16. explain how to calibrate electronic test instruments and check that they are free from damage and defects
17. describe the precautions (such as use of wrist straps, special packaging and handling areas) to be taken to prevent electrostatic discharge (ESD) damage to electronic circuits and components
18. explain how to obtain and interpret drawings, circuit and physical layouts, charts, specifications, manufacturers' manuals, history/maintenance reports, graphical electronic/electrical symbols, BS7671/IEE wiring regulations, and other documents needed in the fault diagnosis activities
19. describe the basic principles of how the circuit functions, its operating sequence, the function/purpose of individual units/components, and how they interact
20. describe the different types of cabling (such as multicore, single core, ribbon, screened cables), fittings/connectors (including insulation displacement), and their application
21. describe the different types of control systems and components, and their operation
22. describe the functions of different types of electronic components (analogue and digital), and their operation
23. explain how to evaluate the likely risk to themselves and others, and the effects the fault could have on the overall system or process

24. explain how to prepare and produce a risk analysis report, where appropriate
25. explain how to prepare a report, or take follow-up action, on conclusion of the fault diagnosis, in accordance with company policy
26. describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve

**Level:** 3  
**Credit value:** 50  
**UAN number:** A/600/5677

## Unit aim

This unit covers the skills and knowledge needed to prove the competences required to carry out inspections and tests on electronic equipment and circuits, in accordance with approved procedures. The learner 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 are functioning at optimal level and to specification. The learner 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.

The learner's responsibilities will require them to comply with organisational policy and procedures for carrying out the testing activities, and to report any problems with these activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work with minimal supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's 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. The learner 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 safely and correctly and ensuring that the equipment remains compliant with all standards and regulations. In addition, the learner 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.

The learner 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 themselves and others against direct and indirect electric shock. The learner will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace.

## Learning outcomes

There are **two** learning outcomes to this unit. The learner will be able to:

1. Test electronic equipment and circuits
2. Know how to test electronic equipment and circuits

## Guided learning hours

It is recommended that **60** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 17: Testing Electronic Equipment and Circuits (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

**Assessment Criteria**

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the testing activities:
  - plan the inspection and testing activities to cause minimal disruption to normal working
  - obtain and use the correct issue of company and/or manufacturers' drawings and maintenance documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - ensure the safe isolation of equipment
  - provide and maintain 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
3. 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
4. follow the appropriate procedures for use of tools and equipment to carry out the required 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. set up and carry out the tests using the correct procedures and within agreed timescales
7. 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

8. 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
9. record the results of the tests in the appropriate format
10. 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
11. review the results and carry out further tests if necessary

**Assessment Criteria**

The learner will be able to:

1. describe the health and safety requirements of the area in which the testing activity is to take place, and the responsibility these requirements place on the learner
2. describe their responsibilities under regulations relevant to the electronic testing activities being undertaken
3. describe the isolation and lock-off procedure or permit-to-work procedure that applies to the testing activities (such as electrical isolation, locking off switchgear, removal of fuses, placing of warning notices, proving the isolation has been achieved and secured)
4. describe the isolation procedure(s) unique or specific to the electronic circuits
5. describe the specific safety precautions to be taken when carrying out formal inspection, safety and circuit testing of electronic equipment
6. describe the hazards associated with testing electronic equipment and circuits, and with the equipment that is used, and how to minimise these and reduce any risks
7. describe the importance of wearing protective clothing, and other appropriate safety equipment, during the testing activities
8. describe the importance of keeping the work area clean, tidy and free from waste and surplus materials
9. explain how the testing activities may affect the work of others, and the procedure for informing them of the work to be carried out
10. describe the procedures and precautions to be adopted to eliminate/protect against electrostatic discharge
11. explain 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. describe the basic principles of how the electronic circuit functions, the operation sequence, the function/purpose of individual units/components, and how they interact
13. explain how to determine the most suitable test points within the circuit
14. explain how to set up and apply the appropriate test equipment
15. explain 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. explain how to ensure that test equipment is correctly calibrated
17. describe the various testing methods and procedures, and how to apply them to different operating conditions
18. explain how to analyse test results, and use comparison and sequential techniques
19. describe the environmental control requirements and company operating procedures relating to functional testing
20. describe the documentation required, and the procedures to be followed, at the conclusion of the test
21. describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve



**Level:** 3  
**Credit value:** 62  
**UAN number:** D/600/5946

## Unit aim

This unit covers the skills and knowledge needed to prove the competences required to carry out repairs on electronic equipment, in accordance with approved procedures. The learner 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. The learner 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. The learner will be expected to take care that they 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 their role.

The learner's responsibilities will require them 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 they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work with minimal supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying electronic repair procedures. The learner 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, correcting faults and ensuring that the repaired equipment functions to the required specification and remains compliant with all standards and regulations.

The learner 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 themselves, and others, against direct and indirect electric shock. The learner will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace.

## Learning outcomes

There are **two** learning outcomes to this unit. The learner will be able to:

1. Repair electronic equipment
2. Know how to repair electronic equipment

## Guided learning hours

It is recommended that **81** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 18: Repairing Electronic Equipment (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

## Unit 118

## Repairing Electronic Equipment

### Outcome 1

### Repair electronic equipment

#### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the repair activities:
  - plan and communicate the repair activities to cause minimal disruption to normal working
  - obtain and use the correct issue of company and/or manufacturers' drawings and maintenance documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - ensure the safe isolation of equipment
  - provide and maintain 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
3. 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
4. follow the relevant maintenance schedules to carry out the required work
5. maintain electronic equipment, in compliance with one of the following:
  - organisational guidelines and codes of practice
  - equipment manufacturer's operation range
  - BS7671/IEE wiring regulations
  - BS, ISO and/or BSEN standards
6. carry out the maintenance activities within the limits of their personal authority
7. carry out the maintenance activities in the specified sequence and in an agreed timescale
8. carry out all of the following repair activities:
  - applying electrostatic discharge (ESD) precautions
  - 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

9. replace a range of electronic components, to include eight 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
  
10. 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
  
11. report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
12. complete relevant maintenance records accurately, to include one of the following, and pass them on to the appropriate person:
  - job cards
  - permits to work/formal risk assessment and/or sign on/off procedures
  - maintenance logs or reports
  - company-specific documentation
  
13. dispose of waste materials in accordance with safe working practices and approved procedures

## Unit 118

## Repairing Electronic Equipment

### Outcome 2

### Know how to repair electronic equipment

#### Assessment Criteria

The learner will be able to:

1. describe the health and safety requirements of the area in which the maintenance activity is to take place, and the responsibility these requirements place on the learner
2. describe their responsibilities under regulations that apply to the electronic repair activities being undertaken
3. describe the isolation and lock-off procedure or permit-to-work procedure that applies to the maintenance activities (such as electrical isolation, locking off switchgear, removal of fuses, placing maintenance warning notices, proving the isolation has been achieved and secured)
4. describe the isolation procedure and safety precautions unique to the electronic equipment or circuits being worked on
5. describe the importance of wearing protective clothing and other appropriate safety equipment during maintenance activities
6. describe 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 to minimise these and reduce any risks
7. describe the importance of keeping the work area clean and tidy, and free from waste and surplus materials
8. explain how the maintenance activities may affect the work of others, and the procedure for informing them of the work to be carried out
9. describe the procedures and precautions to be adopted to eliminate electrostatic discharge hazards
10. explain 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
11. describe the basic principles of how the electronic circuit functions, its operation sequence, the working purpose of individual units/components and how they interact
12. describe the organisational policy on the repair or replacement of faulty components during the maintenance process
13. explain how to check that the replacement components meet the required specification/operating conditions (such as values, tolerance, current-carrying capacity, ambient temperatures)
14. describe the methods of removing and replacing the faulty components from the equipment (such as unplugging, de-soldering, removal of screwed, clamped, edge connected, zero insertion force, and crimped connections)
15. describe the importance of removing faulty components, without causing damage to other components, wiring, or the surrounding structure
16. describe the methods of attaching identification marks/labels to removed components or connections, in order to assist with re-assembly
17. describe 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)
18. explain 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
19. describe the sequence for reconnecting the equipment, and checks to be made prior to restoring power (such as checking components for correct polarity, ensuring that there are no exposed conductors, cable insulation is not damaged, all connections are mechanically and electrically secure, casings are free from loose screws, wire ends or solder blobs that could cause short circuits, and all fuses/protection devices are installed)

20. describe the importance of making 'off-load' checks before proving the equipment with the electrical supply on
21. explain how to make adjustments to components/assemblies to ensure that they function correctly
22. describe the maintenance documentation and/or reports to be completed following the maintenance activity, and the importance of ensuring that these reports are completed accurately and legibly
23. describe the problems that can occur with the maintenance activity, and how they can be overcome
24. describe the organisational procedures to be adopted for the safe disposal of waste of all types of materials
25. describe the extent of their own authority and to whom they should report if they have a problem that they cannot resolve

## Unit 119

# Carrying Out Fault Diagnosis on Fluid Power Equipment and Circuits

**Level:** 3  
**Credit value:** 50  
**UAN number:** T/600/5953

### Unit aim

This unit covers the skills and knowledge needed to prove the competences required to carry out efficient and effective fault diagnosis on fluid power equipment and circuits, on mobile or static plant, in accordance with approved procedures. The learner 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. The learner 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, the learner will be expected to identify the fault and its probable cause, and to suggest appropriate action to remedy the problem.

The learner's responsibilities will require them 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 they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work with minimal supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying fault diagnosis procedures on fluid power equipment. The learner will understand the various fault diagnosis methods and techniques used, and their application. The learner 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.

The learner 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 themselves and others in the workplace. The learner will be required to demonstrate safe working practices throughout.

### Learning outcomes

There are **two** learning outcomes to this unit. The learner will be able to:

1. Carry out fault diagnosis on fluid power equipment and circuits
2. Know how to carry out fault diagnosis on fluid power equipment and circuits

### Guided learning hours

It is recommended that **60** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### Details of the relationship between the unit and relevant national standards

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 19: Carrying Out Fault Diagnosis on Fluid Power Equipment and Circuits (Suite 3)

## **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**



## Unit 119

# Carrying Out Fault Diagnosis on Fluid Power Equipment and Circuits

## Outcome 1

Carry out fault diagnosis on fluid power equipment and circuits

### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the fault diagnostic activity:
  - plan the fault diagnosis activities prior to beginning the work
  - obtain and use the correct issue of company and/or manufacturers' drawings and maintenance documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - adhere to company-specific contamination and control procedures at all times
  - ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
  - provide and maintain 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
3. carry out fault diagnosis on two of the following types of equipment:
  - pneumatic system
  - hydraulic system
  - vacuum system
4. carry out fault diagnosis on all of the following system components:
  - pumps
  - motors
  - actuators/cylinders
  - pipework
  - connectors
  - hoses
  - switches
  - valves
5. find faults that have resulted in two of the following breakdown categories:
  - intermittent problem
  - partial failure or reduced performance
  - complete breakdown
6. review and use all relevant information on the symptoms and problems associated with the products or asset
7. investigate and establish the most likely causes of the faults
8. select, use and apply diagnostic techniques, tools and aids to locate faults

9. 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
  
10. use a range of fault diagnostic techniques, to include two of the following:
  - half-split technique
  - input/output
  - injection and sampling
  - six point technique
  - equipment self-diagnostics
  - emergent sequence
  - unit substitution
  - functional/performance testing
  
11. use a variety of diagnostic aids and equipment, to include two of the following:
  - manufacturer's manual
  - algorithms
  - probability charts/reports
  - equipment self-diagnostics
  - sequence charts
  - physical layout diagrams
  - flow charts
  - fault analysis charts (such as fault trees)
  - troubleshooting guides
  - function diagrams
  
12. use all of the following diagnostic 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)
  
13. use two of the following types of test equipment to aid fault diagnosis:
  - measuring devices/meters
  - flow indicators
  - pressure indicators
  - thermal indicators
  - test rigs
  - self-diagnostic equipment
  - contamination monitoring and analysing devices
  
14. complete the fault diagnosis within the agreed time and inform the appropriate people when this cannot be achieved
15. determine the implications of the fault for other work and for safety considerations
16. use the evidence gained to draw valid conclusions about the nature and probable cause of the fault
17. record details on the extent and location of the faults in an appropriate format
18. 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 119

# Carrying Out Fault Diagnosis on Fluid Power Equipment and Circuits

### Outcome 2

Know how to carry out fault diagnosis on fluid power equipment and circuits

#### Assessment Criteria

The learner will be able to:

1. describe the health and safety requirements of the area in which the fault diagnostic activity is to take place, and the responsibility these requirements place on the learner
2. describe 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. describe the hazards associated with carrying out fault diagnosis on fluid power equipment (such as handling fluids, stored pressure/force, misuse of tools, using practices/procedures that do not follow laid-down procedures), and how to minimise these and reduce any risks
5. describe the regulations and codes of practice relating to working with fluid power equipment
6. describe the importance of following the correct decontamination procedures
7. explain how to obtain and interpret drawings, schematic and physical diagrams, specifications, flow charts, manufacturers' manuals and other documents needed in the fault diagnostic activities
8. describe the various fault finding techniques that can be used, and how they are applied (such as half-split, input/output put, emergent problem sequence, six point technique, functional testing, unit substitution, injection and sampling techniques, and equipment self-diagnostics)
9. describe the procedure to be adopted to establish the background of the fault
10. explain how to evaluate the various types of information available for fault diagnosis
11. explain how to use the various aids and reports available for fault diagnosis
12. explain how to evaluate sensory information from sight, sound, smell, touch
13. explain how to use a range of fault diagnostic equipment to investigate the problem (such as measuring devices, pressure and flow testing devices)
14. describe the importance of checking that test equipment is within current calibration dates, and the procedure to get the test instruments correctly calibrated
15. explain how to use the test equipment, and how to connect it into the circuit at the appropriate points
16. describe the basic principles of how the circuit/equipment functions, and the operation and applications of the individual units/components and their interrelations with other components and assemblies
17. explain how to analyse and evaluate possible characteristics and causes of specific faults/problems
18. explain how to make use of previous reports/records of similar fault conditions
19. explain how to evaluate the likely risk to others and themselves, and the effects the fault could have on the overall process
20. explain how to prepare and produce a risk analysis report, where appropriate
21. explain how to prepare a report or take follow-up action, which complies with the company policy on concluding fault diagnosis
22. describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve

**Level:** 3  
**Credit value:** 70  
**UAN number:** M/600/5983

## Unit aim

This unit covers the skills and knowledge needed to prove the competences required to carry out corrective maintenance on fluid power equipment, on mobile or static plant, in accordance with approved procedures. The learner 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.

The learner's responsibilities will require them 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 they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work with minimal supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying maintenance procedures to fluid power equipment. The learner will understand the dismantling and reassembly methods and procedures used, and their application. The learner 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 that the repaired equipment functions to the required specification and remains compliant with all standards and regulations. In addition, the learner 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.

The learner 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 themselves and others in the workplace. The learner will be required to demonstrate safe working practices throughout.

## Learning outcomes

There are **two** learning outcomes to this unit. The learner will be able to:

1. Maintain fluid power equipment
2. Know how to maintain fluid power equipment

## Guided learning hours

It is recommended that **119** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 20: Maintaining Fluid Power Equipment (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

**Assessment Criteria**

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the maintenance activity:
  - plan and communicate the maintenance activities to cause minimal disruption to normal working
  - obtain and use the correct issue of company and/or manufacturers' drawings and maintenance documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - adhere to company-specific contamination and control procedures at all times
  - ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
  - provide and maintain 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
3. carry out maintenance activities on two of the following types of fluid power equipment:
  - pneumatic
  - hydraulic
  - vacuum
4. carry out maintenance activities to component level on all of the following fluid power components:
  - pumps
  - valves
  - cylinders
  - actuators
5. follow the relevant maintenance schedules to carry out the required work
6. maintain fluid power equipment, in compliance with one of the following:
  - organisational guidelines and codes of practice (such as bfpa guidance documentation)
  - equipment manufacturers' operation range
  - BS, ISO and/or BSEN standards
7. carry out the maintenance activities within the limits of their personal authority
8. carry out the maintenance activities in the specified sequence and in an agreed timescale

9. replace/refit a range of fluid power components, to include ten of the following:
  - pumps
  - pistons
  - spools
  - valves
  - actuators/cylinders
  - motors
  - bearings
  - reservoirs
  - accumulators
  - pressure intensifiers
  - compressors
  - receivers
  - gaskets and seals
  - pipework, hoses/tubing
  - switches
  - sensors
  - lubricators/filters
  - regulators
  - valve solenoid
  - other specific components
  
10. carry out all of the following maintenance activities, as applicable to the equipment being maintained:
  - chocking/supporting actuators/rams/component
  - draining, removing and replacing oil/fluids (as applicable)
  - releasing stored pressure
  - replacing damaged/defective components
  - removing and replacing units/components (such as pumps, valves, actuators)
  - disconnecting/removing hoses, pipes and tubing
  - proof marking/labelling of removed components
  - checking components for serviceability
  - replacing all 'lived' items (such as seals, filters, gaskets, hoses)
  - tightening fastenings to the required torque
  - setting, aligning and adjusting replaced components
  - making 'off-load' checks before re-pressurising the system
  - functional/performance testing of the maintained system
  - priming and bleeding the system (where applicable)
  
11. report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
  
12. complete relevant maintenance records accurately, to include one of the following, and pass them on to the appropriate person:
  - job cards
  - maintenance log or report
  - permit to work/formal risk assessment and/or sign on/off procedures
  - company-specific documentation
  
13. dispose of waste materials in accordance with safe working practices and approved procedures

## Unit 120

## Maintaining Fluid Power Equipment

### Outcome 2

### Know how to maintain fluid power equipment

#### Assessment Criteria

The learner will be able to:

1. describe the health and safety requirements of the area in which the maintenance activity is to take place, and the responsibility these requirements place on the learner
2. describe the isolation procedures or permit-to-work procedure that applies
3. describe the specific health and safety precautions to be taken during the maintenance activities, and their effects on others
4. describe the importance of wearing protective clothing and other appropriate safety equipment during maintenance activities
5. describe the importance of following the correct de-contamination procedure
6. describe the hazards associated with carrying out maintenance activities on fluid power equipment (such as handling fluids, stored pressure/force, misuse of tools), and how to minimise these and reduce any risks
7. describe the regulations and codes of practice that apply to working with fluid power equipment
8. explain 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
9. describe the procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance activities
10. describe the principles and theories associated with fluid power equipment (such as cascading and truth tables, logic/ladder diagrams)
11. describe the basic principles of operation of the equipment to be maintained
12. describe the company policy on repair/replacement of components during maintenance process
13. explain how to construct and apply ladder logic, sequential charts/tables or functional diagrams
14. describe dry and lubricated systems, and their application
15. describe the selection, types and characteristics of fluids for the system
16. describe the effects of pressure and flow on the performance of the system
17. describe the identification of different compressors (such as screw piston, rotary vane)
18. describe the identification of different hydraulic motors (such as piston, gear vane)
19. explain how to determine pressure settings and their effect on the system
20. describe the different types of pipework, fittings and manifolds, and their application
21. describe the identification, application, function and operation of different types of valves (such as poppet, spool, piston, disc and slide)
22. describe the identification, application, function and operation of different types of sensors and actuators (such as rotary, linear, mechanical, electrical)
23. describe the identification, application, function and operation of different types of actuators/cylinders (such as single acting, double acting and telescopic)
24. describe the identification, application, function and operation of different types of pumps (such as positive and gear vane piston)
25. describe the application and fitting of static and dynamic seals
26. describe the recognition of contaminants and the problems they can create, and the effects and likely symptoms of contamination in the system
27. describe the techniques used to dismantle/assemble fluid power equipment (release of pressures/force, proof marking, extraction)



28. describe the methods of checking that components are fit for purpose
29. explain how to make adjustments to components/assemblies to ensure that they function correctly
30. describe the identification and working purpose of individual components, and how they interact
31. explain 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 the intended purpose
32. describe the generation of maintenance documentation and/or reports following the maintenance activity
33. describe the equipment operating and control procedures to be applied during the maintenance activity
34. explain how to use lifting and handling equipment safely and correctly in the maintenance activity
35. describe the problems associated with the maintenance activity, and how they can be overcome
36. describe the procedure to be adopted for the safe disposal of waste of all types of materials
37. describe the limit of their own authority and to whom they should report if they have a problem that they cannot resolve

## Unit 121

# Carrying Out Preventative Planned Maintenance on Fluid Power Equipment

**Level:** 3  
**Credit value:** 38  
**UAN number:** J/600/5990

### Unit aim

This unit covers the skills and knowledge needed to prove the competences required to carry out preventative planned maintenance activities on fluid power equipment, on mobile or static plant, in accordance with approved procedures. The learner 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.

The learner's responsibilities will require them 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 they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner 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.

The learner will be expected to work with minimal supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying planned maintenance procedures to fluid power equipment. The learner 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 that the system is maintained to the required specification and remains compliant with all standards and regulations. In addition, the learner will be expected to report where the outcome of the maintenance activity identifies the need for further investigation or maintenance work.

The learner 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 themselves and others in the workplace. The learner will be required to demonstrate safe working practices throughout.

### Learning outcomes

There are **two** learning outcomes to this unit. The learner will be able to:

1. Carry out preventative planned maintenance on fluid power equipment
2. Know how to carry out preventative planned maintenance on fluid power equipment

### Guided learning hours

It is recommended that **74** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 21: Carrying Out Preventative Planned Maintenance on Fluid Power Equipment (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

## Unit 121

# Carrying Out Preventative Planned Maintenance on Fluid Power Equipment

## Outcome 1

Carry out preventative planned maintenance on fluid power equipment

### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the planned maintenance activities:
  - plan and communicate the maintenance activities to cause minimal disruption to normal working
  - obtain and use the correct issue of company and/or manufacturers' drawings and maintenance documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - adhere to company-specific decontamination and control procedures at all times
  - ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
  - provide and maintain 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
3. carry out planned maintenance activities on two of the following types of fluid power equipment:
  - pneumatic equipment
  - hydraulic equipment
  - vacuum equipment
4. carry out planned maintenance activities on all of the following:
  - pumps
  - valves
  - actuators/cylinders
  - connectors
  - switches and sensors
  - motors (where applicable)
  - pipework, hoses/tubing
  - fluid conditioning and storage devices
5. follow the relevant maintenance schedules to carry out the required work
6. follow planned maintenance activities using one of the following types of maintenance schedules:
  - condition based maintenance
  - predictive maintenance
  - scheduled maintenance
  - total preventative maintenance (TPM)
7. carry out the maintenance activities within the limits of their personal authority

8. carry out the maintenance activities in the specified sequence and in an agreed timescale
9. carry out ten 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 'lived' consumables (such as filters, fluids)
  - carrying out system self-analysis checks
  - 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
10. ensure that the maintained equipment/system meets all of the following:
  - all maintenance activities have been completed to the required schedule
  - equipment remains compliant with appropriate regulations and safety requirements
  - equipment operates within acceptable limits for successful continuous operation
  - any potential defects are identified and reported for future action
11. report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
12. complete relevant maintenance records accurately, to include one of the following, and pass them on to the appropriate person:
  - job cards
  - company-specific documentation
  - maintenance log and action report
  - permit to work/formal risk assessment and/or sign-on/off procedures
13. dispose of waste materials in accordance with safe working practices and approved procedures

## Unit 121

# Carrying Out Preventative Planned Maintenance on Fluid Power Equipment

## Outcome 2

Know how to carry out preventative planned maintenance on fluid power equipment

### Assessment Criteria

The learner will be able to:

1. describe 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 the learner
2. describe the isolation procedures or permit-to-work procedure that applies to the equipment being maintained
3. describe the specific health and safety precautions needed to be applied during the planned maintenance activities, and their effects on others
4. describe the importance of wearing protective clothing and other appropriate safety equipment during maintenance activities
5. describe the importance of following the correct de-contamination procedure
6. describe the hazards associated with carrying out planned maintenance activities on fluid power equipment (such as handling fluids, stored pressure/force, misuse of tools), and how to minimise these and reduce any risks
7. explain how to make sensory checks by sight, sound, smell, touch
8. explain 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
9. describe the various planned maintenance schedules that are generally used (such as condition based maintenance, scheduled maintenance, total preventative maintenance (tpm)), predictive maintenance and the importance of recording any adjustments and modifications on the fluid power documentation, and the implications if this is not carried out
10. describe the schedules and methods to be followed, in compliance with company procedures for planned maintenance on fluid power equipment
11. describe the procedure for obtaining consumables to be used during the planned maintenance activity
12. describe the appropriate testing procedures to be adopted during the maintenance activity
13. explain how to make adjustments to components/assemblies to ensure they function to specification
14. describe the functionality of various components, and their interrelationship with other components and assemblies
15. explain how to compile planned maintenance records/logs/reports, which comply with company policy and procedures
16. describe the equipment operating and control procedures, and how to apply them in order to carry out planned maintenance
17. describe the problems that can occur whilst carrying out planned maintenance activities, and how they can be avoided
18. describe the organisational procedure to be adopted for the safe disposal of waste of all types of materials
19. describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve

**Level:** 3  
**Credit value:** 46  
**UAN number:** D/600/6000

## Unit aim

This unit covers the skills and knowledge needed to prove the competences required to test fluid power equipment, on mobile or static plant, in accordance with approved procedures. The learner will be required to carry out tests on a range of fluid power equipment, which includes pneumatic, hydraulic and vacuum systems. The learner 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. The learner 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.

The learner's responsibilities will require them 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 they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work with minimal supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying test procedures to fluid power equipment. The learner 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 safely and correctly and ensuring that the equipment remains compliant with all standards and regulations. In addition, the learner 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.

The learner 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 themselves and others in the workplace. The learner will be required to demonstrate safe working practices throughout.

## Learning outcomes

There are **two** learning outcomes to this unit. The learner will be able to:

1. Test fluid power equipment and systems
2. Know how to test fluid power equipment and systems

## Guided learning hours

It is recommended that **56** hours should be allocated for this unit, although patterns of delivery are likely to vary.

## Details of the relationship between the unit and relevant national standards

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 22: Testing Fluid Power Equipment and Systems (Suite 3)

## **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**



**Assessment Criteria**

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the testing activities:
  - plan the testing activities to cause minimal disruption to normal working
  - obtain and use the correct issue of company and/or manufacturers drawings and testing documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - adhere to company-specific contamination and control procedures at all times
  - ensure the safe isolation of equipment
  - provide and maintain 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
3. carry out tests on two of the following fluid power systems:
  - pneumatic
  - hydraulic
  - vacuum
4. test two types of fluid power generation/consumption equipment from the following:
  - gear pumps/motor
  - compressor
  - vane pumps/motor
  - piston pumps/motor
5. follow the appropriate procedures for use of tools and equipment to carry out the required tests
6. 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
7. set up and carry out the tests using the correct procedures and within agreed timescales
8. test four types of fluid power valve equipment from:
  - flow
  - pressure
  - directional
  - pilot
  - memory
  - non-return
  - proportional valve
  - solenoid

9. test two of the following types of fluid power actuator equipment:
  - cylinders
  - motors (air/hydraulic)
  - semi-rotary actuators
  
10. test three of the following types of fluid power conditioning equipment:
  - coolers
  - lubricators
  - heaters
  - storage
  - dryers
  - filters
  
11. 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
  - sampling devices
  
12. carry out three of the following types of test:
  - pressure test
  - leak test
  - time
  - flow
  - electrical signal
  - pilot test
  - fluid contamination test
  - sequence
  
13. record the results of the tests in the appropriate format
14. 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
  
15. review the results and carry out further tests if necessary

## Unit 122

### Outcome 2

## Testing Fluid Power Equipment and Systems

Know how to test fluid power equipment and systems

### Assessment Criteria

The learner will be able to:

1. describe the health and safety requirements of the work area where they are carrying out the activities, and the responsibility these requirements place on the learner
2. describe 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. describe the specific safety practices and procedures that they need to observe when testing fluid power systems, including any specific legislation, regulations/codes of practice for the activities, equipment or materials
4. describe the importance of following the correct de-contamination procedure
5. describe the hazards associated with testing fluid power equipment (such as handling hydraulic fluids, stored pressures, moving cylinders or equipment), and how to minimise these and reduce any risks
6. describe the importance of wearing protective clothing and other appropriate safety equipment during the testing activities
7. describe the 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
8. describe the test specifications of the systems they are working on, their interpretation and currency/issue checks
9. describe the basic principles of how the circuit/equipment functions, operation and application of the individual units/components and their interrelations with other components and assemblies
10. describe the types of test equipment to be used, and their selection for particular tests
11. describe the importance of checking the equipment is within current calibration dates, and the procedure for getting the test instruments correctly calibrated
12. explain how the test equipment is connected into the circuit, and the methods of doing this
13. describe the techniques, methods and procedures to be used during the tests
14. explain how to display/record test results, and the documentation used
15. explain how to create and apply logic or sequential charts/tables
16. describe the authorisation systems for changes to test procedures
17. explain how to interpret the test readings obtained, and the significance of the readings gained
18. describe the importance of ensuring that test equipment is used only for its intended purpose and within its specified range and limits
19. describe the potential problems or errors that may occur and that could affect the test results
20. describe the environmental control and company operating procedures relating to the testing activities
21. describe the documentation required and the procedures to be followed on completion of the tests
22. describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve

**Level:** 3  
**Credit value:** 53  
**UAN number:** L/600/6011

**Unit aim**

This unit covers the skills and knowledge needed to prove the competences required to carry out fault diagnosis on engineered systems, in accordance with approved procedures. The learner 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. The learner 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, the learner will be expected to identify the fault and its probable cause, and to suggest appropriate action to remedy the problem.

The learner's responsibilities will require them 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 they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work with minimal supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying fault diagnosis procedures within an integrated system. The learner will understand the various fault diagnosis methods and techniques used, and their application. The learner 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. The learner 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.

The learner 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 themselves and others in the workplace. The learner will be required to demonstrate safe working practices throughout.

**Learning outcomes**

There are **two** learning outcomes to this unit. The learner will be able to:

1. Carry out fault diagnosis on engineered systems
2. Know how to carry out fault diagnosis on engineered systems

**Guided learning hours**

It is recommended that **95** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 23: Carrying Out Fault Diagnosis on Engineered Systems (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

## Unit 123

# Carrying Out Fault Diagnosis on Engineered Systems

### Outcome 1

Carry out fault diagnosis on engineered systems

#### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the fault diagnostic activities:
  - plan the fault diagnosis activities prior to beginning the work
  - obtain and use the correct issue of company and/or manufacturers' drawings and maintenance documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
  - provide and maintain 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
3. carry out fault diagnosis on two of the following types of interactive technologies, to sub-assembly or component level:
4. mechanical
  - fluid power
  - electrical
  - process controller
5. 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
6. review and use all relevant information on the symptoms and problems associated with the products or assets
7. 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
8. investigate and establish the most likely causes of the faults
9. select, use and apply diagnostic techniques, tools and aids to locate faults

10. use a range of fault diagnostic techniques, to include two of the following:
  - half-split technique
  - emergent problem sequence
  - six point technique
  - equipment self diagnostics
  - functional/performance testing
  - injection and sampling
  - input/output
  - unit substitution
  
11. 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
  
12. 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)
  
13. complete the fault diagnosis within the agreed time and inform the appropriate people when this cannot be achieved
14. determine the implications of the fault for other work and for safety considerations
15. use the evidence gained to draw valid conclusions about the nature and probable cause of the fault
16. record details on the extent and location of the faults in an appropriate format
17. 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 123

# Carrying Out Fault Diagnosis on Engineered Systems

### Outcome 2

Know how to carry out fault diagnosis on engineered systems

#### Assessment Criteria

The learner will be able to:

1. describe the health and safety requirements of the area in which they are carrying out the fault diagnosis activities, and the responsibility these requirements place on the learner
2. describe the specific safety precautions to be taken when carrying out the fault diagnosis of the particular engineered system
3. describe the isolation and lock-off procedures or permit-to-work procedure that applies
4. describe 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. describe the 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 these and reduce any risks
6. explain 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. explain where to obtain, and how to interpret drawings, circuit diagrams, specifications, manufacturers' manuals and other documents needed for the fault diagnosis activities
8. describe the basic principles of how the system functions, and the working purpose of the various integrated systems
9. describe 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. explain 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. explain how to evaluate sensory information from sight, sound, smell, touch
12. describe the procedures to be followed to investigate faults, and how to deal with intermittent conditions
13. explain how to use the various aids and reports available for fault diagnosis
14. describe the types of equipment that can be used to aid fault diagnosis (such as mechanical measuring instruments, electrical measuring instruments, test rigs, and pressure and flow devices), and how to check the equipment is calibrated or configured correctly for the intended use, and that it is free from damage and defects
15. describe the application of specific fault finding methods and techniques that are best suited to the problem
16. explain how to analyse and evaluate possible characteristics and causes of specific faults/problems
17. explain how to make use of previous reports/records of similar fault conditions
18. explain 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. explain how to prepare a report which complies with the company policy on fault diagnosis
20. describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve



**Level:** 3  
**Credit value:** 81  
**UAN number:** Y/600/5413

**Unit aim**

This unit covers the skills and knowledge needed to prove the competences required to carry out corrective maintenance on mechanical equipment within an engineered system, in accordance with approved procedures. The learner 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.

The learner 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.

The learner's responsibilities will require them 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 they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner 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. The learner will be expected to work with minimal supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying mechanical maintenance procedures within an engineered system. The learner 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. The learner 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 that the maintained equipment functions to specification and remains compliant with all standards and regulations. The learner will also know about the interaction of the other associated integrated technologies and have sufficient knowledge to carry out the dismantling and reassembly safely and effectively.

The learner 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 themselves and others in the workplace. The learner will be required to demonstrate safe working practices throughout.

### **Learning outcomes**

There are **two** learning outcomes to this unit. The learner will be able to:

1. Maintain mechanical equipment within an engineered system
2. Know how to maintain mechanical equipment within an engineered system

### **Guided learning hours**

It is recommended that **161** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 24: Maintaining Mechanical Equipment within an Engineered System (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

## Unit 124

# Maintaining Mechanical Equipment within an Engineered System

## Outcome 1

Maintain mechanical equipment within an engineered system

### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the maintenance activity as applicable to the equipment being maintained:
  - plan and communicate the maintenance activities to cause minimal disruption to normal working
  - obtain and use the correct issue of company and/or manufacturers' drawings and maintenance documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
  - provide and maintain 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
3. carry out maintenance activities on three 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. follow the relevant maintenance schedules to carry out the required work
5. ensure that the maintenance activities comply with one of the following:
  - organisational guidelines and codes of practice
  - equipment manufacturer's operation range
  - BS7671/IEE wiring regulations
  - BS, ISO and/or BSEN standards
6. carry out the maintenance activities within the limits of their personal authority
7. carry out the maintenance activities in the specified sequence and in an agreed timescale

8. 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, 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

9. 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
- setting, aligning and adjusting replaced components
- replacing all 'lived' 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
- checking components for serviceability

10. replace/refit 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)

11. report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule

12. complete relevant maintenance records accurately, to include one of the following, and pass them on to the appropriate person:
  - job cards
  - permits to work/formal risk assessment and/or sign on/off procedures
  - maintenance log or report
  - company-specific documentation
13. dispose of waste materials in accordance with safe working practices and approved procedures

## Unit 124

# Maintaining Mechanical Equipment within an Engineered System

### Outcome 2

Know how to maintain mechanical equipment within an engineered system

#### Assessment Criteria

The learner will be able to:

1. describe the health and safety requirements of the area in which the maintenance activity is to take place, and the responsibility these requirements place on the learner
2. describe the isolation and lock-off procedure or permit-to-work procedure that applies to the system
3. describe the specific health and safety precautions to be applied during the maintenance activity, and their effects on others
4. explain 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. describe the importance of wearing protective clothing and other appropriate safety equipment during the maintenance activities
6. describe the hazards associated with carrying out maintenance activities on an integrated system (such as handling fluids, stored pressure/force, electrical supplies, process controller interface, using damaged or badly maintained tools and equipment, not following laid-down maintenance procedures), and how to minimise these and reduce any risks
7. explain how to obtain and interpret drawings, charts, specifications, manufacturers' manuals, history/maintenance reports and other documents needed for the maintenance activities
8. describe the basic principles of how the system functions, its operation sequence, the working purpose of individual units/components, and how they interact
9. describe the procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance
10. describe the company policy on repair/replacement of components during the maintenance activities
11. describe the sequence to be adopted for dismantling and reassembling the equipment, to both sub-assembly and individual component level
12. describe the methods of removing components that have interference fits (expansion, contraction or pressure)
13. describe the techniques used to dismantle/assemble integrated equipment (such as release of pressures/force, proof marking to aid assembly, plugging exposed pipe/component openings, dealing with soldered joints, screwed, clamped and crimped connections)
14. describe the methods of attaching identification marks/labels to removed components or cables, to assist with re-assembly
15. describe the methods of checking that components are fit for purpose, and the need to replace 'lived' items (such as seals, gaskets and bearings)
16. explain how to make adjustments to components/assemblies, to ensure they function correctly
17. explain 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. describe the importance of making 'off-load' checks before proving the equipment with the electrical supply on
19. describe the generation of maintenance documentation and/or reports on completion of the maintenance activity
20. describe the equipment operating and control procedures to be applied during the maintenance activity

21. explain how to use lifting and handling equipment safely and correctly in the maintenance activity
22. describe the problems that can occur during the maintenance activity, and how they can be overcome
23. describe the organisational procedure to be adopted for the safe disposal of waste of all types of material
24. describe the extent of their authority and to whom they should report if they have a problem that they cannot resolve

**Level:** 3  
**Credit value:** 81  
**UAN number:** M/600/5417

**Unit aim**

This unit covers the skills and knowledge needed to prove the competences required to carry out corrective maintenance activities on electrical equipment within an engineered system, in accordance with approved procedures. The learner 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.

The learner 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.

The learner's responsibilities will require them 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 they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner 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. The learner will be expected to work with minimal supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying electrical maintenance procedures. The learner 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. The learner 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 that the repaired equipment functions to specification and remains compliant with all standards and regulations. The learner will also know about the interaction of the other associated integrated technologies and have sufficient knowledge to carry out the dismantling and reassembly safely and effectively.

The learner 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 themselves and others in the workplace. The learner will be required to demonstrate safe working practices throughout.



### **Learning outcomes**

There are **two** learning outcomes to this unit. The learner will be able to:

1. Maintain electrical equipment within an engineered system
2. Know how to maintain electrical equipment within an engineered system

### **Guided learning hours**

It is recommended that **161** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 25: Maintaining Electrical Equipment within an Engineered System (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

## Unit 125

# Maintaining Electrical Equipment within an Engineered System

### Outcome 1

Maintain electrical equipment within an engineered system

#### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the maintenance activity as applicable to the equipment being maintained:
  - plan and communicate the maintenance activities to cause minimal disruption to normal working
  - obtain and use the correct issue of company and/or manufacturers' drawings and maintenance documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - ensure the safe isolation of equipment (such as electricity, mechanical, gas, air or fluids)
  - provide and maintain 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
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. follow the relevant maintenance schedules to carry out the required work
5. ensure that maintenance activities comply with one of the following:
  - organisational guidelines and codes of practice
  - equipment manufacturer's operation range
  - BS7671/IEE wiring regulations
  - BS, ISO and/or BSEN standards
6. carry out the maintenance activities within the limits of their personal authority
7. carry out the maintenance activities in the specified sequence and in an agreed timescale

8. 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, 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, work holding/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

9. 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

10. replace/refit 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)

11. report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule

12. complete relevant maintenance records accurately, to include one of the following, and pass them on to the appropriate person:
  - job cards
  - maintenance log or report
  - permits to work/formal risk assessment and/or sign-on/off procedures
  - company-specific documentation
  
13. dispose of waste materials in accordance with safe working practices and approved procedures

## Unit 125

# Maintaining Electrical Equipment within an Engineered System

### Outcome 2

Know how to maintain electrical equipment within an engineered system

#### Assessment Criteria

The learner will be able to:

1. describe the health and safety requirements of the area in which the maintenance activity is to take place, and the responsibility these requirements place on the learner
2. describe the isolation and lock-off procedure or permit-to-work procedure that applies to the system
3. describe the specific health and safety precautions to be applied during the maintenance activity, and their effects on others
4. explain 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. describe the importance of wearing protective clothing and other appropriate safety equipment during the maintenance activities
6. describe the hazards associated with carrying out electrical maintenance activities on an integrated system (such as handling fluids, stored pressure/force, electrical supplies, process controller interface, using damaged or badly maintained tools and equipment, not following laid-down maintenance procedures), and how to minimise these and reduce any risks
7. explain how to obtain and interpret drawings, charts, specifications, manufacturers' manuals, history/maintenance reports, graphical electrical symbols, bs7671/iee wiring regulations and other documents needed for the maintenance activities
8. describe the basic principles of how the system functions, its operation sequence, the working purpose of individual units/components, and how they interact
9. describe 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. describe the different types of electric motors and motor starters
11. describe the different types of control systems and their various components
12. describe the application and use of a range of electrical components (such as plugs, switches, sockets, lighting and fittings, junction boxes, consumer units)
13. describe the various lighting systems used including tungsten, sodium, mercury vapour and fluorescent
14. describe the different types of wiring enclosures that are used (to include conduit, trunking and traywork systems)
15. describe the care, handling and application of ohmmeters, multimeters and other electrical measuring instruments
16. describe the procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance activities
17. describe the company policy on repair/replacement of components during the maintenance activities
18. describe the techniques used to dismantle/assemble integrated equipment (such as release of pressures/force, proof marking to aid re-assembly, plugging exposed pipe/component openings, dealing with soldered joints, screwed, clamped and crimped connections)
19. describe the methods of removing and replacing cables and wires in wiring enclosures, without causing damage to existing cables

20. describe the use of BS7671/IEE and other regulations when selecting wires and cables, and when carrying out tests on systems
21. describe the methods of attaching identification marks/labels to removed components or cables, to assist with re-assembly
22. describe the methods of checking that components are fit for purpose, and the need to replace 'lived' items (such as motor brushes, seals and gaskets, and overload protection devices)
23. explain how to make adjustments to components/assemblies to ensure they function correctly
24. explain 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. describe the importance of making 'off-load' checks before proving the equipment with the electrical supply on
26. describe the generation of maintenance documentation and/or reports on completion of the maintenance activity
27. describe the equipment operating and control procedures to be applied during the maintenance activity
28. explain how to use lifting and handling equipment in the maintenance activity
29. describe the problems that can occur during the electrical maintenance activity, and how they can be overcome
30. describe the organisational procedure to be adopted for the safe disposal of waste of all types of materials
31. describe the extent of their own authority and to whom they should report if they have a problem that they cannot resolve

**Level:** 3  
**Credit value:** 81  
**UAN number:** A/600/5422

**Unit aim**

This unit covers the skills and knowledge needed to prove the competences required to carry out corrective maintenance activities on fluid power equipment within an engineered system, in accordance with approved procedures. The learner 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 on mobile or static plant involving two or more of the following interactive technologies: mechanical, electrical, or process controller.

The learner 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.

The learner's responsibilities will require them 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 they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner 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. The learner will be expected to work with minimal supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying fluid power maintenance procedures. The learner 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. The learner will understand the maintenance methods and procedures used, and their application within an engineered system, in sufficient depth to enable them to carry out the maintenance activities, correct faults, and ensure that the maintained equipment functions to specification and remains compliant with all standards and regulations. The learner will also know about the interaction of the other associated integrated technologies and have sufficient knowledge to carry out the dismantling and reassembly safely and effectively.

The learner 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 themselves and others in the workplace. The learner will be required to demonstrate safe working practices throughout.

### **Learning outcomes**

There are **two** learning outcomes to this unit. The learner will be able to:

1. Maintain fluid power equipment within an engineered system
2. Know how to maintain fluid power equipment within an engineered system

### **Guided learning hours**

It is recommended that **161** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 26: Maintaining Fluid Power Equipment within an Engineered System (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

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**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**



## Unit 126

# Maintaining Fluid Power Equipment within an Engineered System

### Outcome 1

Maintain fluid power equipment within an engineered system

#### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the maintenance activity:
  - plan and communicate the maintenance activities to cause minimal disruption to normal working
  - obtain and use the correct issue of company and/or manufacturers' drawings and maintenance documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
  - provide and maintain 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
3. carry out maintenance activities on two of the following types of fluid power equipment:
  - pneumatic
  - hydraulic
  - vacuum
4. follow the relevant maintenance schedules to carry out the required work
5. ensure that maintenance activities comply with one of the following:
  - organisational guidelines and codes of practice
  - equipment manufacturer's operation range
  - BS7671/IEE wiring regulations
  - BS, ISO and/or BSEN standards
6. carry out the maintenance activities within the limits of their personal authority
7. carry out the maintenance activities in the specified sequence and in an agreed timescale
8. 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, traywork and cable ways)

programmable 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 programming devices (such as laptop, programmer, PDA)

9. carry out all of the following maintenance activities, as applicable to the equipment being maintained:

- chocking/supporting actuators/rams/component
- draining, removing and replacing oil/fluids (as applicable)
- releasing stored pressure
- replacing damaged/defective components
- disconnecting/removing hoses, pipes and tubing
- proofmarking/labelling of removed components
- checking components for serviceability
- replacing all 'lived' items (seals, filters, gaskets, hoses)
- tightening fastenings to the required torque
- 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
- priming and bleeding the system (where applicable)
- functional/performance testing of the maintained system

10. carry out maintenance activities to component level on one of the following fluid power components:

- pumps
- valves
- motors
- actuators

11. replace/refit 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



12. report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
13. complete relevant maintenance records accurately, to include one of the following, and pass them on to the appropriate person:
  - job cards
  - maintenance log or report
  - permit to work/formal risk assessment and/or sign on/off procedures
  - company-specific documentation
14. dispose of waste materials in accordance with safe working practices and approved procedures

## Unit 126

# Maintaining Fluid Power Equipment within an Engineered System

### Outcome 2

Know how to maintain fluid power equipment within an engineered system

#### Assessment Criteria

The learner will be able to:

1. describe the health and safety requirements of the area in which the maintenance activity is to take place, and the responsibility these requirements place on the learner
2. describe the isolation and lock-off procedure or permit-to-work procedure that applies to the system being worked on
3. describe the specific health and safety precautions to be taken during the maintenance activities, and their effects on others
4. describe the importance of wearing protective clothing and other appropriate safety equipment during the maintenance activities, and where to obtain it
5. describe the hazards associated with carrying out maintenance activities on an integrated system (such as handling fluids, stored pressure/force, electrical supplies, process controller interface, using damaged or badly maintained tools and equipment, not following laid-down maintenance procedures), and how to minimise these and reduce any risks
6. describe the regulations and codes of practice that apply to working with fluid power equipment
7. explain 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. describe the basic principles of operation of the equipment to be maintained
9. describe the importance of following the correct de-contamination procedures
10. describe the principles and theories associated with fluid power equipment (such as cascading and truth tables, logic/ladder diagrams)
11. explain how to construct and apply ladder logic, sequential charts/tables or functional diagrams
12. describe dry and lubricated systems and their application
13. describe the selection, types and characteristics of fluids for the system
14. describe the effects of pressure and flow on the performance of the system
15. describe the identification of different compressors (such as screw piston, rotary vane)
16. describe the identification of different hydraulic motors (such as piston, gear vane)
17. describe the effects, and likely symptoms, of contamination in the system
18. describe the different types of pipework, fittings and manifolds, and their application
19. describe the identification, application, function and operation of different types of valves (such as poppet, spool, piston, disc and slide)
20. describe the identification, application function and operation of different types of sensors and actuators (such as rotary, linear, mechanical, electrical)
21. describe the identification, application function and operation of different types of actuators/cylinders (such as single acting, double acting and telescopic)
22. describe the identification and application of different types of pumps (positive, gear vane and piston)
23. describe the application and fitting of static and dynamic seals
24. describe the company policy on repair/replacement of components, and the procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance activities
25. describe the sequence to be adopted for the dismantling and reassembling of the equipment, to both sub-assembly and individual component level

26. describe 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)
27. describe the methods of attaching identification marks/labels to removed components or cables, to assist with re-assembly
28. describe the methods of checking that components are fit for purpose, and the need to replace 'lived' items (such as seals, gaskets, filters, pistons, spools and bearings)
29. explain how to make adjustments to components/assemblies, to ensure they function correctly
30. explain 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
31. describe the importance of making 'off-load' checks before applying full pressure
32. describe the generation of maintenance documentation and/or reports on completion of the maintenance activity
33. describe the manufacturer's equipment operating and control procedures to be applied during the maintenance activity
34. explain how to use lifting and handling equipment in the maintenance activity
35. describe the problems that can occur during the maintenance activity, and how they can be overcome
36. describe the organisational procedure to be adopted for the safe disposal of waste of all types of materials
37. describe the extent of their own authority and to whom they should report if they have a problem that they cannot resolve

## Unit 127

# Maintaining Process Controller Equipment within an Engineered System

**Level:** 3  
**Credit value:** 81  
**UAN number:** Y/600/5427

### Unit aim

This unit covers the skills and knowledge needed to prove the competences required to carry out corrective maintenance to process controller equipment within an engineered system, in accordance with approved procedures. The learner 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) 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. The learner 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.

The learner's responsibilities will require them 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 they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work with minimal supervision, taking personal responsibility for their actions, and for the quality and accuracy of the work that they carry out.

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

The learner 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 themselves and others in the workplace. The learner will be required to demonstrate safe working practices throughout.

### Learning outcomes

There are **two** learning outcomes to this unit. The learner will be able to:

1. Maintain process controller equipment within an engineered system
2. Know how to maintain process controller equipment within an engineered system

### **Guided learning hours**

It is recommended that **161** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 27: Maintaining Process Controller Equipment within an Engineered System (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

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## Unit 127

# Maintaining Process Controller Equipment within an Engineered System

### Outcome 1

Maintain process controller equipment within an engineered system

#### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the maintenance activities:
  - plan and communicate the maintenance activities to cause minimal disruption to normal working
  - obtain and use the correct issue of company and/or manufacturers' drawings and maintenance documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
  - provide and maintain 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
3. carry out maintenance activities on one of the following types of process controller equipment:
  - fixed I/O
  - rack mount
  - modular
4. follow the relevant maintenance schedules to carry out the required work
5. ensure maintenance activities comply with one of the following:
  - BS7671/IEE wiring regulations
  - BS, ISO and/or BSEN standards
  - organisational guidelines and codes of practice
  - equipment manufacturer's operation range
6. carry out the maintenance activities within the limits of their personal authority
7. carry out the maintenance activities in the specified sequence and in an agreed timescale
8. 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, mechanical handling, workholding/transfer equipment)
- proofmarking components to aid reassembly
- setting, aligning and adjusting replaced units

electrical components

- isolating the power supply using correct lock-off communication procedure
- 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 cable traywork)

fluid power components

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

9. 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

10. carry out all of the following during the maintenance activities:

- take electrostatic precautions when working on or close to sensitive components and circuit boards
- proofmark or label removed wires and components
- inspect and/or test 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

11. report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule

12. complete relevant maintenance records accurately, to include one of the following, and pass them on to the appropriate person:

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

13. dispose of waste materials in accordance with safe working practices and approved procedures

## Unit 127

# Maintaining Process Controller Equipment within an Engineered System

### Outcome 2

Know how to maintain process controller equipment within an engineered system

#### Assessment Criteria

The learner will be able to:

1. describe the health and safety requirements of the area in which the maintenance activity is to take place, and the responsibility these requirements place on the learner
2. describe the isolation and lock-off procedure or permit-to-work procedure that applies to the system being worked on
3. describe the isolation procedure which is specific to the process controller system being worked on
4. describe the specific health and safety precautions that need to be applied during the maintenance activities, and their effects on others
5. explain 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. describe the importance of wearing protective clothing and other appropriate safety equipment during the maintenance activities, and where this can be obtained
7. describe the procedures and precautions to be adopted to eliminate electrostatic discharge hazards
8. describe the hazards associated with carrying out maintenance activities on a process controlled integrated system (such as handling fluids, stored pressure/force, electrical supplies, process controller interface, using damaged or badly maintained tools and equipment, not following laid-down maintenance procedures), and how to minimise these and reduce any risks
9. explain 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
10. describe the basic principles of how the system functions, its operation sequence, the working purpose of individual units/components, and how they interact
11. describe the devices and systems for storing programmes
12. describe the procedures to be applied to storage, location and method of backing up programmes
13. describe the different types of interface cards, and their application
14. describe the procedures for the application of computer-based authoring software for design and development
15. describe the numbering system and codes used for identification inputs and outputs
16. explain how to search a programme within the process controller for specific elements
17. describe the programming techniques and codes used (such as interlocking, timers, counters, sub-routines etc)
18. describe 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
19. describe the procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance process
20. describe the company policy on repair/replacement of components during the maintenance activities
21. describe the techniques used to dismantle/assemble integrated equipment (such as release of pressures/force, proofmarking to aid re-assembly, plugging exposed pipe/component openings, dealing with soldered joints, screwed, clamped and crimped connections)

22. describe the methods of attaching identification marks/labels to removed components or cables to assist with re-assembly
23. describe the methods of checking that components are fit for purpose, and the need to replace items such as batteries, boards and other failed items
24. explain 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. describe the importance of making 'off-load' checks before proving the equipment with the electrical supply on
26. describe the generation of maintenance documentation and/or reports on completion of the maintenance activity
27. describe the equipment operating and control procedures to be applied during the maintenance activity
28. explain how to use lifting and handling equipment in the maintenance activity
29. describe the problems that can occur during the maintenance of the process controller system, and how they can be overcome
30. describe the organisational procedure to be adopted for the safe disposal of waste of all types of materials
31. describe the extent of their own authority and to whom they should report if they have a problem they cannot resolve

**Level:** 3  
**Credit value:** 38  
**UAN number:** F/600/5440

**Unit aim**

This unit covers the skills and knowledge needed to prove the competences required to carry out preventative planned maintenance activities on engineered systems, in accordance with approved procedures. The learner 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. The learner 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.

The learner's responsibilities will require them 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 they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner 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. The learner will be expected to work with minimal supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying planned maintenance procedures within an engineered system. The learner will know about the integrated technologies within the system, how the system functions, and potential problems or defects that may occur. The learner 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 that the system is maintained to the required specification and remains compliant with all standards and regulations. In addition, the learner will be expected to report where the outcome of the maintenance activity identifies the need for further investigation or maintenance work.

The learner 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 themselves and others in the workplace. The learner will be required to demonstrate safe working practices throughout.

**Learning outcomes**

There are **two** learning outcomes to this unit. The learner will be able to:

1. Carry out preventative planned maintenance on engineered systems
2. Know how to carry out preventative planned maintenance on engineered systems

**Guided learning hours**

It is recommended that **74** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 28: Carrying Out Preventative Planned Maintenance on Engineered Systems (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

## Unit 128

# Carrying Out Preventative Planned Maintenance on Engineered Systems

## Outcome 1

Carry out preventative planned maintenance on engineered systems

### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the maintenance activities:
  - plan and communicate the maintenance activities to cause minimal disruption to normal working
  - obtain and use the correct issue of company and/or manufacturers' drawings and maintenance documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
  - provide and maintain 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
3. 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 control
4. follow the relevant maintenance schedules to carry out the required work
5. follow planned maintenance activities based on one of the following types of maintenance schedule:
  - condition based maintenance
  - scheduled maintenance
  - total preventative maintenance (TPM)
  - preventative planned maintenance
6. carry out the maintenance activities within the limits of their personal authority
7. carry out the maintenance activities in the specified sequence and in an agreed timescale

8. 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 'lived' 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
  
9. ensure the maintained equipment/system meets all of the following:
  - all maintenance activities have been completed to the required schedule
  - equipment operates within acceptable limits for successful continuous operation to meet output specification
  - equipment remains compliant with appropriate regulations and safety requirements
  - any potential defects are identified and reported for future action
  
10. report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
  
11. complete relevant maintenance records accurately, to include one of the following, and pass them on to the appropriate person:
  
12. dispose of waste materials in accordance with safe working practices and approved procedures



## Unit 128

# Carrying Out Preventative Planned Maintenance on Engineered Systems

### Outcome 2

Know how to carry out preventative planned maintenance on engineered systems

#### Assessment Criteria

The learner will be able to:

1. describe the health and safety requirements of the area in which the maintenance activity is to take place, and the responsibility these requirements place on the learner
2. describe the isolation and lock-off procedure or permit-to-work procedure that applies to the system being maintained
3. describe the specific health and safety precautions to be applied during the maintenance activities, and their effects on others
4. explain 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. describe the importance of wearing protective clothing and other appropriate safety equipment during the maintenance activities, and where it may be obtained
6. describe the 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 these and reduce any risks
7. explain how to obtain and interpret drawings, charts, specifications, manufacturers' manuals, history/maintenance reports and other documents needed for the maintenance activities
8. describe the various planned maintenance schedules that are generally used (such as condition based maintenance, scheduled maintenance, and total preventative maintenance (tpm))
9. describe the basic principles of how the system functions, its operation sequence, the working purpose of individual units/components, and how they interact
10. describe the equipment operating and control procedures, and how to apply them in order to carry out the planned maintenance activities
11. describe the testing methods and procedures to be used to check that the system conforms to acceptable limits
12. explain how to make sensory checks by sight, sound, smell, touch
13. describe the procedure for obtaining consumables and 'lived' items that will require replacing during the maintenance activity
14. describe the company policy on repair/replacement of components during the maintenance activities
15. describe the methods of checking that components are fit for purpose, and the need to replace 'lived' items such as filters, seals, gaskets, belts, chains and bearings
16. explain how to make adjustments to components and assemblies to ensure they function correctly
17. describe the generation of maintenance documentation and/or reports on completion of the maintenance activity
18. describe the problems that can occur during the planned maintenance activity, and how they can be overcome
19. describe the organisational procedure to be adopted for the safe disposal of waste of all types of materials
20. describe the extent of their own authority and to whom they should report if they have a problem that they cannot resolve

## Unit 129

# Reading and Extracting Information from Service Drawings and Specifications

**Level:** 3  
**Credit value:** 5  
**UAN number:** J/600/5469

### Unit aim

This unit covers the skills and knowledge needed to prove the competences required to read and extract information from drawings and specifications relating to factory/building services. In this unit, the learner will be required to make effective use of text, numerical and graphical information, by interpreting and using technical information extracted from engineering service drawings, specifications, technical data sheets and maintenance manuals, in accordance with approved procedures. The learner 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.

The learner's responsibilities will require them to comply with organisational policy and procedures for the care and control of the drawings and related specifications. The learner will be expected to use the drawings and specifications in order to obtain relevant information about the factory services. The learner will be expected to report any problems with the use and interpretation of the drawings and specifications that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work with minimal supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's 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. The learner 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.

### Learning outcomes

There are **two** learning outcomes to this unit. The learner will be able to:

1. Read and extract information from service drawings and specifications
2. Know how to read and extract information from service drawings and specifications

### Guided learning hours

It is recommended that **25** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### Details of the relationship between the unit and relevant national standards

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 29: Reading and Extracting Information from Service Drawings and Specifications (Suite 3)

### Support of the unit by a sector or other appropriate body

This unit is endorsed by Semta.

## **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

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## Unit 129

# Reading and Extracting Information from Service Drawings and Specifications

## Outcome 1

Read and extract information from service drawings and specifications

### Assessment Criteria

The learner will be able to:

1. use the approved source to obtain the required drawings and 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)
  - 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)
  - 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)
  
3. use information extracted from related documentation, to include two from the following:
  - works instructions
  - maintenance log/reports
  - fault diagnosis guides
  - test schedules
  - performance charts/readings
  - national, international and organisational standards/codes of practise
  - health and safety standards relating to activity (such as coshh)
  - environmental requirements
  - organisational standards
  
4. correctly interpret the drawings and specification
5. identify, extract and interpret the required information

6. 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 steam, water, compressed air, oil)
  - protective arrangements and equipment (such as containment, pressure relief valves, environmental controls, warning and evacuation systems and equipment)
  - performance characteristics (such as steam, water and operational cycle)
7. use the information obtained to ensure that work output meets the specification
8. deal promptly and effectively with any problems within their control and report those which cannot be solved
9. report any inaccuracies or discrepancies in drawings and specifications

## Unit 129

# Reading and Extracting Information from Service Drawings and Specifications

## Outcome 2

Know how to read and extract information from service drawings and specifications

### Assessment Criteria

The learner will be able to:

1. describe the sources of the drawings and specifications that they use in their work activities
2. explain how drawings and documents are obtained, and how to check that they are current and valid
3. explain how to use other sources of information to support the drawings (such as organisational standards, national and international standards, health and safety documentation) and relevant codes of practice
4. describe the procedures for reporting discrepancies in the drawings, and for reporting lost or damaged drawings/documents
5. describe the 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. describe the basic drawing conventions, colour coding of services, symbols and notations used, and why there needs to be different types of drawing
7. describe the types of drawing used, and how they interrelate (such as general layout drawings; piping and cable route diagrams; flow, block, schematic and system diagrams)
8. describe the imperial and metric systems of measurement; dimensions and tolerances; scales and reference points
9. describe 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. explain how damage and contaminants on drawings can lead to delays in carrying out work
11. describe the extent of their own responsibility, when to act on their own initiative to find, clarify and evaluate information, and to whom they should report if they have problems that they cannot resolve

## Unit 130

# Carrying Out Fault Diagnosis on Services and Systems

**Level:** 3  
**Credit value:** 50  
**UAN number:** R/600/5474

### Unit aim

This unit covers the skills and knowledge needed to prove the competences required to carry out fault diagnosis on services, and service equipment and systems, in accordance with approved procedures. The learner 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 including medical gas pipelines, process control, instrumentation control, refrigeration, and medical decontamination at sub-assembly and/or component level, as applicable to the equipment. The learner 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, the learner will be expected to identify the fault and its probable cause, and to suggest appropriate action to remedy the problem.

The learner's responsibilities will require them 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 they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work with minimal supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying fault diagnostic procedures to services equipment and systems. The learner will understand the various fault diagnostic methods and techniques used, and their application. The learner 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 for identifying faults or conditions that are outside the required specification.

The learner will understand the safety precautions required when carrying out the fault diagnostic activities, especially those for isolating the equipment. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

### Learning outcomes

There are **two** learning outcomes to this unit. The learner will be able to:

1. Carry out fault diagnosis on services and systems
2. Know how to carry out fault diagnosis on services and systems

### Guided learning hours

It is recommended that **60** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 30: Carrying Out Fault Diagnosis on Services and Systems (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**



## Unit 130

# Carrying Out Fault Diagnosis on Services and Systems

## Outcome 1

Carry out fault diagnosis on services and systems

### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the fault diagnostic activities:
  - plan the fault diagnosis so as to minimise disruption to normal working
  - obtain and use the correct issue of company and/or manufacturers' drawings and maintenance documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
  - provide and maintain safe access and working arrangements for the maintenance area
  - carry out the fault diagnostic activities using approved procedures
  - collect equipment fault diagnostic evidence from live and isolated systems
  - disconnect or isolate components or parts of the system, when appropriate, to confirm the 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
3. 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
  - medical gas pipelines
  - decontamination equipment (such as medical)
4. 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
5. review and use all relevant information on the symptoms and problems associated with the products or assets
6. investigate and establish the most likely causes of the faults
7. select, use and apply diagnostic techniques, tools and aids to locate faults

8. 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
  
9. use a range of fault diagnostic techniques, to include two of the following:
  - half-split technique
  - emergent problem sequence
  - six point technique
  - equipment self diagnostics
  - function/performance testing
  - injection and sampling
  - input/output technique
  - unit substitution
  
10. 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
  - performance charts/readings
  
11. 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)
  
12. complete the fault diagnosis within the agreed time and inform the appropriate people when this cannot be achieved
13. determine the implications of the fault for other work and for safety considerations
14. use the evidence gained to draw valid conclusions about the nature and probable cause of the fault
15. record details on the extent and location of the faults in an appropriate format
16. 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 130

# Carrying Out Fault Diagnosis on Services and Systems

### Outcome 2

Know how to carry out fault diagnosis on services and systems

#### Assessment Criteria

The learner will be able to:

1. describe the health and safety requirements of the area in which they are carrying out the fault diagnostic activities, and the responsibility these requirements place on the learner
2. describe the specific safety precautions to be taken when carrying out the fault diagnosis of the particular service system
3. describe the isolation and lock-off procedures or permit-to-work procedure that applies
4. describe 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. describe the 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 that do not follow laid-down procedures), and how to minimise them and reduce any risks
6. explain 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. explain where to obtain, and how to interpret, drawings, service and circuit diagrams, specifications, manufacturers' manuals and other documents needed in the fault diagnostic activities
8. describe the basic principles of how the system functions, and the working purpose of the various units within it
9. describe the various fault finding techniques that can be used, and how they are applied (such as half-split, input/output put, emergent problem sequence, six point technique, function testing, unit substitution, injection and sampling techniques and equipment self-diagnostics)
10. explain 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. explain how to evaluate sensory information (sight, sound, smell, touch)
12. describe the procedures to be followed to investigate faults, and how to deal with intermittent conditions
13. explain how to use the various aids and reports available for fault diagnosis
14. describe 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 that it is calibrated or configured correctly for the intended use, and that it is free from damage and defects
15. describe the application of specific fault finding methods and techniques best suited to the problem
16. explain how to analyse and evaluate possible characteristics and causes of specific faults/problems
17. explain how to relate previous reports/records of similar fault conditions
18. explain 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. explain how to prepare a report which complies with the company policy on fault diagnosis
20. describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve

**Level:** 3  
**Credit value:** 70  
**UAN number:** K/600/5481

**Unit aim**

This unit covers the skills and knowledge needed to prove the competences required to carry out corrective maintenance activities on water distribution systems and equipment, in accordance with approved procedures. The learner 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. The learner 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.

The learner's responsibilities will require them 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 they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner 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. The learner will be expected to work with minimal supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying maintenance procedures on water distribution equipment. The learner will understand the dismantling and reassembly methods and procedures, and their application. The learner 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 that the repaired equipment/system functions to the required specification and remains compliant with all standards and regulations. The learner will also have sufficient depth of knowledge of these components to ensure that they are fit for purpose and meet the specifications, thus providing a sound basis for carrying out reassembly.

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

**Learning outcomes**

There are **two** learning outcomes to this unit. The learner will be able to:

1. Maintain fresh water distribution systems and equipment
2. Know how to maintain fresh water distribution systems and equipment

### **Guided learning hours**

It is recommended that **119** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 31: Maintaining Fresh Water Distribution Systems and Equipment (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

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## Unit 131

# Maintaining Fresh Water Distribution Systems and Equipment

### Outcome 1

Maintain fresh water distribution systems and equipment

#### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the maintenance activity:
  - plan and communicate the maintenance activities to cause minimal disruption to normal working
  - obtain and use the correct issue of company and/or manufacturers' drawings and maintenance documentation
  - adhere to procedures or systems in place for risk assessment, coshh, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
  - provide and maintain 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
3. 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
4. follow the relevant maintenance schedules to carry out the required work
5. maintain water distribution systems, to comply with one of the following:
  - organisational guidelines and codes of practice
  - equipment manufacturer's operation range
  - BS7671/IEE wiring regulations
  - BS, ISO and/or BSEN standards
6. carry out the maintenance activities within the limits of their personal authority
7. carry out the maintenance activities in the specified sequence and in an agreed timescale
8. 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 'lived' 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

9. maintain and/or replace a range of water distribution equipment, to include twelve 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)
10. report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
11. complete relevant maintenance records accurately, to include one of the following, and pass them on to the appropriate person:
  - job cards
  - permits to work/formal risk assessment and/or sign-on/off procedures
  - maintenance log or report
  - company-specific documentation
12. dispose of waste materials in accordance with safe working practices and approved procedures

## Unit 131

# Maintaining Fresh Water Distribution Systems and Equipment

## Outcome 2

Know how to maintain fresh water distribution systems and equipment

### Assessment Criteria

The learner will be able to:

1. describe the health and safety requirements of the area in which the maintenance activity is to take place
2. describe the isolation and lock-off procedures or permit-to-work procedure that applies
3. describe 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. describe the hazards associated with carrying out maintenance activities on water distribution equipment and systems, and how to minimise these and reduce any risks
5. describe the importance of wearing protective clothing and other appropriate safety equipment during the maintenance process
6. explain how to obtain and interpret drawings, specifications, manufacturers' manuals and other documents needed in the maintenance process
7. describe the procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance
8. describe the company policy on repair/replacement of components during maintenance process
9. describe the sequence to be adopted for the dismantling/reassembly of various types of assemblies
10. describe the methods and techniques used to dismantle/assemble mechanical equipment (release of pressures/force, proofmarking, extraction, pressing, alignment)
11. describe the methods of checking components are fit for purpose, and how to identify defects and wear characteristics
12. explain how to make adjustments to components/assemblies to ensure they function correctly
13. describe the basic principles of how the equipment functions, its operation sequence, the working purpose of individual units/components and how they interact
14. describe the types and applications of the different types of pipework systems (such as copper, plastic, lead, iron)
15. describe the applications of the different types of couplings and their fittings (tees, bends, branches)
16. describe the equipment and tools used to bend, form and thread pipework
17. describe the types of contaminants in water systems, and the problems they can cause
18. describe the different methods used to treat water supplies to meet user needs
19. describe the applications of the different pipework and equipment cleaning procedures (rod, water jet, solvents)
20. describe the methods of checking removed components are fit for purpose, and the need to replace 'lifer' items (such as seals, gaskets, washers)
21. explain how to make adjustments to components to ensure they function correctly
22. explain how to check tools and equipment are free from damage or defects, and are in a safe and usable condition
23. describe the generation of maintenance documentation and/or reports following the maintenance activity



24. describe the equipment operating and control procedures to be applied during the maintenance activity
25. explain how to use lifting and handling equipment correctly and safely in the maintenance activity
26. describe the problems associated with the maintenance activity, and how they can be overcome
27. describe the organisational procedure to be adopted for the safe disposal of waste of all types of materials
28. describe the extent of their own authority and to whom they should report if they have problems they cannot resolve

**Level:** 3  
**Credit value:** 70  
**UAN number:** H/600/5494

**Unit aim**

This unit covers the skills and knowledge needed to prove the competences required to carry out corrective maintenance activities on waste/foul water distribution systems and equipment, in accordance with approved procedures. The learner will be required to maintain distribution systems such as foul, storm and waste 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. The learner 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.

The learner's responsibilities will require them 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 they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner 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. The learner will be expected to work with minimal supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying maintenance procedures on waste/foul water distribution equipment. The learner will understand the dismantling and reassembly methods and procedures, and their application. The learner 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 that the repaired equipment functions to the required specification and remains compliant with all standards and regulations. The learner will also have sufficient knowledge of these components to ensure that they are fit for purpose and meet the specifications, thus providing a sound basis for carrying out reassembly.

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

**Learning outcomes**

There are **two** learning outcomes to this unit. The learner will be able to:

1. Maintain waste/foul water distribution systems and equipment
2. Know how to maintain waste/foul water distribution systems and equipment

### **Guided learning hours**

It is recommended that **119** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 32: Maintaining Waste/Foul Water Distribution Systems and Equipment (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

## Unit 132

# Maintaining Waste/Foul Water Distribution Systems and Equipment

### Outcome 1

Maintain waste/foul water distribution systems and equipment

#### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the maintenance activity:
  - plan and communicate the maintenance activities to cause minimal disruption to normal working
  - obtain and use the correct issue of company and/or manufacturers' drawings and maintenance documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - ensure the safe isolation of equipment (such as mechanical, electricity, or fluids)
  - provide and maintain 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
3. carry out maintenance activities on two of the following types of water system:
  - waste
  - storm water
  - foul water
4. follow the relevant maintenance schedules to carry out the required work
5. maintain waste water distribution systems in compliance with one of the following:
  - organisational guidelines and codes of practice
  - equipment manufacturer's operation range
  - BS7671/IEE wiring regulations
  - BS, ISO and/or BSEN standards
6. carry out the maintenance activities within the limits of their personal authority
7. carry out the maintenance activities in the specified sequence and in an agreed timescale
8. 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 'lived' 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

9. maintain and/or replace a range of water distribution equipment/components, to include twelve of the following:
  - pumps
  - motors
  - valves
  - couplings/connectors
  - pump chambers
  - macerators
  - interceptors
  - plastic pipe
  - lead pipe
  - clay pipe
  - iron pipe
  - gauges/indicators
  - tanks
  - manifolds
  - traps
  - filters
  - sensors
  - switches
  - gaskets and seals
  - faucets
  - control devices
  - electrical wiring
  - electrical connectors
  - dosing plant
  - ancillary equipment (such as sinks, toilets, showers)
10. report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
11. complete relevant maintenance records accurately, to include one of the following, and pass them on to the appropriate person:
  - job cards
  - maintenance log or report
  - permits to work/formal risk assessment and/or sign-on/off procedures
  - company-specific documentation
12. dispose of waste materials in accordance with safe working practices and approved procedures

## Unit 132

# Maintaining Waste/Foul Water Distribution Systems and Equipment

### Outcome 2

Know how to maintain waste/foul water distribution systems and equipment

#### Assessment Criteria

The learner will be able to:

1. describe the health and safety requirements of the area in which the maintenance activity is to take place
2. describe the isolation and lock-off procedures or permit-to-work procedure that applies
3. describe 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. describe the hazards associated with carrying out maintenance on waste water distribution systems, and how to minimise them to reduce the risks
5. describe the importance of wearing protective clothing and other appropriate safety equipment during the maintenance process
6. explain how to obtain and interpret drawings, specifications, manufacturers' manuals and other documents needed in the maintenance process
7. describe the procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance activities
8. describe the company policy on repair/replacement of components during the maintenance process
9. describe the sequence to be adopted for the dismantling/re-assembly of various types of assemblies
10. describe the methods and techniques used to dismantle/assemble mechanical equipment (such as release of pressures/force, component identification, extraction, pressing, alignment)
11. describe the methods of checking that components are fit for purpose, how to identify defects and wear characteristics, and the need to replace 'lifer' items (such as seals, washers and gaskets)
12. explain how to make adjustments to components/assemblies to ensure they function correctly
13. describe the basic principles of how the equipment functions, its operation sequence, the working purpose of individual units/components and how they interact
14. describe the applications of the different types of pipework system (such as iron, clay, plastic, lead)
15. describe the applications of the different types of coupling and their fittings (such as bends, branches, reduction pieces)
16. describe the different methods used to treat water supplies to meet user needs
17. describe the applications of the different pipework and equipment cleaning procedures (such as rod, water jet, solvents)
18. explain how to check that tools and equipment are free from damage or defects, and are in a safe and usable condition
19. describe the generation of maintenance documentation and/or reports following the maintenance activity
20. describe the equipment operating and control procedures to be applied during the maintenance activity
21. explain how to use lifting and handling equipment correctly and safely in the maintenance activity
22. describe the problems associated with the maintenance activity, and how they can be overcome

23. describe the organisational procedure to be adopted for the safe disposal of waste of all types of materials
24. describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve

**Level:** 3  
**Credit value:** 70  
**UAN number:** T/600/5497

**Unit aim**

This unit covers the skills and knowledge needed to prove the competences required 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. The learner 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, de-soldering, removal of screwed, clamped and crimped connections, and aligning and adjusting components.

The learner's responsibilities will require them 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 they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner 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. The learner will be expected to work with minimal supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying maintenance procedures to workplace environmental control systems and equipment. The learner will understand the dismantling and reassembly methods and procedures used, and their application. The learner 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 that the repaired equipment functions to the required specification and remains compliant with all standards and regulations. The learner will also have sufficient knowledge of these components to ensure that they are fit for purpose and meet the specifications, thus providing a sound basis for carrying out re-assembly.

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

**Learning outcomes**

There are **two** learning outcomes to this unit. The learner will be able to:

1. Maintain workplace environmental control systems
2. Know how to maintain workplace environmental control systems



### **Guided learning hours**

It is recommended that **119** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 33: Maintaining Workplace Environmental Control Systems (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

## Unit 133

# Maintaining Workplace Environmental Control Systems

### Outcome 1

## Maintain workplace environmental control systems

### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the maintenance activity:
  - plan and communicate the maintenance activities to cause minimal disruption to normal working
  - obtain and use the correct issue of company and/or manufacturers' drawings and maintenance documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
  - provide and maintain 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
3. 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
4. follow the relevant maintenance schedules to carry out the required work
5. maintain workplace environmental control equipment/systems in compliance with one of the following:
  - organisational guidelines and codes of practice
  - equipment manufacturer's operation range
  - BS7671/IEE wiring regulations
  - BS, ISO and/or BSEN standards
6. carry out the maintenance activities within the limits of their personal authority
7. carry out the maintenance activities in the specified sequence and in an agreed timescale

8. 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 'lived' 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
9. maintain and/or replace a range of environmental control equipment components, to include twelve 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
10. report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
11. complete relevant maintenance records accurately, to include one of the following, and pass them on to the appropriate person:
  - job cards
  - permits to work/formal risk assessment and/or sign-on/off procedures
  - maintenance log or report
  - company-specific documentation
12. dispose of waste materials in accordance with safe working practices and approved procedures

## Unit 133

# Maintaining Workplace Environmental Control Systems

### Outcome 2

Know how to maintain workplace environmental control systems

#### Assessment Criteria

The learner will be able to:

1. describe the health and safety requirements of the area in which the maintenance activity is to take place
2. describe the isolation and lock-off procedures or permit-to-work procedure that applies to the equipment being maintained
3. describe the specific health and safety precautions to be applied during the maintenance procedure, and their effects on others
4. describe the 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 to minimise them to reduce any risks
5. describe the importance of wearing protective clothing and other appropriate safety equipment during the maintenance process
6. explain how to obtain and interpret drawings, specifications, manufacturers' manuals and other documents needed in the maintenance process
7. describe the procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance activities
8. describe the company policy on repair/replacement of components during maintenance process
9. describe the sequence to be adopted for the dismantling/reassembly of various types of assemblies
10. describe 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. describe the methods of checking that components are fit for purpose, how to identify defects and wear characteristics, and the need to replace 'lived' items (such as batteries, lamps, seals and gaskets)
12. explain how to make adjustments to components/assemblies to ensure they function correctly
13. describe the basic principles of how the equipment functions, its operation sequence, the working purpose of individual units/components and how they interact
14. describe the methods of removing and replacing components and units without damaging the system and infrastructure
15. explain 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. describe the generation of maintenance documentation and/or reports following the maintenance activity
17. describe the equipment operating and control procedures to be applied during the maintenance activity
18. explain how to use lifting and handling equipment correctly and safely in the maintenance activity
19. describe the problems associated with the maintenance activity, and how they can be overcome
20. describe the organisational procedure to be adopted for the safe disposal of waste of all types of materials
21. describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve.

**Level:** 3  
**Credit value:** 70  
**UAN number:** T/600/5502

**Unit aim**

This unit covers the skills and knowledge needed to prove the competences required 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.

The learner 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.

The learner's responsibilities will require them 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 they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner 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. The learner will be expected to work with minimal supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying maintenance procedures to emergency power generation systems and equipment. The learner will understand the dismantling and reassembly methods and procedures used, and their application. The learner 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 that the repaired equipment functions to the required specification and remains compliant with all standards and regulations. The learner will also have sufficient knowledge of these components to ensure that they are fit for purpose and meet the specifications, thus providing a sound basis for carrying out reassembly.

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

### **Learning outcomes**

There are **two** learning outcomes to this unit. The learner will be able to:

1. Maintain emergency power generation equipment
2. Know how to maintain emergency power generation equipment

### **Guided learning hours**

It is recommended that **119** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 34: Maintaining Emergency Power Generation Equipment (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

## Unit 134

# Maintaining Emergency Power Generation Equipment

### Outcome 1

Maintain emergency power generation equipment

#### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the maintenance activity:
  - plan and communicate the maintenance activities to cause minimum disruption to normal working
  - obtain and use the correct issue of company and/or manufacturers' drawings and maintenance documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - ensure the safe isolation of equipment (such as mechanical, electricity, gas, air, fuel oil, fluids)
  - provide and maintain 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
3. 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
4. follow the relevant maintenance schedules to carry out the required work
5. maintain emergency power generation equipment /systems in compliance with one of the following:
  - organisational guidelines and codes of practice
  - equipment manufacturer's guidelines
  - BS7671/IEE wiring regulations
  - BS, ISO and/or BSEN standards
6. carry out the maintenance activities within the limits of their personal authority
7. carry out the maintenance activities in the specified sequence and in an agreed timescale

8. 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 'lived' items (such as batteries, lamps)
  - functionally testing the completed system
  
9. maintain and/or replace a range of emergency power generation equipment components, to include twelve 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
  - 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
  - temperature control components (thermostat, thermocouples, thermistors)
  - electronic components (circuit boards, timers, transducers)
  
10. report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
  
11. complete relevant maintenance records accurately, to include one of the following and pass them on to the appropriate person:
  - job cards
  - permits to work/formal risk assessment and/or sign-on/off procedures
  - electronic recording
  - maintenance log or report
  - company-specific documentation
  
12. dispose of waste materials in accordance with safe working practices and approved procedures



## Unit 134

# Maintaining Emergency Power Generation Equipment

## Outcome 2

Know how to maintain emergency power generation equipment

### Assessment Criteria

The learner will be able to:

1. describe the health and safety requirements of the area in which the maintenance activity is to take place
2. describe the isolation and lock-off procedures or permit-to-work procedure that applies to the equipment being maintained
3. describe the specific health and safety precautions to be applied during the maintenance procedure, and their effects on others
4. describe the 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 to minimise them to reduce any risks
5. describe the importance of wearing the correct personal and environmental protection equipment and other appropriate safety equipment during the maintenance process
6. explain how to obtain and interpret drawings, specifications, manufacturers' manuals and other documents needed in the maintenance process
7. describe the procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance activities
8. describe the company policy on repair/replacement of components during the maintenance process
9. describe 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. describe the generator and prime mover tripping and protection devices
11. describe the generator and bus terminal connections
12. explain why electrical earthing and bonding is critical and why it must be both mechanically and electrically secure
13. describe the sequence to be adopted for the dismantling/reassembly of various types of assemblies
14. describe 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. describe the methods of checking components are fit for purpose, how to identify defects and wear characteristics, and the need to replace 'lifer' items (such as batteries, lamps, seals and gaskets)
16. explain how to make adjustments to components/assemblies to ensure they function correctly
17. describe the methods of removing and replacing components and units without damaging the system and infrastructure
18. describe the use of electrical measuring equipment (such as multimeters and resistance testers)
19. describe the methods of testing equipment and systems for leaks, and the tools and equipment that can be used

20. describe the types and application of coolants and antifreeze agents; quantities used; and methods of flushing and filling the system
21. explain 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. describe the generation of maintenance documentation and/or reports following the maintenance activity
23. describe the equipment operating and control procedures to be applied during the maintenance activity
24. explain how to use lifting and handling equipment correctly and safely in the maintenance activity
25. describe the problems associated with the maintenance activity, and how they can be overcome
26. describe the organisational procedure to be adopted for the safe disposal of waste of all types of materials
27. describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve

**Level:** 3  
**Credit value:** 70  
**UAN number:** L/600/5506

### Unit aim

This unit covers the skills and knowledge needed to prove the competences required to carry out corrective maintenance activities on heating and ventilation systems, in accordance with approved procedures. The learner 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. The learner 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.

The learner's responsibilities will require them 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 they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner 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. The learner will be expected to work with minimal supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying maintenance procedures on heating and ventilation equipment. The learner will understand the dismantling and reassembly methods and procedures, and their application. The learner 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 that the repaired equipment functions to the required specification and remains compliant with all standards and regulations. The learner will also have sufficient knowledge of these components to ensure that they are fit for purpose and meet the specifications, thus providing a sound basis for carrying out reassembly.

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

### Learning outcomes

There are **two** learning outcomes to this unit. The learner will be able to:

1. Maintain heating and ventilation systems
2. Know how to maintain heating and ventilation systems

### **Guided learning hours**

It is recommended that **119** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 35: Maintaining Heating and Ventilation Systems (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

**Assessment Criteria**

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the maintenance activity:
  - plan and communicate the maintenance activities to cause minimal disruption to normal working
  - obtain and use the correct issue of company and/or manufacturers' drawings and maintenance documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - ensure the safe isolation of equipment (such as mechanical, electricity, gas, or fluids)
  - provide and maintain 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
3. carry out maintenance activities on one of the following types of primary energy heat source systems:
  - liquid
  - gaseous
  - solid fuel
  - renewable energy
  - electrical
4. follow the relevant maintenance schedules to carry out the required work
5. maintain heating and ventilation systems in compliance with one of the following:
  - organisational guidelines and codes of practice
  - equipment manufacturer's operation range
  - BS7671/IEE wiring regulations
  - BS, ISO and/or BSEN standards
6. carry out the maintenance activities within the limits of their personal authority
7. carry out the maintenance activities in the specified sequence and in an agreed timescale
8. 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 'lifer' 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

9. maintain and/or replace a range of heating/ventilation components, to include twelve 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)
10. report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
11. complete relevant maintenance records accurately, to include one of the following, and pass them on to the appropriate person:
  - job cards
  - maintenance log or report
  - permits to work/formal risk assessment and/or sign-on/off procedures
  - company-specific documentation
12. dispose of waste materials in accordance with safe working practices and approved procedures

## Unit 135

### Outcome 2

## Maintaining Heating and Ventilation Systems

Know how to maintain heating and ventilation systems

### Assessment Criteria

The learner will be able to:

1. describe the health and safety requirements of the area in which the maintenance activity is to take place
2. describe the isolation and lock-off procedures or permit-to-work procedure that applies
3. describe the specific health and safety precautions to be applied during the maintenance procedure, and their effects on others
4. describe the hazards associated with carrying out maintenance activities on heating and ventilation equipment (such as 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 to reduce any risks
5. describe the importance of wearing protective clothing and other appropriate safety equipment during the maintenance process
6. explain how to obtain and interpret drawings, specifications, manufacturers' manuals and other documents needed in the maintenance process
7. describe the procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance activities
8. describe the company policy on repair/replacement of components during the maintenance process
9. describe the sequence to be adopted for the dismantling/reassembly of various types of assemblies
10. describe the methods and techniques used to dismantle/assemble heating and ventilation equipment (such as release of pressures/force, proofmarking, extraction, pressing, alignment)
11. describe the methods of checking that components are fit for purpose, how to identify defects and wear characteristics, and the need to replace 'lived' items (such as seals and gaskets)
12. explain how to make adjustments to components/assemblies to ensure they function correctly
13. describe the basic principles of how the equipment functions, its operation sequence, the working purpose of individual units/components and how they interact
14. describe the correct operating ranges, including temperature and pressure of secondary heating sources (air and water)
15. describe 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. describe the typical building design temperatures, such as for offices, factories (light and heavy work) warehouses and canteens
17. explain how to make adjustments to components to ensure they function correctly
18. explain 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. describe the generation of maintenance documentation and/or reports following the maintenance activity
20. describe the equipment operating and control procedures to be applied during the maintenance activity
21. explain how to use lifting and handling equipment correctly and safely in the maintenance activity

22. describe the problems associated with the maintenance activity, and how they can be overcome
23. describe the organisational procedure to be adopted for the safe disposal of waste of all types of material
24. describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve



**Level:** 3  
**Credit value:** 70  
**UAN number:** H/600/5513

**Unit aim**

This unit covers the skills and knowledge needed to prove the competences required to carry out corrective maintenance activities on air conditioning and ventilation systems, in accordance with approved procedures. The learner 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. The learner 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.

The learner's responsibilities will require them 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 they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner 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. The learner will be expected to work with minimal supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying maintenance procedures on air conditioning and ventilation equipment. The learner will understand the dismantling and reassembly methods and procedures, and their application. The learner 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 that the repaired equipment functions to the required specification and remains compliant with all standards and regulations. The learner will also have sufficient knowledge of these components to ensure that they are fit for purpose and meet the specifications, thus providing a sound basis for carrying out reassembly.

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

**Learning outcomes**

There are **two** learning outcomes to this unit. The learner will be able to:

1. Maintain air conditioning and ventilation systems
2. Know how to maintain air conditioning and ventilation systems

### **Guided learning hours**

It is recommended that **119** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 36: Maintaining Air Conditioning and Ventilation Systems (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

## Unit 136

# Maintaining Air Conditioning and Ventilation Systems

## Outcome 1

### Maintain air conditioning and ventilation systems

#### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following activities during the maintenance activity:
  - plan and communicate the maintenance activities to cause minimal disruption to normal working
  - obtain and use the correct issue of company and/or manufacturers' drawings and maintenance documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - ensure the safe isolation of equipment (such as mechanical, electricity, heating, chilling and air sources)
  - provide and maintain 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
3. carry out maintenance activities on all of the following types of equipment:
  - remote air conditioning generation
  - local air conditioning distribution
  - air conditioning control
4. follow the relevant maintenance schedules to carry out the required work
5. maintain air conditioning and ventilation systems in compliance with one of the following:
  - organisational guidelines and codes of practice
  - equipment manufacturer's operation range
  - BS7671/IEE wiring regulations
  - BS, ISO and/or BSEN standards
6. carry out the maintenance activities within the limits of their personal authority
7. carry out the maintenance activities in the specified sequence and in an agreed timescale
8. 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 'lived' 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

9. maintain and/or replace a range of air conditioning components to include twelve of the following:
  - motors
  - chiller batteries
  - pumps
  - humidifiers
  - chilled beams
  - condensers
  - evaporators
  - fans (supply and extraction)
  - ducting/trunking
  - dampers
  - vents/diffusers
  - valves
  - filters
  - pipework
  - couplings
  - manifolds/flanges
  - silencers/attenuators
  - gaskets and sealants
  - gauges/indicators
  - sensors
  - switches
  - local air conditioning system
  - battery heaters (generation/local controlled)
  - thermostats
  - insulation
  - electrical connectors
  - electrical components
  - wiring safety devices
10. report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
11. complete relevant maintenance records accurately, to include one of the following, and pass them on to the appropriate person:
  - job cards
  - maintenance log or report
  - permits to work/formal risk assessment and/or sign-on/off procedures
  - company-specific documentation
12. dispose of waste materials in accordance with safe working practices and approved procedures

## Unit 136

# Maintaining Air Conditioning and Ventilation Systems

### Outcome 2

Know how to maintain air conditioning and ventilation systems

#### Assessment Criteria

The learner will be able to:

1. describe the health and safety requirements of the area in which the maintenance activity is to take place
2. describe the isolation and lock-off procedures or permit-to-work procedure that applies
3. describe 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. describe the hazards associated with carrying out maintenance activities on air conditioning equipment (such as handling oils, greases, stored pressure/force, misuse of tools, using damaged or badly maintained tools and equipment, not following laid-down maintenance procedures), and how to minimise them to reduce any risks
5. describe the importance of wearing protective clothing and other appropriate safety equipment during the maintenance process
6. explain how to obtain and interpret drawings, specifications, manufacturers' manuals and other documents needed in the maintenance process
7. describe the procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance
8. describe the company policy on the repair/replacement of components during the maintenance process
9. describe the sequence to be adopted for the dismantling/reassembly of various types of assemblies
10. describe the methods and techniques used to dismantle/assemble air conditioning equipment (such as release of pressures/force, proofmarking, extraction, pressing, alignment)
11. describe the methods of checking components are fit for purpose, how to identify defects and wear characteristics, and the need to replace 'lived' items (such as seals and gaskets)
12. explain how to make adjustments to components/assemblies to ensure that they function correctly
13. describe the basic principles of how the equipment functions, its operation sequence, the working purpose of individual units/components and how they interact
14. describe the correct operating ranges, including temperature and pressure of secondary heating sources (air and water)
15. describe the 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. describe the typical building design temperatures, such as for offices, factories (light and heavy work) warehouses and canteens
17. describe the uses of measuring equipment, such as micrometers, Verniers and other measuring devices
18. explain how to make adjustments to components to ensure they function correctly
19. explain 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. describe the generation of maintenance documentation and/or reports following the maintenance activity

21. describe the equipment operating and control procedures to be applied during the maintenance activity
22. explain how to use lifting and handling equipment correctly and safely in the maintenance activity
23. describe the problems associated with the maintenance activity, and how they can be overcome
24. describe the organisational procedure to be adopted for the safe disposal of waste of all types of material
25. describe the extent of their own authority and to whom they should report if they have problems that they cannot

**Level:** 3  
**Credit value:** 70  
**UAN number:** J/600/5519

**Unit aim**

This unit covers the skills and knowledge needed to prove the competences required to carry out corrective maintenance activities on gas distribution systems and equipment, in accordance with approved procedures. The learner 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. The learner 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.

The learner's responsibilities will require them 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 they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner 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. The learner will be expected to work with minimal supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying gas distribution maintenance procedures. The learner will understand the dismantling and reassembly methods and procedures used, and their application. The learner 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 that the repaired equipment functions to the required specification and remains compliant with all standards and regulations. The learner will also have sufficient knowledge of these components to ensure that they are fit for purpose and meet the specifications, thus providing a sound basis for carrying out reassembly.

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

**Learning outcomes**

There are **two** learning outcomes to this unit. The learner will be able to:

1. Maintain gas distribution systems and equipment
2. Know how to maintain gas distribution systems and equipment

### **Guided learning hours**

It is recommended that **119** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 37: Maintaining Gas Distribution Systems and Equipment (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**



## Unit 137

# Maintaining Gas Distribution Systems and Equipment

### Outcome 1

Maintain gas distribution systems and equipment

#### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following activities during the maintenance activity:
  - plan and communicate maintenance activities to cause minimal disruption to normal working
  - obtain and use the correct issue of company and/or manufacturers' drawings and maintenance documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - ensure the safe isolation of equipment (such as mechanical, electricity, gas)
  - provide and maintain 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
3. carry out maintenance activities on two of the following types of gas distribution systems:
  - mains
  - cylinders
  - tanks
  - other
4. follow the relevant maintenance schedules to carry out the required work
5. maintain gas distribution systems in compliance with one of the following:
  - organisational guidelines and codes of practice
  - equipment manufacturer's operation range
  - BS7671/IEE wiring regulations
  - BS, ISO and/or BSEN standards
6. carry out the maintenance activities within the limits of their personal authority
7. carry out the maintenance activities in the specified sequence and in an agreed timescale
8. 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 'lived' 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

9. maintain and/or replace a range of gas distribution components, to include twelve 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
10. report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
11. complete relevant maintenance records accurately, to include one of the following, and pass them on to the appropriate person:
  - job cards
  - maintenance log or report
  - permits to work/formal risk assessment and/or sign-on/off procedures
  - company-specific documentation
12. dispose of waste materials in accordance with safe working practices and approved procedures

## Unit 137

# Maintaining Gas Distribution Systems and Equipment

### Outcome 2

Know how to maintain gas distribution systems and equipment

#### Assessment Criteria

The learner will be able to:

1. describe the health and safety requirements of the area in which the maintenance activity is to take place
2. describe the isolation and lock-off procedures or permit-to-work procedure that applies to the gas system being maintained
3. describe the specific health and safety precautions to be applied during the maintenance procedure, and their effects on others
4. describe the 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 to minimise them and reduce any risks
5. describe the importance of wearing protective clothing and other appropriate safety equipment during the maintenance process
6. explain how to obtain and interpret drawings, specifications, manufacturers' manuals and other documents needed in the maintenance process
7. describe the procedure for updating drawings and other documentation on gas distribution systems
8. describe the procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance activities
9. describe the importance of following the correct procedures for purging and de-commissioning components
10. describe the company policy on the repair/replacement of components during the maintenance process
11. describe the sequence to be adopted for the dismantling/reassembly of various types of gas assemblies
12. describe the methods of checking components are fit for purpose, how to identify defects and wear characteristics, and the need to replace 'lived' items (such as seals and gaskets)
13. explain how to make adjustments to components/assemblies to ensure they function correctly
14. describe the basic principles of how the equipment functions, its operation sequence, the working purpose of individual units/components and how they interact
15. describe the methods used to label and identify different pipework systems (including colour coding and warning signs)
16. describe the different types and applications of measuring and monitoring equipment used
17. explain 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. describe the generation of maintenance documentation and/or reports following the maintenance activity
19. describe the equipment operating and control procedures to be applied during the maintenance activity

20. explain how to use lifting and handling equipment correctly and safely in the maintenance activity
21. describe the problems associated with the maintenance activity, and how they can be overcome
22. describe the organisational procedure to be adopted for the safe disposal of waste of all types of material
23. describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve

**Level:** 3  
**Credit value:** 70  
**UAN number:** Y/600/5525

**Unit aim**

This unit covers the skills and knowledge needed to prove the competences required to carry out corrective maintenance activities on compressed air systems and equipment, in accordance with approved procedures. The learner 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. The learner 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.

The learner's responsibilities will require them 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 they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner 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. The learner will be expected to work with minimal supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying maintenance procedures on compressed air equipment. The learner will understand the dismantling and reassembly methods and procedures used, and their application. The learner 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 that the repaired equipment functions to the required specification and remains compliant with all standards and regulations. The learner will also have sufficient knowledge of these components to ensure that they are fit for purpose and meet the specifications, thus providing a sound basis for carrying out reassembly.

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

**Learning outcomes**

There are **two** learning outcomes to this unit. The learner will be able to:

1. Maintain compressed air systems and equipment
2. Know how to maintain compressed air systems and equipment

### **Guided learning hours**

It is recommended that **119** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 38: Maintaining Compressed Air Systems and Equipment (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

## Unit 138

# Maintaining Compressed Air Systems and Equipment

## Outcome 1

### Maintain compressed air systems and equipment

#### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the maintenance activity:
  - plan and communicate the maintenance activities to cause minimal disruption to normal working
  - obtain and use the correct issue of company and/or manufacturers' drawings and maintenance documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - ensure the safe isolation of equipment (such as mechanical, electricity, air or fluids)
  - provide and maintain 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
3. carry out maintenance activities on all of the following types of equipment:
  - compressed air generation
  - compressed air distribution
  - compressed air control
4. follow the relevant maintenance schedules to carry out the required work
5. maintain compressed air systems equipment which complies with one of the following:
  - organisational guidelines and codes of practice
  - equipment manufacturer's operation range
  - BS7671-IEE wiring regulations
  - BS, ISO and/or BSEN standards
6. carry out the maintenance activities within the limits of their personal authority
7. carry out the maintenance activities in the specified sequence and in an agreed timescale
8. 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 'lived' 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

9. maintain and/or replace a range of compressed air equipment and components, to include twelve 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
10. report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
11. complete relevant maintenance records accurately, to include one of the following, and pass them on to the appropriate person:
  - job cards
  - maintenance log or report
  - permits to work/formal risk assessment and/or sign-on/off procedures
  - company-specific documentation
12. dispose of waste materials in accordance with safe working practices and approved procedures



## Unit 138

# Maintaining Compressed Air Systems and Equipment

### Outcome 2

Know how to maintain compressed air systems and equipment

#### Assessment Criteria

The learner will be able to:

1. describe the health and safety requirements of the area in which the maintenance activity is to take place
2. describe the isolation and lock-off procedures or permit-to-work procedure that applies to the compressed air equipment/system being worked on
3. describe the specific health and safety precautions to be applied during the maintenance procedure, and their effects on others
4. describe the hazards associated with carrying out maintenance activities on compressed air equipment (such as handling oils, greases, stored pressure/force, misuse of tools, using damaged or badly maintained tools and equipment, not following laid-down maintenance procedures), and how to minimise them to reduce any risks
5. describe the importance of wearing protective clothing and other appropriate safety equipment during the maintenance process
6. explain how to obtain and interpret drawings, specifications, manufacturers' manuals and other documents needed in the maintenance process
7. describe the procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance activities
8. describe the company policy on the repair/replacement of components during the maintenance process
9. describe the sequence to be adopted for the dismantling/reassembly of various types of assemblies used on compressed air equipment
10. describe the methods and techniques used to dismantle/assemble compressed air equipment (such as release of pressures/force, proof marking, extraction, pressing, alignment)
11. describe the methods of checking components are fit for purpose, how to identify defects and wear characteristics, and the need to replace 'lifer' items (such as seals and gaskets)
12. explain how to make adjustments to components/assemblies to ensure they function correctly
13. describe the basic principles of how the equipment functions, its operation sequence, the working purpose of individual units/components and how they interact
14. describe the use of measuring equipment (such as micrometers, verniers, and other measuring devices)
15. explain 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. describe the generation of maintenance documentation and/or reports following the maintenance activity
17. describe the equipment operating and control procedures to be applied during the maintenance activity
18. explain how to use lifting and handling equipment correctly and safely in the maintenance activity
19. describe the problems associated with the maintenance activity, and how they can be overcome
20. describe the organisational procedure to be adopted for the safe disposal of waste of all types of material
21. describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve

**Level:** 3  
**Credit value:** 70  
**UAN number:** H/600/5530

**Unit aim**

This unit covers the skills and knowledge needed to prove the competences required to carry out corrective maintenance activities to process controller equipment, in accordance with approved procedures. The learner 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. The learner 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.

The learner's responsibilities will require them 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 they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work with minimal supervision, taking personal responsibility for their actions, and for the quality and accuracy of the work that they carry out.

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

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

**Learning outcomes**

There are **two** learning outcomes to this unit. The learner will be able to:

1. Maintain process control systems
2. Know how to maintain process control systems

### **Guided learning hours**

It is recommended that **119** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 39: Maintaining Process Control Systems (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

**Assessment Criteria**

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the maintenance activities:
  - plan and communicate the maintenance activities to cause minimal disruption to normal working
  - obtain and use the correct issue of company and/or manufacturers' drawings and maintenance documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
  - provide and maintain 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
3. carry out maintenance activities on one of the following types of process control equipment:
  - fixed I/O
  - modular
  - rack mount
4. follow the relevant maintenance schedules to carry out the required work
5. maintain process control equipment in compliance with one of the following:
  - BS7671-IEE wiring regulations
  - BS, ISO and/or BSEN standards
  - organisational guidelines and codes of practice
  - equipment manufacturer's operation range
6. carry out the maintenance activities within the limits of their personal authority
7. carry out the maintenance activities in the specified sequence and in an agreed timescale
8. carry out seven of the following program maintenance activities on the process control 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

9. 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
10. report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
11. complete relevant maintenance records accurately, to include one of the following, and pass them on to the appropriate person:
  - job cards
  - maintenance log or report
  - permits to work/formal risk assessment and/or sign-on/off procedures
  - company-specific documentation
12. dispose of waste materials in accordance with safe working practices and approved procedures

**Assessment Criteria**

The learner will be able to:

1. describe the health and safety requirements of the area in which the maintenance activity is to take place, and the responsibility they place on the learner
2. describe the isolation and lock-off procedure or permit-to-work procedure that applies to the process control system being worked on
3. describe the specific health and safety precautions to be applied during the maintenance activity, and their effects on others
4. explain 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. describe the importance of wearing protective clothing and other appropriate safety equipment during the maintenance activities, and where this can be obtained
6. describe the procedures and precautions to be adopted to eliminate electrostatic discharge (esd)
7. describe the hazards associated with carrying out maintenance activities on process 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 to minimise them to reduce any risks
8. explain 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. describe the basic principles of how the system functions, its operation sequence, the working purpose of individual units/components and how they interact
10. describe the devices and systems for storing programs
11. describe the procedures to be applied to the storage, location and method of backing up programs
12. describe the different types of interface cards and their application
13. describe the procedures and application of 'design and development' computer-based authoring software
14. describe the numbering system and codes used for identification of inputs and outputs
15. explain how to search the user program within the process controller for specific elements
16. describe the programming techniques and codes used (such as interlocking, timers, counters, subroutines)
17. describe 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. describe the procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance process
19. describe the company policy on the repair/replacement of components during the maintenance process
20. describe the techniques used to dismantle/assemble integrated equipment (such as release of pressures/force, proofmarking to aid assembly, plugging exposed pipe/component openings, dealing with soldered joints, screwed, clamped and crimped connections)
21. describe the methods of attaching identification marks/labels to removed components or cables, to assist with reassembly

22. describe the methods of checking that components are fit for purpose, and the need to replace batteries, boards and other failed items
23. explain 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. describe the importance of making 'off-load' checks before proving the equipment with the electrical supply on
25. describe the generation of maintenance documentation and/or reports following the maintenance activity
26. describe the equipment operating and control procedures to be applied during the maintenance activity
27. explain how to use lifting and handling equipment correctly and safely in the maintenance activity
28. describe the problems that can occur during the maintenance of the process control system, and how they can be overcome
29. describe the organisational procedure to be adopted for the safe disposal of waste of all types of material
30. describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve

**Level:** 3  
**Credit value:** 70  
**UAN number:** J/600/5536

**Unit aim**

This unit covers the skills and knowledge needed to prove the competences required to carry out corrective maintenance activities to instrumentation and control equipment, in accordance with approved procedures. The learner 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.

The learner's responsibilities will require them 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 they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work with minimal supervision, taking personal responsibility for their actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying maintenance procedures on instrumentation and control equipment and systems. The learner 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 that the equipment operates to the required specification and remains compliant with all standards and regulations. The learner 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.

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

**Learning outcomes**

There are **two** learning outcomes to this unit. The learner will be able to:

1. Maintain instrumentation and control systems
2. Know how to maintain instrumentation and control systems

**Guided learning hours**

It is recommended that **119** hours should be allocated for this unit, although patterns of delivery are likely to vary.



### **Details of the relationship between the unit and relevant national standards**

This This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 40: Maintaining Instrumentation and Control Systems (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

## Unit 140

# Maintaining Instrumentation and Control Systems

### Outcome 1

## Maintain instrumentation and control systems

### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the maintenance activities:
  - plan and communicate the maintenance activities to cause minimal disruption to the process/system operation
  - obtain and use the correct issue of company and/or manufacturers' drawings and maintenance documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - 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 and maintain 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
3. 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
  - nucleonics and radiation
  - analysers
  - recorders and indicators
  - telemetry systems
4. follow the relevant maintenance schedules to carry out the required work
5. maintain instrumentation and control equipment in compliance with one of the following:
  - BS7671/IEE wiring regulations
  - BS, ISO and/or BSEN standards
  - organisational guidelines and codes of practice
  - equipment manufacturer's operation range

6. carry out the maintenance activities within the limits of their personal authority
7. carry out the maintenance activities in the specified sequence and in an agreed time scale
8. 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 'lifer' 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
9. 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
10. 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
11. report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
12. complete relevant maintenance records accurately, to include one of the following, and pass them on to the appropriate person:
  - job cards
  - maintenance log or report
  - permits to work/formal risk assessment and/or sign-on/off procedures
  - company-specific documentation
13. dispose of waste materials in accordance with safe working practices and approved procedures

## Unit 140

# Maintaining Instrumentation and Control Systems

### Outcome 2

Know how to maintain instrumentation and control systems

#### Assessment Criteria

The learner will be able to:

1. describe the health and safety requirements of the area in which the maintenance activity is to take place, and the responsibility they place on the learner
2. describe 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. describe the specific health and safety precautions that need to be applied during the maintenance process, and their effects on others
4. explain 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. describe the importance of wearing protective clothing and other appropriate safety equipment during the maintenance activities, and where this can be obtained
6. describe the procedures and precautions to be adopted to eliminate electrostatic discharge
7. describe the 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 to minimise them to reduce any risks
8. explain 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. describe 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. describe 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. describe the identification and selection of instrument sensors (including how to identify their markings, calibration information, component values, operating parameters and working range)
12. describe the methods of checking and calibrating instruments, and the type and range of equipment that can be used
13. describe 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. describe the correct and tidy installation and connection of external wiring and components, to avoid electronic interference or mechanical damage
15. explain how to carry out visual checks of the instruments (checking for leaks, security of joints and physical damage)
16. describe the procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance process
17. describe the company policy on the repair/replacement of components during the maintenance process

18. describe 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. describe the methods of attaching identification marks/labels to removed components or cables, to assist with reassembly
20. describe the methods of checking that components are fit for purpose, and the need to replace batteries, boards and other failed items
21. explain 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. describe the generation of maintenance documentation and/or reports following the maintenance activity
23. describe the equipment operating and control procedures to be applied during the maintenance activity
24. describe the problems that can occur during the maintenance of the instrumentation and control system, and how they can be overcome
25. describe the organisational procedure to be adopted for the safe disposal of waste of all types of material
26. describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve

**Level:** 3  
**Credit value:** 70  
**UAN number:** L/600/5540

**Unit aim**

This unit covers the skills and knowledge needed to prove the competences required 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.

The learner 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, de-soldering removal of screwed, clamped and crimped connections, and aligning and adjusting components. The learner 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.

The learner's responsibilities will require them 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 they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner 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. The learner will be expected to work with minimal supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying maintenance procedures on refrigeration systems and equipment. The learner will understand the dismantling and reassembly methods and procedures used, and their application. The learner 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 that the repaired equipment functions to the required specification and remains compliant with all standards and regulations. The learner will also have sufficient knowledge of these components to ensure that they are fit for purpose and meet the specifications, thus providing a sound basis for carrying out reassembly.

The learner will understand the safety precautions required when carrying out the maintenance activities, especially those for isolating, charging and purging the equipment. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

### **Learning outcomes**

There are **two** learning outcomes to this unit. The learner will be able to:

1. Maintain industrial refrigeration equipment
2. Know how to maintain industrial refrigeration equipment

### **Guided learning hours**

It is recommended that **119** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 41: Maintaining Industrial Refrigeration Equipment (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

## Unit 141

# Maintaining Industrial Refrigeration Equipment

### Outcome 1

Maintain industrial refrigeration equipment

#### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the maintenance activity:
  - plan and communicate the maintenance activities to cause minimal disruption to normal working
  - obtain and use the correct issue of company and/or manufacturers' drawings and maintenance documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - ensure the safe isolation of equipment (such as mechanical, electricity, refrigerants)
  - provide and maintain 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
3. 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
4. follow the relevant maintenance schedules to carry out the required work
5. maintain refrigeration equipment/systems in compliance with one of the following:
  - organisational guidelines and codes of practice
  - equipment manufacturer's operation range
  - BS7671/IEE wiring regulations
  - BS, ISO and/or BSEN standards
6. carry out the maintenance activities within the limits of their personal authority
7. carry out the maintenance activities in the specified sequence and in an agreed timescale
8. 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 'lifer' 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



9. maintain and/or replace a range of refrigeration equipment components, to include ten 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
10. 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
11. setting thermostats and controls
12. 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
13. report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
14. complete relevant maintenance records accurately, to include one of the following, and pass them on to the appropriate person:
  - job cards
  - permits to work/formal risk assessment and/or sign-on/off procedures
  - maintenance log or report
  - company-specific documentation
15. dispose of waste materials in accordance with safe working practices and approved procedures

## Unit 141

# Maintaining Industrial Refrigeration Equipment

### Outcome 2

Know how to maintain industrial refrigeration equipment

#### Assessment Criteria

The learner will be able to:

1. describe the health and safety requirements of the area in which the maintenance activity is to take place
2. describe the isolation and lock-off procedures or permit-to-work procedure that applies to the refrigeration equipment being maintained
3. describe the specific health and safety precautions to be applied during the maintenance procedure, and their effects on others
4. describe the 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 to minimise them to reduce any risks
5. describe the 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. describe the importance of wearing protective clothing and other appropriate safety equipment during the maintenance process
7. explain how to obtain and interpret drawings, specifications, manufacturers' manuals and other documents needed in the maintenance process
8. describe the procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance activities
9. describe the company policy on the repair/replacement of components during the maintenance process
10. describe the sequence to be adopted for the dismantling/reassembly of various types of assembly
11. describe the methods and techniques used to dismantle/assemble refrigeration equipment (such as unplugging, de-soldering removal of screwed, clamped and crimped connections, removing bolted components and assemblies)
12. describe the methods of checking that components are fit for purpose, how to identify defects and wear characteristics, and the need to replace 'lived' items (such as batteries, lamps, seals and gaskets)
13. explain how to make adjustments to components/assemblies to ensure they function correctly
14. describe 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. describe the types of compressor, condenser, expansion valves and evaporators, and methods of stopping compressor prime movers
16. describe the system operating pressures and temperatures, and the relationship between refrigerant gas pressures and temperatures
17. describe the methods of removing and replacing components and units without damaging the system and infrastructure
18. describe the 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. describe the types and application of primary and secondary refrigerants, and methods of purging and charging the system using liquid and vapour refrigerants
20. describe the use of vacuum pumps, pressure gauges, compound gauges, flow gauges and indicators
21. explain 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. describe the generation of maintenance documentation and/or reports following the maintenance activity
23. describe the equipment operating and control procedures to be applied during the maintenance activity
24. explain how to use lifting and handling equipment correctly and safely in the maintenance activity
25. describe the problems associated with the maintenance activity, and how they can be overcome
26. describe the organisational procedure to be adopted for the safe disposal of waste of all types of material
27. describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve

**Level:** 3  
**Credit value:** 70  
**UAN number:** M/600/5546

**Unit aim**

This unit covers the skills and knowledge needed to prove the competences 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.

The learner needs to demonstrate their 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. The learner 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 the learner will, when dismantling equipment, be required to use a logical approach to component identification (proof marking/labelling), and to their assembly criteria.

The learner's responsibilities will require them 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 they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner 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. The learner will be expected to work with minimal supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying maintenance procedures to environmental control systems and equipment. The learner will understand the dismantling and reassembly methods and procedures, and their application. The learner 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 that the repaired equipment functions to the required specification and remains compliant with all standards and regulations. The learner will also have sufficient knowledge of these components to ensure that they are fit for purpose and meet the specifications, thus providing a sound basis for carrying out reassembly.

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

**Learning outcomes**

There are **two** learning outcomes to this unit. The learner will be able to:

1. Maintain environmental control equipment
2. Know how to maintain environmental control equipment

### **Guided learning hours**

It is recommended that **119** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 42: Maintaining Environmental Control Equipment (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

**Assessment Criteria**

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the maintenance activities:
  - plan and communicate the maintenance work so as to cause minimal disruption to normal working
  - obtain and use the correct issue of company and equipment suppliers' drawings and maintenance documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - 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
3. carry out maintenance activities on three or more of the following types of pollution control equipment:
  - air pollution control equipment (such as decarbonisation (CO<sub>2</sub> 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)
4. follow the relevant maintenance schedules to carry out the required work
5. maintain environmental control equipment in compliance with one of the following:
  - organisational guidelines and codes of practice
  - equipment manufacturer's operation range
  - BS7671/IEE wiring regulations
  - BS, ISO and/or BSEN standards
6. carry out the maintenance activities within the limits of their personal authority
7. carry out the maintenance activities in the specified sequence and in an agreed timescale
8. 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 'lifer' items
  - replacing damaged/defective components
  - replenishing oils and greases
  - setting, aligning and adjusting replaced components
  - tightening fasteners to the required torque



9. maintain a range of mechanical environmental control equipment, to include ten 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

10. maintain a range of electrical environmental control equipment to include ten 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
  - thermistors
  - thermocouples
  - thermostats
  - timers
  - transducers
  - transformers
11. report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
  12. complete the necessary verbal, written or computer communication requirements, to include one from the following:
    - job cards
    - permits to work/formal risk assessment and/or sign-on/off procedures
    - maintenance log or report
    - company-specific documentation
    - electronic recording
  13. complete relevant maintenance records accurately and pass them on to the appropriate person
  14. dispose of waste materials in accordance with safe working practices and approved procedures

## Unit 142

### Outcome 2

## Maintaining Environmental Control Equipment

Know how to maintain environmental control equipment

### Assessment Criteria

The learner will be able to:

1. describe the health and safety requirements of the area in which the maintenance activity is to take place
2. describe the safe working practices, isolation procedures and permit-to-work systems
3. describe the specific health and safety precautions to be applied during the maintenance procedure, and their effects on others
4. describe the specific regulations relating to the environmental control equipment being maintained
5. describe the 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 to minimise them to reduce any risks
6. describe the importance of using the correct personal and workplace-safety protection equipment
7. explain how to obtain and interpret drawings, specifications, manufacturers' manuals and other documents needed in the maintenance process
8. describe the procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance activities
9. describe the company policy on the repair/replacement of components during the maintenance process
10. describe the sequence to be adopted for the dismantling/re-assembly of various types of assemblies
11. describe the methods and techniques used to dismantle/assemble mechanical equipment (such as release of pressures/force, proof marking, extraction, pressing, alignment)
12. describe the methods of checking that components are fit for purpose, and how to identify defects and wear characteristics
13. explain how to make adjustments to components/assemblies to ensure that they function correctly
14. describe the basic principles of how the equipment functions, its operation sequence, the working purpose of individual units/components and how they interact
15. describe associated hazardous substances, their measurements and exposure limits
16. explain how to carry out biological monitoring
17. explain how to carry out hazard and risk assessment
18. describe the procedures for carrying out noise and vibration measurement
19. describe the prevention and reduction systems for noise and vibration
20. describe the methods of checking that removed components are fit for purpose, and the need to replace 'lived' items (such as seals and gaskets)
21. describe the uses of measuring equipment (such as tapes, rules and other measuring devices)
22. explain how to make adjustments to components to ensure they function correctly
23. explain 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. describe the generation of maintenance documentation and/or reports following the maintenance activity

25. describe the equipment operating and control procedures to be applied during the maintenance activity
26. explain how to use lifting and handling equipment correctly and safely in the maintenance activity
27. describe the problems associated with the maintenance activity, and how they can be overcome
28. describe the organisational procedure to be adopted for the safe disposal of waste of all types of material
29. describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve

## Unit 143

# Carrying Out Preventative Planned Maintenance on Services Systems and Equipment

**Level:** 3

**Credit value:** 38

**UAN number:** F/600/5552

### Unit aim

This unit covers the skills and knowledge needed to prove the competences required to carry out preventative 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 including medical gas pipelines, compressed air, process control, and instrumentation and control and medical decontamination equipment. The learner 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.

The learner's responsibilities will require them 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 they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner 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. The learner will be expected to work with minimal supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying planned maintenance procedures to services systems and equipment. The learner will know how the system functions, and the potential problems or defects that may occur. The learner 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 that the system is maintained to the required specification and remains compliant with all standards and regulations. In addition the learner will be expected to report where the outcome identifies the need for further investigation or maintenance work.

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

### Learning outcomes

There are **two** learning outcomes to this unit. The learner will be able to:

1. Carry out preventative planned maintenance on services systems and equipment
2. Know how to carry out preventative planned maintenance on services systems and equipment

### **Guided learning hours**

It is recommended that **74** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 43: Carrying Out Preventative Planned Maintenance on Services Systems and Equipment (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

## Unit 143

# Carrying Out Preventative Planned Maintenance on Services Systems and Equipment

### Outcome 1

Carry out preventative planned maintenance on services systems and equipment

#### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the maintenance activities:
  - plan and communicate the maintenance activities so as to minimise disruption to normal working
  - obtain and use the correct issue of company and/or manufacturers' drawings and maintenance documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - ensure the safe isolation of equipment (such as mechanical, electricity, gas, air or fluids)
  - provide and maintain 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
3. carry out planned maintenance activities on services systems and equipment, including two or more of the following, to sub-assembly or 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
  - medical gas pipelines
  - decontamination equipment (such as medical)
4. follow the relevant maintenance schedules to carry out the required work
5. follow planned maintenance activities, based on one of the following types of maintenance schedule:
  - condition based maintenance
  - preventative planned maintenance
  - scheduled maintenance
  - total preventative maintenance (TPM)
6. carry out the maintenance activities within the limits of their personal authority

7. carry out the maintenance activities in the specified sequence and in an agreed timescale
8. carry out ten 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 'lived' 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
9. ensure that the maintained equipment/system meets all of the following:
  - all maintenance activities have been completed to the required schedule
  - equipment operates within acceptable limits for successful continuous operation
  - equipment remains compliant with appropriate regulations and safety requirements
  - any potential defects are identified and reported for future action
10. report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
11. complete relevant maintenance records accurately, to include one of the following, and pass them on to the appropriate person:
  - job cards
  - maintenance log or report
  - company-specific documentation
  - permit to work/formal risk assessment and/or sign-on/off procedures
12. dispose of waste materials in accordance with safe working practices and approved procedures

## Unit 143

# Carrying Out Preventative Planned Maintenance on Services Systems and Equipment

## Outcome 2

Know how to carry out preventative planned maintenance on services systems and equipment

### Assessment Criteria

The learner will be able to:

1. describe the health and safety requirements of the area in which the maintenance activity is to take place, and the responsibility they place on the learner
2. describe the isolation and lock-off procedure or permit-to-work procedure that applies to the system being maintained
3. describe the specific health and safety precautions to be applied during the maintenance activity, and their effects on others
4. explain 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. describe the importance of wearing protective clothing and other appropriate safety equipment during the maintenance activities, and where it may be obtained
6. describe the 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 to minimise these and reduce any risks
7. explain how to obtain and interpret drawings, charts, specifications, manufacturers' manuals, history/maintenance reports and other documents needed in the maintenance process
8. describe 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. describe the basic principles of how the system functions, its operating sequence, the working purpose of individual units/components and how they interact
10. describe the equipment operating and control procedures, and how to apply them along with the planned maintenance procedures
11. describe the testing methods and procedures to be used to check that the system conforms within acceptable limits
12. explain how to make sensory checks (by sight, sound, smell, touch)
13. describe the procedure for obtaining consumables and 'lified' items that will require replacing during the maintenance activity
14. describe the company policy on the repair/replacement of components during the maintenance process
15. describe the methods for checking that components are fit for purpose, and the need to replace 'lified' items (such as filters, seals, gaskets, belts, chains and bearings)
16. explain how to make adjustments to components and assemblies to ensure that they function correctly
17. describe the generation of maintenance documentation and/or reports following the maintenance activity
18. describe the problems that can occur during the planned maintenance activity, and how they can be overcome
19. describe the organisational procedure to be adopted for the safe disposal of waste of all types of material
20. describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve



**Level:** 3  
**Credit value:** 50  
**UAN number:** T/601/2224

## Unit aim

This unit covers the skills and knowledge needed to prove the competences required to carry out fault diagnosis on lifts, in accordance with approved procedures. The learner 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. The learner 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 the learner will be expected to identify the fault and its probable cause, and to suggest action to remedy the problem.

The learner's responsibilities will require them 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 they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work with minimal supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying fault diagnosis procedures on lift equipment. The learner will understand the various fault diagnosis methods and techniques used, and their application. The learner 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. The learner 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.

The learner will understand the safety precautions required when carrying out the fault diagnosis activities, especially those for isolating the equipment. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

## Learning outcomes

There are **two** learning outcomes to this unit. The learner will be able to:

1. Carry out fault diagnosis on lifts
2. Know how to carry out fault diagnosis on lifts

## Guided learning hours

It is recommended that **60** hours should be allocated for this unit, although patterns of delivery are likely to vary.

## Details of the relationship between the unit and relevant national standards

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 44: Carrying Out Fault Diagnosis on Lifts (Suite 3)

## **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

**Assessment Criteria**

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the fault diagnostic activities:
  - plan the fault diagnosis to cause minimal disruption to normal working
  - obtain and use the correct issue of company and/or manufacturers' drawings and maintenance documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - ensure the safe isolation of the equipment (such as mechanical, electricity, or fluids)
  - provide and maintain 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
3. carry out fault diagnosis on three of the following types of lift equipment:
  - mechanical
  - fluid power
  - electrical
  - electronic
4. find faults that have resulted in two of the following breakdown categories:
  - intermittent problem
  - partial failure/out-of-specification operation
  - complete breakdowns
5. review and use all relevant information on the symptoms and problems associated with the products or assets
6. investigate and establish the most likely causes of the faults
7. select, use and apply diagnostic techniques, tools and aids to locate faults
8. 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
9. use a range of fault diagnostic techniques, to include two of the following:
  - half-split technique
  - emergent problem sequence
  - six point technique
  - unit substitution
  - equipment self-diagnostics
  - function/performance testing
  - injection and sampling
  - input/output technique



10. 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
11. 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)
  - Complete the fault diagnosis within the agreed time and inform the appropriate people when this cannot be achieved
12. determine the implications of the fault for other work and for safety considerations
13. use the evidence gained to draw valid conclusions about the nature and probable cause of the fault
14. record details on the extent and location of the faults in an appropriate format
15. 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 144

### Outcome 2

## Carrying Out Fault Diagnosis on Lifts

### Know how to carry out fault diagnosis on lifts

#### Assessment Criteria

The learner will be able to:

1. describe the health and safety requirements of the area in which they are carrying out the fault diagnosis activities
2. describe the specific safety precautions to be taken when carrying out the fault diagnosis of lift equipment
3. describe the isolation and lock-off procedures or permit-to-work procedure that applies
4. describe 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. describe the hazards associated with carrying out fault diagnosis on lifts (such as 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 to minimise them and reduce any risks
6. explain 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. explain where to obtain, and how to interpret, drawings, circuit diagrams, specifications, manufacturers' manuals and other documents needed in the fault diagnosis activities
8. describe the various fault finding techniques that can be used, and how they are applied (such as half-split, input/output put, emergent problem sequence, six point technique, function testing, unit substitution, injection and sampling techniques and equipment self-diagnostics)
9. explain 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. explain how to evaluate sensory information from sight, sound, smell, touch
11. describe the procedures to be followed to investigate faults, and how to deal with intermittent conditions
12. explain how to use the various aids and reports available for fault diagnosis
13. describe 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. describe the application of specific fault finding methods and techniques best suited to the problem
15. explain how to analyse and evaluate possible characteristics and causes of specific faults/problems
16. explain how to relate previous reports/records of similar fault conditions
17. explain 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. explain how to prepare a report which complies with the company policy on fault diagnosis
19. describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve

**Level:** 3  
**Credit value:** 38  
**UAN number:** K/600/5495

## Unit aim

This unit covers the skills and knowledge needed to prove the competences required to carry out routine inspection and servicing of lift installations, in accordance with approved procedures. The learner 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.

The learner's responsibilities will require them 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 they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner 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. The learner will be expected to work with minimal supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying planned servicing procedures on lift equipment. The learner 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 safely and effectively, and for ensuring that the system is maintained to the required specification and remains compliant with all standards and regulations. The learner will also be expected to report where the outcome of the servicing identifies the need for further investigation or maintenance work.

The learner will understand the safety precautions required when carrying out the inspection and servicing activities, especially those for isolating the equipment. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

## Learning outcomes

There are **two** learning outcomes to this unit. The learner will be able to:

1. Inspect and service lift equipment
2. Know how to inspect and service lift equipment

## Guided learning hours

It is recommended that **74** hours should be allocated for this unit, although patterns of delivery are likely to vary.

## Details of the relationship between the unit and relevant national standards

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 45: Inspecting and Servicing Lift Equipment (Suite 3)

## **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**



## Unit 145

# Inspecting and Servicing Lift Equipment

### Outcome 1

## Inspect and service lift equipment

### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the planned servicing activities:
  - plan and communicate the inspection and servicing activities to cause minimal disruption to normal working
  - obtain and use the correct issue of company and/or manufacturers' drawings and servicing documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - ensure the safe isolation of equipment (such as mechanical, electricity or fluids)
  - provide and maintain 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
3. 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
4. follow the relevant servicing schedules to carry out the required work
5. follow planned servicing activities, using one of the following types of servicing schedules:
  - condition based servicing
  - scheduled servicing
  - preventative planned maintenance
  - calendar based servicing
  - total preventative maintenance (TPM)
6. carry out inspections and servicing in compliance 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

7. carry out the servicing activities within the limits of their personal authority
8. carry out the servicing activities in the specified sequence and in an agreed timescale
9. 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 (e.g. 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 (such as 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
10. ensure that the maintained equipment meets all of the following:
  - 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
  - equipment remains compliant with all standards and regulations
11. report any instances where the servicing activities cannot be fully met or where there are identified defects outside the planned schedule
12. complete relevant servicing records accurately, to include one of the following, and pass them on to the appropriate person:
  - job cards
  - servicing log or report
  - permit to work/formal risk assessment and/or sign-on/off procedures
  - company-specific documentation
13. dispose of waste materials in accordance with safe working practices and approved procedures

## Unit 145

## Inspecting and Servicing Lift Equipment

### Outcome 2

### Know how to inspect and service lift equipment

#### Assessment Criteria

The learner will be able to:

1. describe the health and safety requirements of the area in which the inspection and servicing activity is to take place
2. describe the isolation procedures or permit-to-work procedure that applies to the equipment being serviced
3. describe the specific health and safety precautions to be applied during the planned servicing procedure, and their effects on others
4. describe the importance of wearing protective clothing and other appropriate safety equipment during the servicing process
5. describe the 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 to minimise them and reduce any risks
6. explain 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. explain where to obtain, and how to interpret, drawings, specifications, manufacturers' manuals, servicing schedules and other relevant documents for the servicing activity
8. describe 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. describe the procedure for obtaining consumables to be used during planned servicing activity
10. describe the appropriate test procedures to be adopted during servicing
11. describe the appropriate inspection techniques and procedures to be adopted during servicing
12. explain how to identify excessive wear and damage of components
13. explain how to make adjustments to components/assemblies to ensure they function to specification
14. describe the principles and functions of all lift components
15. explain how to complete servicing records/logs/reports in compliance with company policy and procedures
16. describe the problems associated with carrying out planned servicing, and how to resolve them
17. describe the correct and safe procedure to be adopted for the disposal of waste of all types of material
18. describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve

**Level:** 3  
**Credit value:** 50  
**UAN number:** R/600/5507

## Unit aim

This unit covers the skills and knowledge needed to prove the competences required to carry out checks and adjustments to the operation of a lift installation whilst undertaking maintenance, in accordance with approved procedures. The learner 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.

The learner's responsibilities will require them 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 they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner 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. The learner will be expected to work with minimal supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying checking and adjusting procedures on lift equipment. The learner 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 that the lift operates to the required specification and remains compliant with all standards and regulations. The learner will also be expected to report where the outcome of the checks identifies the need for further investigation or maintenance work.

The learner will understand the safety precautions required when carrying out the checking activities, especially those for isolating the equipment. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

## Learning outcomes

There are **two** learning outcomes to this unit. The learner will be able to:

1. Check lift function
2. Know how to check lift function

## Guided learning hours

It is recommended that **60** hours should be allocated for this unit, although patterns of delivery are likely to vary.

## Details of the relationship between the unit and relevant national standards

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 46: Checking Lift Function (Suite 3)

## **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

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**Assessment Criteria**

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following activities during the checking and adjusting activity:
  - obtain and use the correct issue of drawings and specifications
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - ensure that the lift area is clear of maintenance equipment, tools, debris and surplus materials
  - provide and maintain 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
3. follow the appropriate operating specifications for the equipment being maintained
4. carry out checking and adjustment in compliance 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. carry out adjustments within the limits of their personal authority
6. make the required adjustments in the specified sequence and in an agreed timescale
7. carry out the checking and adjustment on all of 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 (such as 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

8. make adjustments to all of the following:
  - tensions (such as ropes, belts, chains)
  - switches (such as reed, micro, photo)
  - clearances
  - alignment
  - speed of operation
9. confirm that the adjusted equipment meets the required operating specification
10. report any instances where the equipment fails to meet the required performance after adjustments or where there are identified defects outside the required adjustments
11. maintain documentation in accordance with organisational requirements
12. complete the relevant paperwork from one of the following, and pass it to the appropriate people:
  - job cards
  - servicing log or report
  - permit to work/formal risk assessment and/or sign-on/off procedures
  - company-specific documentation

## Unit 146

## Checking Lift Function

### Outcome 2

### Know how to check lift function

#### Assessment Criteria

The learner will be able to:

1. describe 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 the learner
2. describe the health and safety requirements of the work area in which they are carrying out the checking and adjustment
3. describe the hazards associated with carrying out checks and adjustments on lifts and lift equipment (such as handling oils/greases, stored pressure/force, misuse of tools), and how to minimise them to reduce the risks
4. describe the company procedure for safe systems of work, risk assessment and use of a permit to work
5. describe the personal protective equipment that they need to wear during the checking activities
6. describe the safe methods of manual handling and the safe use of mechanical lifting devices
7. explain 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. explain how to obtain the required checking documentation and specifications for the lift being checked, and how to check their currency and validity
9. explain how to read and interpret the specifications
10. describe the principles of operation of the equipment being checked and set
11. describe the tools and equipment to be used during the checking and adjusting activities
12. describe the appropriate method of checking alignment using measuring equipment
13. describe the procedures for adjustments, settings and checking
14. describe the checks to be made on tools and equipment used to ensure that they are fit for service
15. explain how they would know if the tools or equipment are covered by calibration or legislative inspections
16. describe tool control during the checking and adjusting of equipment
17. describe the documentation to be completed for the activities undertaken
18. describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve



**Level:** 3

**Credit value:** 47

**UAN number:** A/600/5520

## Unit aim

This unit covers the skills and knowledge needed to prove the competences required 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 'lived' items, such as bulbs, grease and oil. The learner will also be expected to check the repaired lift and to confirm its correct function. The learner 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.

The learner's responsibilities will require them 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 they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner 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. The learner will be expected to work with minimal supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying repair and rectification procedures on lift equipment. The learner 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 that the repaired lift operates safely and correctly, to the required specification, and remains compliant with all standards and regulations.

The learner will understand the safety precautions required when carrying out the repair activities, especially those for isolating the equipment. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

## Learning outcomes

There are **two** learning outcomes to this unit. The learner will be able to:

1. Rectify faults in lifts
2. Know how to rectify faults in lifts

## Guided learning hours

It is recommended that **91** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 47: Rectifying Faults in Lifts (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

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Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

## Unit 147

## Rectifying Faults in Lifts

### Outcome 1

### Rectify faults in lifts

#### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the fault rectifying activity:
  - verify that the fault exists
  - plan the activities to cause minimal disruption to normal working
  - obtain and use the correct issue of company and/or manufacturers' drawings and documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - ensure the safe isolation of equipment (such as mechanical, electricity, fluids)
  - provide and maintain 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
3. rectify faults in all of the following lift equipment:
  - landing doors
  - lift doors
  - safety equipment
  - machine equipment
  - controller equipment
  - hydraulic equipment
  - ancillary equipment
4. follow the relevant maintenance schedules to carry out the required work
5. ensure that the maintained equipment meets 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. carry out the maintenance activities within the limits of their personal authority
7. carry out the maintenance activities in the specified sequence and in an agreed timescale
8. repair and/or replace all of the following lift equipment components:
  - motors
  - pumps
  - switches
  - sensors
  - lights
  - control boards
  - valves
  - brakes

9. make adjustments to all of the following:
  - tensions (such as ropes, belts, chains)
  - switches (such as reed, micro, photo)
  - clearances
  - alignment
  - speed of operation
10. report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
11. complete relevant maintenance records accurately, to include one of the following, and pass them on to the appropriate person:
  - job cards
  - servicing log or report
  - permit to work/formal risk assessment and/or sign-on/off procedures
  - company-specific documentation
12. dispose of waste materials in accordance with safe working practices and approved procedures

**Assessment Criteria**

The learner will be able to:

1. describe the health and safety requirements of the area in which they are carrying out the fault rectification activities
2. describe the specific safety precautions to be taken when carrying out the fault rectification on lift equipment
3. describe the isolation and lock-off procedures or permit-to-work procedure that applies
4. describe 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. describe the hazards associated with carrying out fault rectification work on lifts (such as 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 to minimise them and reduce any risks
6. explain 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. describe the correct procedures for the emergency release of passengers
8. explain where to obtain, and how to interpret, drawings, circuit diagrams, specifications, manufacturers' manuals and other documents needed in the fault rectification process
9. describe the principles of operation of the equipment being repaired
10. describe the procedures for replacing or adjusting faulty equipment
11. explain 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. explain how to evaluate sensory information (sight, sound, smell, touch)
13. describe the types of tools and equipment that can be used in fault rectification (such as mechanical measuring instruments, electrical measuring instruments)
14. explain 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. describe the correct and safe procedure to be adopted for the disposal of waste of all types of material
16. explain how to relate previous reports/records of similar fault conditions
17. explain how to prepare a report which complies with the company policy on fault rectification
18. describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve

## Unit 148

# Repairing/Replacing Lift Doors, Chains, Ropes and Equipment

**Level:** 3  
**Credit value:** 47  
**UAN number:** A/600/5534

### Unit aim

This unit covers the skills and knowledge needed to prove the competences required to remove and replace lift chains, ropes and belts, 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 manual, two speed, centre opening, bi-parting and collapsible or shutter gates on existing installations.

The learner's responsibilities will require them 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 they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner 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. The learner will be expected to work with minimal supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying lift door, chains and rope repair/replacement procedures. The learner 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 that the repaired lifts operate safely and correctly, to the required specification and remains compliant with all standards and regulations. The learner will also be expected to report where the outcome of the replacement work identifies the need for further investigation or maintenance work.

The learner will understand the safety precautions required when carrying out the inspection and servicing activities, especially those for isolating the equipment. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

### Learning outcomes

There are **two** learning outcomes to this unit. The learner will be able to:

1. Repair/replace lift doors, chains, ropes and equipment
2. Know how to repair/replace lift doors, chains, ropes and equipment

### Guided learning hours

It is recommended that **91** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### Details of the relationship between the unit and relevant national standards

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 48: Repairing/Replacing Lift Doors, Chains, Ropes and Equipment (Suite 3)

## **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

## Unit 148

# Repairing/Replacing Lift Doors, Chains, Ropes and Equipment

## Outcome 1

Repair/replace lift doors, chains, ropes and equipment

### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the repair/replacement activity:
  - verify the extent of the damage
  - plan and communicate the activities to cause minimal disruption to normal working
  - use permit-to-work and/or sign-on/off procedures
  - obtain and 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 and maintain 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 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
3. repair and/or replace six of the following:
  - two-speed side opening doors
  - manual doors
  - gates (collapsible or shutter)
  - centre opening doors
  - lift chains
  - lift controller
  - bi-parting doors
  - lift ropes/belts
4. follow the relevant specifications for the component to be repaired
5. ensure that the maintained equipment meets 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. prepare the component for repair
7. carry out the repairs within agreed timescale using approved materials, components, methods and procedures



8. carry out all of the following activities:
  - remove doors
  - replace rollers
  - replace hangers
  - refit/replace door operators
  - replace spigots
  - replace shoes
  - refit/replace doors
  - refit/replace safety devices
  - remove/replace lift ropes
  - remove/replace lift chains
  - disconnect and reconnect electrical wires
  - modify electrical wiring (where appropriate)
  - remove/replace hydraulic pump unit (where appropriate)
  - remove/replace main gears (where appropriate)
  
9. 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
  - check direction of motors
  - ensure doors move freely
  - check doors function in accordance with specifications
  - check chain lengths
  - check and adjust backlash and end float
  
10. ensure that the repaired component meets the specified operating conditions
11. produce accurate and complete records of all repair work carried out
12. complete the relevant paperwork from one of the following, and pass it to the appropriate people:
  - job cards
  - servicing log or report
  - permit to work/formal risk assessment and/or sign-on/off procedures
  - company-specific documentation

## Unit 148

# Repairing/Replacing Lift Doors, Chains, Ropes and Equipment

## Outcome 2

Know how to repair/replace lift doors, chains, ropes and equipment

### Assessment Criteria

The learner will be able to:

1. describe 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 the learner
2. describe the health and safety requirements of the work area in which they are carrying out the repair/replacement activities
3. describe the company procedure for safe systems of work and risk assessment
4. describe the isolation and lock-off procedures or permit-to-work procedure that applies
5. describe the personal protective equipment that they need to wear during the repair/replacement activities
6. describe the safe methods of manual handling, and the safe use of mechanical lifting devices
7. describe the hazards associated with carrying out repair/replacement activities to lift doors, chains and ropes (such as 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 to minimise them and reduce any risks
8. explain 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. explain where to obtain, and how to interpret, drawings, circuit diagrams, specifications, manufacturers' manuals and other documents needed in the repair/replacement activities
10. describe the principles of operation of the equipment being repair/replaced
11. describe the preparation of materials for fitting
12. describe the tools and equipment to be used during the repair/replacement activities
13. describe the appropriate method of alignment, using plumb lines and gauges/pointers
14. describe the methods of adjustments, settings and checks
15. describe the checks to be made on tools and equipment used, to ensure that they are fit for service
16. explain how they would know if the tools or equipment are covered by calibration or legislative inspections
17. describe tool control during the repair/replacement activities
18. describe the care required when working with decorative finishes and surfaces
19. describe the documentation to be completed for the activities undertaken
20. describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve

**Level:** 3  
**Credit value:** 50  
**UAN number:** R/600/5541

## Unit aim

This unit covers the skills and knowledge needed to prove the competences required to carry out fault diagnosis on escalators, in accordance with approved procedures. The learner 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. The learner 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, the learner 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.

The learner's responsibilities will require them 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 they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work with minimal supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying fault diagnosis procedures on escalators. The learner will understand the various fault diagnosis methods and techniques used, and their application. The learner 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. The learner 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.

The learner will understand the safety precautions required when carrying out the fault diagnosis activities, especially those for isolating the equipment. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

## Learning outcomes

There are **two** learning outcomes to this unit. The learner will be able to:

1. Carry out fault diagnosis on escalators
2. Know how to carry out fault diagnosis on escalators

## Guided learning hours

It is recommended that **60** hours should be allocated for this unit, although patterns of delivery are likely to vary.

## Details of the relationship between the unit and relevant national standards

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 49: Carrying Out Fault Diagnosis on Escalators (Suite 3)

## **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

## Unit 149

# Carrying Out Fault Diagnosis on Escalators

### Outcome 1

## Carry out fault diagnosis on escalators

### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the fault diagnostic activities:
  - plan the fault diagnosis to cause minimal disruption to normal working
  - obtain and use the correct issue of company and/or manufacturers' drawings and maintenance documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - ensure the safe isolation of equipment (such as mechanical or electricity)
  - provide and maintain 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
3. carry out fault diagnosis on two of the following types of escalator equipment:
  - mechanical
  - electrical
  - electronic
4. find faults that have resulted in two of the following breakdown categories:
  - intermittent problem
  - partial failure/out-of-specification operation
  - complete breakdowns
5. review and use all relevant information on the symptoms and problems associated with the products or assets
6. investigate and establish the most likely causes of the faults
7. select, use and apply diagnostic techniques, tools and aids to locate faults
8. 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
9. use a range of fault diagnostic techniques, to include two of the following:
  - half-split technique
  - emergent problem sequence
  - six point technique
  - unit substitution
  - equipment self-diagnostics
  - function/performance testing
  - injection and sampling
  - input/output technique

10. 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
11. 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)
12. complete the fault diagnosis within the agreed time and inform the appropriate people when this cannot be achieved
13. determine the implications of the fault for other work and for safety considerations
14. use the evidence gained to draw valid conclusions about the nature and probable cause of the fault
15. record details on the extent and location of the faults in an appropriate format
16. 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

**Assessment Criteria**

The learner will be able to:

1. Describe the health and safety requirements of the area in which they are carrying out the fault diagnostic activities
2. describe the specific safety precautions to be taken when carrying out the fault diagnosis of escalator equipment
3. describe the isolation and lock-off procedures or permit-to-work procedure that applies
4. describe the importance of wearing protective clothing and other appropriate safety equipment during the fault diagnostic process; the type of equipment to be used, and where to obtain it
5. describe the hazards associated with carrying out fault diagnosis on escalators (such as 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 to minimise them and reduce any risks
6. explain 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. explain where to obtain, and how to interpret, drawings, circuit diagrams, specifications, manufacturers' manuals and other documents needed in the fault diagnostic process
8. describe the various fault finding techniques that can be used, and how they are applied (such as half-split, input/output put, emergent problem sequence, six point technique, function testing, unit substitution, injection and sampling techniques and equipment self-diagnostics)
9. explain 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. explain how to evaluate sensory conditions (sight, sound, smell, touch)
11. describe the procedures to be followed to investigate faults, and how to deal with intermittent conditions
12. explain how to use the various aids and reports available for fault diagnosis
13. describe the type of equipment that can be used to aid fault diagnosis (such as mechanical measuring instruments, electrical measuring instruments), and how to check that it is calibrated or configured correctly for the intended use, and that it is free from damage and defects
14. describe the application of specific fault finding methods and techniques best suited to the problem
15. explain how to analyse and evaluate possible characteristics and causes of specific faults/problems
16. explain how to relate previous reports/records of similar fault conditions
17. explain 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. explain how to prepare a report which complies with the company policy on fault diagnosis
19. describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve

**Level:** 3  
**Credit value:** 47  
**UAN number:** R/600/5555

## Unit aim

This unit covers the skills and knowledge needed to prove the competences required 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 'lived' items, such as grease and oil. The learner will also be expected to check the repaired escalator and to confirm its correct function. The learner 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).

The learner's responsibilities will require them 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 they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner 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. The learner will be expected to work with minimal supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, will and provide an informed approach to applying repair and rectification procedures on escalator equipment. The learner 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 that the repaired escalator operates safely and correctly, to the required specification, and remains compliant with all standards and regulations.

The learner will understand the safety precautions required when carrying out the repair activities, especially those for isolating the equipment. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

## Learning outcomes

There are **two** learning outcomes to this unit. The learner will be able to:

1. Rectify faults in escalators
2. Know how to rectify faults in escalators

## Guided learning hours

It is recommended that **91** hours should be allocated for this unit, although patterns of delivery are likely to vary.



### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 50: Rectifying Faults in Escalators (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

## Unit 150

## Rectifying Faults in Escalators

### Outcome 1

### Rectify faults in escalators

#### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the rectifying faults activity:
  - verify that the fault exists
  - plan and communicate the activities to cause minimal disruption to normal operation
  - use permit-to-work procedures and/or sign-on/off procedures
  - obtain and use the correct issue of company and/or manufacturers' drawings and documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - ensure the safe isolation of equipment (such as mechanical, electricity)
  - provide and maintain 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 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
3. 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
4. follow the relevant maintenance schedules to carry out the required work
5. ensure that the maintained equipment meets 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. carry out the maintenance activities within the limits of their personal authority
7. carry out the maintenance activities in the specified sequence and in an agreed timescale

8. repair and/or replace all of the following escalator equipment components:
  - steps
  - chains
  - handrail
  - control panel
  - combs
  - step rollers
  - step band
  - skirting
  - motor
  - brakes
  
9. make adjustments to all of the following:
  - handrail tensions
  - chain assemblies
  - skirting clearances
  - safety devices
  - guiding systems
  - gearbox backlash
  
10. report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
  
11. complete relevant maintenance records accurately, to include one of the following, and pass them on to the appropriate person:
  - job cards
  - servicing log or report
  - permit to work/formal risk assessment and/or sign-on/off procedures
  - company-specific documentation
  
12. dispose of waste materials in accordance with safe working practices and approved procedures

**Assessment Criteria**

The learner will be able to:

1. describe the health and safety requirements of the area in which they are carrying out the rectification activities, and the responsibility they place on the learner
2. describe the specific safety precautions to be taken when carrying out the rectification of faults on escalator equipment
3. describe the isolation and lock-off procedures or permit-to-work procedure that applies
4. describe 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. describe the hazards associated with carrying out rectification work on escalators (such as 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 to minimise them and reduce any risks
6. explain 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. explain where to obtain, and how to interpret, drawings, circuit diagrams, specifications, manufacturers' manuals and other documents needed in the rectification process
8. describe the principles of operation of the equipment being rectified
9. describe the various procedures for replacing or adjusting faulty equipment
10. explain 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. describe the tools and equipment that can be used in fault rectification (such as mechanical measuring instruments, electrical measuring instruments)
12. explain 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. describe the correct and safe procedure to be adopted for the disposal of waste of all types of material
14. explain how to relate previous reports/records of similar fault conditions
15. explain how to prepare a report which complies with the company policy on fault rectification
16. describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve

**Level:** 3  
**Credit value:** 38  
**UAN number:** R/600/5457

## Unit aim

This unit covers the skills and knowledge needed to prove the competences required to carry out routine inspection and servicing of escalator installations, in accordance with approved procedures. The learner 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.

The learner's responsibilities will require them 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 they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner 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. The learner will be expected to work with minimal supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying planned servicing procedures on escalator equipment. The learner 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 safely and effectively, and for ensuring that the system is maintained to the required specification and remains compliant with all standards and regulations. The learner will also be expected to report where the outcome of the servicing identifies the need for further investigation or maintenance work.

The learner will understand the safety precautions required when carrying out the inspection and servicing activities, especially those for isolating the equipment. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

## Learning outcomes

There are **two** learning outcomes to this unit. The learner will be able to:

1. Inspect and service escalators
2. Know how to inspect and service escalators

## Guided learning hours

It is recommended that **74** hours should be allocated for this unit, although patterns of delivery are likely to vary.

## Details of the relationship between the unit and relevant national standards

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 51: Inspecting and Servicing Escalators (Suite 3)

## **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

## Unit 151

# Inspecting and Servicing Escalators

### Outcome 1

## Inspect and service escalators

### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the planned inspection and servicing activities:
  - plan and communicate the inspection and servicing activities to cause minimal disruption to normal operation
  - obtain and use the correct issue of company and/or manufacturers' drawings and servicing documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - ensure the safe isolation of equipment (such as mechanical, electricity)
  - provide and maintain 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 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
3. 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 decking
  - comb plate and step mechanism
  - newels and guides
4. follow the relevant servicing schedules to carry out the required work
5. follow planned servicing activities, using one of the following types of servicing schedule:
  - condition based servicing
  - scheduled servicing
  - preventative planned maintenance
  - calendar based servicing
  - total preventative maintenance (TPM)

6. carry out inspecting and servicing in compliance 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
7. carry out the servicing activities within the limits of their personal authority
8. carry out the servicing activities in the specified sequence and in an agreed timescale
9. carry out all of the following planned servicing activities:
  - checking operation of escalator
  - making routine adjustments
  - removing excessive dirt, grime and rubbish
  - 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)
  - test and review escalator operation, including safety and alarm systems
  - record the results of the servicing and report any defects found
10. ensure that the maintained equipment meets all of the following:
  - 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
  - equipment remains compliant with all standards and regulations
11. report any instances where the servicing activities cannot be fully met or where there are identified defects outside the planned schedule
12. complete relevant servicing records accurately, to include one of the following, and pass them on to the appropriate person:
  - job cards
  - servicing log or report
  - permit to work/formal risk assessment and/or sign-on/off procedures
  - company-specific documentation
13. dispose of waste materials in accordance with safe working practices and approved procedures



**Assessment Criteria**

The learner will be able to:

1. describe the health and safety requirements of the area in which the escalator inspection and servicing activity is to take place
2. describe the isolation procedures or permit-to-work procedure that applies to the escalator equipment being serviced
3. describe the specific health and safety precautions to be applied during the planned servicing procedure, and their effects on others
4. describe the importance of wearing protective clothing and other appropriate safety equipment during servicing process
5. describe the hazards associated with carrying out planned servicing activities on escalators (such as handling oils/greases, stored pressure/force, misuse of tools), and how to minimise them and reduce any risks
6. explain 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. explain where to obtain, and how to interpret, drawings, specifications, manufacturers' manuals, servicing schedules and other documents needed for the servicing activities
8. describe 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. describe the procedure for obtaining the consumables to be used during planned servicing activity
10. describe the appropriate testing procedures to be adopted during servicing
11. describe the appropriate inspection techniques and procedures to be adopted during servicing
12. explain how to identify excessive wear and damage of components
13. explain how to make adjustments to components/assemblies to ensure they function to specification
14. describe the principles and functions of all escalator components
15. explain how to complete servicing records/logs/reports which comply with company policy and procedures
16. describe the problems associated with carrying out planned servicing, and how to resolve them
17. describe the correct and safe procedure to be adopted for the disposal of waste of all types of material
18. describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve

**Level:** 3  
**Credit value:** 46  
**UAN number:** T/600/5564

## Unit aim

This unit covers the skills and knowledge needed to prove the competences required to carry out checks and adjustments to the operation of an escalator installation, to specified standards and in accordance with approved procedures. The learner 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.

The learner's responsibilities will require them 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 they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner 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. The learner will be expected to work with minimal supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying testing and adjusting procedures on escalator installations. The learner 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 that the escalator operates safely and correctly to the required specification and remains compliant with all standards and regulations. The learner will also be expected to report where the outcome of the tests and adjustments identifies the need for further investigation or maintenance work.

The learner will understand the safety precautions required when carrying out the testing activities, especially those for isolating the equipment. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

## Learning outcomes

There are **two** learning outcomes to this unit. The learner will be able to:

1. Test and reinstate escalator installations
2. Know how to test and reinstate escalator installations

## Guided learning hours

It is recommended that **56** hours should be allocated for this unit, although patterns of delivery are likely to vary.

## Details of the relationship between the unit and relevant national standards

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 52: Testing and Reinstating Escalator Installations (Suite 3)

## **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

**Assessment Criteria**

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following activities during the testing and adjusting activity:
  - obtain and use the correct issue of drawings and specifications
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - follow the approved maintenance schedule for testing and reinstating escalator installations (such as response (direction and stopping) and functional (speed, vibration, safety equipment))
  - ensure that the escalator area is clear of maintenance equipment, tools, debris and surplus materials
  - provide and maintain safe access and working arrangements for the area
  - carry out all work to the appropriate testing standard, at the relevant speed
  - confirm that the escalator installation is operating to specification
  - leave the work area in a safe condition on completion of the testing activities
3. carry out the testing and adjustment activities on one of the following types of equipment:
  - escalator
  - passenger conveyor
4. follow the appropriate operating specifications for the equipment being maintained
5. carry out testing activities in compliance 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. carry out adjustments within the limits of their personal authority
7. make the required adjustments in the specified sequence and in an agreed timescale
8. make adjustments to all of the following:
  - tensions
  - switches
  - clearances
  - alignment
  - speed of operation
9. confirm that the adjusted equipment meets the required operating specification
10. report any instances where the equipment fails to meet the required performance after adjustments or where there are identified defects outside the required adjustments
11. maintain documentation in accordance with organisational requirements
12. complete the relevant paperwork from one of the following, and pass it to the appropriate people:
  - job cards
  - servicing log or report
  - permit to work/formal risk assessment and/or sign-on/off procedures
  - company-specific documentation

## Unit 152

## Testing and Reinstating Escalator Installations

### Outcome 2

Know how to test and reinstate escalator installations

#### Assessment Criteria

The learner will be able to:

1. describe 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 the learner
2. describe the health and safety requirements of the work area in which they are carrying out the testing and adjustment
3. describe the company procedure(s) for safe systems of work, risk assessment and use of a permit to work
4. describe the hazards associated with carrying out testing and adjusting activities on escalators (such as 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 to minimise them and reduce any risks
5. describe the personal protective equipment that they need to wear during the testing activities
6. explain 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. describe the safe methods of manual handling, and the safe use of mechanical lifting devices
8. explain how to obtain the required testing documentation and specifications for the escalator being tested, and how to check their currency and validity
9. explain how to read and interpret the specifications
10. describe the principles of operation of the equipment being tested or reinstated
11. describe the tools and equipment to be used during the testing and adjusting activities
12. describe the appropriate methods of checking alignment using measuring equipment
13. describe the procedures for adjustments, settings and checking
14. describe the checks to be made on tools and equipment used, to ensure that they are fit for service
15. explain how they would know if the tools or equipment are covered by calibration or legislative inspections
16. describe tool control during the testing and adjusting of equipment
17. describe the documentation to be completed for the activities undertaken
18. describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve

## Unit 153

# Carrying Out Fault Diagnosis on Communication-Electronic Systems

**Level:** 3  
**Credit value:** 50  
**UAN number:** Y/600/5573

### Unit aim

This unit covers the skills and knowledge needed to prove the competences required to carry out efficient and effective fault diagnosis on communication-electronic systems, in accordance with approved procedures. The learner will be required to diagnose faults on a range of communication-electronic systems, sub-systems or assemblies at line replacement unit (LRU) level. The learner 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, the learner will be expected to identify the fault and its probable cause, and to suggest appropriate action to remedy the problem.

The learner's responsibilities will require them 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 they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work with minimal supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying fault diagnosis procedures on communication-electronic systems. The learner will understand the various fault diagnosis methods and techniques used, and their application. The learner 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.

The learner 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 themselves against direct and indirect electric shock. The learner will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace.

### Learning outcomes

There are **two** learning outcomes to this unit. The learner will be able to:

1. Carry out fault diagnosis on communication-electronic systems
2. Know how to carry out fault diagnosis on communication-electronic systems

### Guided learning hours

It is recommended that **60** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### Details of the relationship between the unit and relevant national standards

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 53: Carrying Out Fault Diagnosis on Communication-Electronic Systems (Suite 3)

## **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

## Unit 153

# Carrying Out Fault Diagnosis on Communication-Electronic Systems

### Outcome 1

Carry out fault diagnosis on communication-electronic systems

#### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the fault diagnostic activity:
  - plan the fault diagnosis prior to beginning the work
  - obtain and use the correct issue of company and/or manufacturer's drawings and maintenance documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - ensure the safe isolation of equipment
  - provide and maintain 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
3. 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, 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)
4. find faults that have resulted in two of the following breakdown categories:
    - intermittent action/system failure
    - partial failure or reduced performance
    - complete breakdown
  5. review and use all relevant information on the symptoms and problems associated with the products or assets
  6. investigate and establish the most likely causes of the faults
  7. select, use and apply diagnostic techniques, tools and aids to locate faults
  8. 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
  9. use a range of fault-diagnostic techniques, to include two of the following:
    - half-split
    - injection and sampling
    - six point technique
    - equipment self diagnostics
    - emergent sequence
    - unit substitution
    - function/performance testing
  10. 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
  11. use all of the following fault diagnostic procedures:
    - inspection
    - operation
    - measurement

12. 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
13. complete the fault diagnosis within the agreed time and inform the appropriate people when this cannot be achieved
14. determine the implications of the fault for other work and for safety considerations
15. use the evidence gained to draw valid conclusions about the nature and probable cause of the fault
16. record details on the extent and location of the faults in an appropriate format
17. 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 153

# Carrying Out Fault Diagnosis on Communication-Electronic Systems

### Outcome 2

Know how to carry out fault diagnosis on communication-electronic systems

#### Assessment Criteria

The learner will be able to:

1. describe the health and safety requirements of the area in which the fault diagnosis activity is to take place, and the responsibility they place on the learner
2. describe the isolation and lock-off procedure, or permit-to-work procedure that applies
3. explain 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. describe the importance of wearing protective clothing and other appropriate safety equipment during the fault diagnostic process
5. describe the hazards associated with carrying out fault diagnosis on communication-electronic systems (such as mains electricity, stored capacitive/inductive energy, misuse of tools), and how to minimise them and reduce any risks
6. describe the procedure to be adopted to establish background evidence of a fault
7. explain how to evaluate the various types of information available for fault diagnosis
8. explain how to use the various aids and reports available for fault diagnosis
9. explain how to use various items of fault diagnostic equipment to investigate the problem
10. describe 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. explain how to evaluate sensory conditions (sight, smell, sound or touch)
12. explain how to analyse evidence and evaluate possible characteristics and causes of specific faults or problems
13. explain how to relate previous reports/records of similar fault conditions
14. describe the care, handling and application of electronic test instruments (such as multimeters, logic probes, oscilloscopes, etc)
15. explain how to determine the calibration state of the equipment, and the actions to be taken if equipment is out of calibration
16. explain how to ensure that the equipment used is free from damage or defect
17. explain 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. describe the principles of how communication-electronic or associated systems function and interact
19. explain how sub-systems and assemblies function within the system
20. describe the purpose of each lru within a given system
21. explain how to evaluate the likely risk to themselves and others, and the effects the fault could have on the overall process
22. explain how to prepare and produce a risk analysis report, where appropriate
23. explain how to complete the necessary paperwork or take follow-up action, which satisfies the company policy on concluding fault diagnosis
24. describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve

**Level:** 3  
**Credit value:** 50  
**UAN number:** A/600/5579

**Unit aim**

This unit covers the skills and knowledge needed to prove the competences required to carry out inspections and tests on communication-electronic systems, in accordance with approved procedures. The learner 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. The learner 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 they are working on.

The learner's responsibilities will require them to comply with organisational policy and procedures for carrying out the testing activities and to report any problems with these activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work with minimal supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's 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. The learner 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 correcting faults, and ensuring that the equipment operates safely and correctly to the required specification and remains compliant with all standards and regulations. In addition, the learner 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.

The learner 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 themselves against direct and indirect electric shock. The learner will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace.

**Learning outcomes**

There are **two** learning outcomes to this unit. The learner will be able to:

1. Test communication-electronic systems
2. Know how to test communication-electronic systems

**Guided learning hours**

It is recommended that **60** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 54: Testing Communication-Electronic Systems (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

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**Assessment Criteria**

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the testing activities:
  - plan the inspection and testing activities to cause minimal disruption to normal working
  - obtain and use the correct issue of company and/or manufacturers' drawings and maintenance documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - ensure the safe isolation of equipment
  - provide and maintain 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
3. carry out inspections and tests on four communication-electronic systems, subsystems or assemblies to LRU level, at least two of which must be selected from group A

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

Group A - communication 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)
4. follow the appropriate procedures for use of tools and equipment to carry out the required tests
  5. set up and carry out the tests using the correct procedures and within agreed timescales
  6. 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
    - temperature testing devices
    - power meters
    - valve tester
    - spectrum analyser
    - time domain reflectometer
    - frequency counter
    - protocol analyser
    - breakout box
    - automatic test equipment
    - other specific test equipment
  7. 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
  8. 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

9. record the results of the tests in the appropriate format
10. 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
11. review the results and carry out further tests if necessary



## Unit 154

### Outcome 2

## Testing Communication-Electronic Systems

Know how to test communication-electronic systems

### Assessment Criteria

The learner will be able to:

1. describe the health and safety requirements of the area in which the testing activity is to take place, and the responsibility they place on the learner
2. describe their responsibilities under regulations relevant to the communication-electronic testing activities being undertaken
3. describe 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 that isolation has been achieved and secured)
4. describe the isolation procedures that are unique to communication-electronic systems
5. describe the specific safety precautions to be taken when carrying out formal inspection and testing of communication-electronic equipment
6. describe the hazards associated with testing communication-electronic systems and with the equipment that is used, and how to minimise them and reduce any risks
7. describe the importance of wearing protective clothing and other appropriate safety equipment during the testing activities
8. describe the importance of keeping the work area clean and tidy, and free from waste and surplus materials
9. explain how the testing activities may effect the work of others, and the procedure for informing them of the work to be carried out
10. describe the procedures and precautions to be adopted to eliminate electrostatic discharge (ESD)
11. explain 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. describe the principles of how communication-electronic or associated systems function and interact
13. explain how subsystems and assemblies function within a system
14. explain how to determine suitable test points within a system, subsystem or assembly
15. explain how to set up and apply the appropriate test equipment
16. explain how to determine the calibration state of the equipment, and the actions to be taken if equipment is out of calibration,
17. explain how to ensure that the test equipment is free from damage or defect
18. explain 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. describe the various testing methods and procedures, and how to apply them to different operating conditions
20. explain how to analyse test results, and how to use comparison and sequential techniques
21. describe the environmental control and company operating procedure relating to functional testing
22. describe the documentation required, and the procedures to be followed at the conclusion of the test
23. describe the extent of their authority and to whom they should report to if they have problems that they cannot resolve

**Level:** 3

**Credit value:** 62

**UAN number:** M/600/5465

### **Unit aim**

This unit covers the skills and knowledge needed to prove the competences required to carry out repairs on communication-electronic systems, in accordance with approved procedures. The learner 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. The learner 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. The learner will be expected to take care that they 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 their role.

The learner's responsibilities will require them 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 they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work with minimal supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying communication-electronic repair procedures. The learner will understand the various repair procedures and their application, and will know about the tools and techniques used, in adequate depth to provide a sound basis for carrying out the activities, recognising and correcting faults and ensuring that the repaired system is to the required specification and remains compliant with all standards and regulations.

The learner 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 themselves against direct and indirect electric shock. The learner will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace.

### **Learning outcomes**

There are **two** learning outcomes to this unit. The learner will be able to:

1. Repair communication-electronic systems
2. Know how to repair communication-electronic systems

### **Guided learning hours**

It is recommended that **81** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 55: Repairing Communication-Electronic Systems (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

**Assessment Criteria**

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the repair activities:
  - plan and communicate the repairing activities to cause minimal disruption to normal working
  - obtain and use the correct issue of company and/or manufacturers' drawings and maintenance documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - ensure the safe isolation of equipment
  - provide and maintain 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
3. carry out repair activities on four communication-electronic systems, subsystems or assemblies to LRU level, at least two of which must be selected from group A:

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

Group A - communication electronic

- 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 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)
4. follow the relevant maintenance schedules to carry out the required work
  5. ensure the repaired systems comply with one of the following:
    - organisational guidelines and codes of practice
    - equipment manufacturers' operation range
    - BS, ISO and/or BSEN standards
    - Ministry of Defence (MoD)
  6. carry out the maintenance activities within the limits of their personal authority
  7. carry out the maintenance activities in the specified sequence and in an agreed timescale
  8. 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
  9. replace five different LRUs from communication-electronic systems, subsystems or assemblies, at least three of which must be selected from group A:

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

#### Group A - communication electronics

- 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)

10. 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)

11. report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule

12. complete relevant maintenance records accurately, to include one of the following, and pass them on to the appropriate person:

- job cards
- permits-to-work/formal risk assessment and/or sign-on/off procedures
- maintenance logs or reports
- company-specific documentation

13. dispose of waste materials in accordance with safe working practices and approved procedures

## Unit 155

### Outcome 2

## Repairing Communication-Electronic Systems

Know how to repair communication-electronic systems

### Assessment Criteria

The learner will be able to:

1. describe the health and safety requirements of the area in which the repair activity is to take place, and the responsibility they place on the learner
2. describe the isolation and lock-off procedure, or permit-to-work procedure that applies to the maintenance activities (such as electrical isolation, locking off switch gear, removal of fuses, placing maintenance warning notices, proving that isolation has been achieved and secured)
3. describe their responsibilities under regulations relevant to the communication-electronic repair activities being undertaken
4. describe the isolation procedure and safety precautions unique to the communication-electronic systems, subsystem or assembly being worked on
5. describe the importance of wearing protective clothing and other appropriate safety equipment during the repair activities
6. describe the hazards associated with repairing communication-electronic systems, subsystems or assemblies, or with equipment that is used, and how to minimise them and reduce any risks
7. describe the importance of keeping the work area clean and tidy and free from waste and surplus materials
8. explain how the activities may effect the work of others, and the procedure for informing them of the work to be carried out
9. describe the procedures and precautions to be adopted to eliminate electrostatic discharge
10. explain 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. describe the principles of how communication-electronic or associated systems function and interact
12. explain how subsystems and assemblies function within a system
13. describe the organisational policy on the repair or replacement of faulty LRUs during the maintenance process
14. explain how to check that the replacement LRUs meet the required specification/operating conditions (such as values, tolerance, current-carrying capacity, ambient temperatures)
15. describe the methods of removing and replacing the faulty LRUs from the equipment (such as unplugging, de-soldering, removal of screwed, clamped, edge connected, zero insertion force, fitted and crimped connection)
16. describe the importance of removing faulting LRUs without causing damage to other components or the surrounding structure
17. describe the methods of attaching identification marks/labels to removed LRUs or connections, to assist with re-assembly
18. describe 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. explain 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. explain how to reconnect the equipment, and the checks to be made prior to restoring power (such as checking components for correct polarity, ensuring that there are no exposed conductors, cable insulation is not damaged, all connections are mechanically and electrically secure, casings are free from loose screws)

21. describe the importance of making 'off-load' checks before proving the equipment with the electrical supply on
22. explain how to make adjustments to LRUs to ensure that they function correctly
23. describe the maintenance documentation and/or reports to be completed following the maintenance activity, and the importance of ensuring that these reports are completed accurately, legibly and using appropriate technical language
24. describe the organisational procedures to be adopted for the safe disposal of waste of all types of material
25. describe the extent of their own authority and to whom they should report if they have a problem that they cannot resolve



## Unit 156

# Carrying Out Preventative Planned Maintenance on Communication-Electronic Systems

**Level:** 3

**Credit value:** 38

**UAN number:** D/600/5476

### Unit aim

This unit covers the skills and knowledge needed to prove the competences required to carry out preventative planned maintenance on communication-electronic systems, in accordance with approved procedures. The learner will be required to carry out planned maintenance on a range of communication-electronic systems, sub-systems or assemblies. The learner 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.

The learner's responsibilities will require them to comply with organisational policy and procedures for carrying out planned maintenance activities, and to report any problems with these activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner 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. The learner will be expected to work with minimal supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying planned maintenance procedures within a communication-electronic system. The learner will know about the integrated technologies within the system, how the system functions, and the potential problems or defects that may occur. The learner 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 that the system is maintained to the required specification and remains compliant with all standards and regulations. In addition, the learner will be expected to report where the outcome identifies the need for further investigation or maintenance work.

The learner 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 themselves against direct and indirect electric shock. The learner will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace.

### Learning outcomes

There are **two** learning outcomes to this unit. The learner will be able to:

1. Carry out preventative planned maintenance on communication-electronic systems
2. Know how to carry out preventative planned maintenance on communication-electronic systems

### **Guided learning hours**

It is recommended that **74** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 56: Carrying Out Preventative Planned Maintenance on Communication-Electronic Systems (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

## Unit 156

# Carrying Out Preventative Planned Maintenance on Communication-Electronic Systems

### Outcome 1

Carry out preventative planned maintenance on communication-electronic systems

#### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the maintenance activities:
  - plan and communicate the maintenance activities to cause minimal disruption to normal working
  - obtain and use the correct issue of company and/or manufacturers' drawings and maintenance documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - ensure the safe isolation of equipment
  - provide and maintain 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
3. carry out maintenance activities on four communication electronic systems, subsystems or assemblies to LRU level, at least two of which must be selected from group A:

*Note: Any of the items below can be identified as a system, subsystem 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, subsystem 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)
4. follow the relevant maintenance schedules to carry out the required work
  5. follow planned maintenance activities using one of the following types of maintenance schedule:
    - condition based maintenance
    - scheduled maintenance
    - total preventative maintenance (TPM)
    - preventative planned maintenance
  6. carry out the maintenance activities within the limits of their personal authority
  7. carry out the maintenance activities in the specified sequence and in an agreed timescale
  8. carry out ten 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 'lified' 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
  9. ensure that the maintained system meets all of the following:
    - all maintenance activities have been completed to the required schedule
    - equipment operates within acceptable limits for successful continuous operation
    - equipment remains compliant with appropriate regulations and safety requirements
    - any potential defects are identified and reported for future action
  10. report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
  11. complete relevant maintenance records accurately, to include one of the following, and pass them on to the appropriate person:
    - job cards
    - maintenance log or report
    - permit-to-work/formal risk assessment and/or sign-on/off procedures
    - company-specific documentation
  12. dispose of waste materials in accordance with safe working practices and approved procedures

## Unit 156

# Carrying Out Preventative Planned Maintenance on Communication-Electronic Systems

### Outcome 2

Know how to carry out preventative planned maintenance on communication-electronic systems

#### Assessment Criteria

The learner will be able to:

1. describe the health and safety requirements of the area in which the planned maintenance activity is to take place, and the responsibility they place on the learner
2. describe their responsibilities under regulations relevant to the maintenance activities being undertaken
3. describe 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 that isolation has been achieved and secured)
4. describe the isolation procedures unique to communication-electronic systems, subsystems or assemblies
5. describe the specific health and safety precautions needed to be applied during the planned maintenance procedure and their effects on others
6. describe 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 to minimise these and reduce any risks
7. describe the importance of wearing protective clothing and other appropriate safety equipment during the maintenance activities
8. describe the importance of keeping the work area clean and tidy and free from waste and surplus materials
9. explain how the maintenance activities may effect the work of others, and the procedure for informing them of the work to be carried out
10. describe the procedures and precautions to be adopted to eliminate electrostatic discharge (ESD)
11. explain 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. describe the maintenance schedules and methods to be followed in order to comply with company procedures for planned maintenance
13. describe the principles of how communication-electronic or associated systems function and interact
14. explain how subsystems and assemblies function within a system
15. describe the maintenance methods and procedures to be used to check that the system conforms to acceptable limits
16. explain how to make sensory checks (sight, sound, smell or touch)
17. describe the procedure for obtaining consumables and 'lified' items that will require replacing during the maintenance activity
18. describe the company policy on repair/replacement of systems, subsystems and assemblies during the planned maintenance process
19. describe the methods of checking that systems, subsystems and assemblies are fit for purpose, and the need to replace 'lified' items (such as batteries)

20. explain how to make adjustments to systems, subsystems and assemblies to ensure that they function correctly
21. describe the generation of maintenance documentation and/or reports following the maintenance activity
22. describe the problems that can occur during the planned maintenance activity, and how they can be overcome
23. describe the organisational procedure to be adopted for the safe disposal of waste of all types of material
24. describe the extent of their authority and to whom they should report if they have problems that they cannot resolve

**Level:** 3  
**Credit value:** 35  
**UAN number:** L/600/5585

## Unit aim

This unit covers the skills and knowledge needed to prove the competences required to modify communications-electronic systems, sub-systems or assemblies, in accordance with approved procedures. The learner 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. The learner will be expected to remove and replace cables, add new cables and change the route of cables. The learner will also be expected to modify LRUs (line replacement units) within communication-electronic systems. The learner will need to show proficiency in using various tools and techniques during the modification process.

The learner's responsibilities will require them to comply with organisational policy and procedures for the modifications undertaken, and to report any problems with the modification activities or components that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work with minimal supervision, taking full responsibility for their actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying modifications procedures to communication-electronic systems. The learner 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 that the completed modification is to the required specification and remains compliant with all standards and regulations.

The learner will understand the safety precautions required when carrying out the modifications. The learner will be required to demonstrate safe practices throughout, and will understand the responsibility they owe to themselves and others in the workplace.

## Learning outcomes

There are **two** learning outcomes to this unit. The learner will be able to:

1. Modify communication-electronic systems
2. Know how to modify communication-electronic systems

## Guided learning hours

It is recommended that **63** hours should be allocated for this unit, although patterns of delivery are likely to vary.

## Details of the relationship between the unit and relevant national standards

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 57: Modifying Communication-Electronic Systems (Suite 3)

## Support of the unit by a sector or other appropriate body

This unit is endorsed by Semta.

## **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**



**Assessment Criteria**

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the modification activity:
  - obtain and use the correct issue of company and/or manufacturers' documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - ensure the safe isolation of equipment
  - provide and maintain 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
3. carry out modification activities on four communication electronic systems, subsystems or assemblies to LRU level, at least two of which must be selected from group A:

*Note: Any of the items below can be identified as a system, subsystem 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

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)

4. obtain and follow the relevant modification specifications and job instructions
5. produce modifications, which comply with one of the following:
  - customer standards and requirements
  - company standards and requirements
  - BS, ISO and/or BSEN standards
  - Ministry of Defence (MOD)
  - manufacturers' standards and requirements
6. confirm and agree what modifications are to be carried out to meet the specification
7. prepare the communication-electronic system for the required modification
8. carry out the system modification using approved materials, methods and procedures
9. 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
10. 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
11. complete the modification within the agreed timescale
12. ensure the modified communication-electronic system meets the specified operating conditions
13. produce accurate and complete records of all modification work carried out
14. complete the relevant paperwork from one of the following, and pass it to the appropriate people:
  - job cards
15. deal promptly and effectively with problems within their control and report those that cannot be solved

## Unit 157

### Outcome 2

## Modifying Communication-Electronic Systems

Know how to modify communication-electronic systems

### Assessment Criteria

The learner will be able to:

1. describe 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. describe the health and safety requirements of the work area in which they are carrying out the modification activities, and the responsibilities these requirements place on the learner
3. describe the hazards associated with carrying out modifications to ground communication-electronic systems, and how to minimise them and reduce any risks
4. describe the personal protective equipment and clothing to be worn during the modification activities
5. describe 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. explain how to identify the components to be used; component identification systems; codes and component orientation indicators
7. describe the preparations to be undertaken on the system, prior to carrying out the modification
8. describe the methods and techniques to be used for soldering and de-soldering, and the importance of adhering to them
9. describe the methods and techniques to be used for crimping and heat shrinking, and the importance of adhering to them
10. describe the procedures and precautions to be adopted to eliminate electrostatic discharge
11. describe the basic operation of the communication-electronic system, subsystem and assembly being modified, and the purpose of associated components
12. describe the different types of cable protection, and reasons for using each type
13. describe the various mechanical fasteners that will be used, and their method of installation
14. describe the importance of using the specified fasteners for the modification, and why they must not use substitutes
15. describe the quality control procedures to be followed during the modification operations
16. explain how to conduct any necessary checks to ensure the accuracy and quality of the modification
17. explain how to recognise defects (such as misalignment, ineffective fasteners, foreign object damage or contamination)
18. describe the problems that can occur with the modification operations, and how these can be overcome
19. describe the organisational procedures to be adopted for the safe disposal of waste of all types of materials
20. describe 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. describe the organisational policy on modification and how the process should be undertaken
22. describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve

**Level:** 3  
**Credit value:** 51  
**UAN number:** Y/600/5590

## Unit aim

This unit covers the skills and knowledge needed to prove the competences required to carry out configuration tasks on communication-electronic systems, in accordance with approved procedures. The learner will be required to configure a range of communication-electronic systems, sub-systems or assemblies into a complete communication-electronic operating system. The learner 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.

The learner's responsibilities will require them to comply with organisational policy and procedures for the configuration activities undertaken, and to report any problems with the configuration activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work with minimal supervision, taking full responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying configuration procedures to communication-electronic systems and equipment. The learner 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.

The learner 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 themselves against direct and indirect electric shock. The learner will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace.

## Learning outcomes

There are **two** learning outcomes to this unit. The learner will be able to:

1. Configure communication-electronic systems
2. Know how to configure communication-electronic systems

## Guided learning hours

It is recommended that **77** hours should be allocated for this unit, although patterns of delivery are likely to vary.

## Details of the relationship between the unit and relevant national standards

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 58: Configure Communication-Electronic Systems (Suite 3)

## Support of the unit by a sector or other appropriate body

This unit is endorsed by Semta.

## **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

**Assessment Criteria**

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the configuration activities:
  - obtain and use the correct issue of company publications and/or manufacturers' documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - 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
3. configure systems that contain at least four communication-electronic subsystems or assemblies, at least two of which must be selected from group A:

*Note: Any of the items below can be identified as a subsystem 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 subsystem 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)

4. follow all relevant setting up and operating specifications for the products or assets being configured
5. follow the defined procedures and set up the equipment correctly ensuring that all operating parameters are achieved
6. 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
7. 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
8. deal promptly and effectively with problems within their control and report those that cannot be solved
9. check that the configuration is complete and that the equipment operates to specification
10. 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
11. ensure the configured system meets all of the following:
  - 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

12. complete all relevant documentation accurately and legibly
13. provide a record/report of the configuration outcome(s), using one of the following:
  - job card
  - company-specific reporting procedure
  - specific configuration report



## Unit 158

### Outcome 2

## Configure Communication-Electronic Systems

Know how to configure communication-electronic systems

### Assessment Criteria

The learner will be able to:

1. describe the specific safety practices and procedures that they need to observe when configuring communication-electronic systems (including any specific legislation, regulations/codes of practice for the activities, equipment or materials)
2. explain 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. describe the health and safety requirements of the work area where they are carrying out the activities, and the responsibility these requirements place on the learner
4. describe the hazards associated with configuring communication-electronic systems, and how to minimise them and reduce any risks
5. describe the personal protective equipment that they need to use during the configuration activities
6. describe the interpretation of drawings, standards, quality control procedures and specifications used for the configuration activity
7. describe the methods used during the configuring of a communication-electronic system
8. describe the components to be configured, and their function within the particular communications-electronic systems
9. describe the quality control procedures to be followed during the configuration process
10. describe the techniques used to check the position, alignment and security of the components in a communication-electronic system
11. explain why electrical bonding is critical, and why it must be both mechanically and electrically secure
12. explain how to conduct any necessary checks and adjustments to the equipment to ensure the system integrity, functionality, accuracy and quality
13. describe the various system operating procedures and their specific configuration requirements
14. describe the tools and equipment used in the configuration process, and their calibration/care and control procedures
15. explain 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. describe the problems that can occur with the configuration process, and how these can be overcome
17. describe the recording documentation to be completed for the configuration activities undertaken
18. describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve

**Level:** 3

**Credit value:** 32

**UAN number:** J/600/5598

### **Unit aim**

This unit covers the skills and knowledge needed to prove the competences required to install communication-electronic systems, in accordance with approved procedures. The learner will be required to use appropriate installation publications, orders and specifications to install the various systems, sub-systems or assemblies. The learner will be expected to position, align and connect communication-electronic systems, subsystems or assemblies in their correct locations, using the specified or appropriate techniques.

The learner's responsibilities will require them 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 they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work with minimal supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying installation techniques and procedures. The learner 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.

The learner 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 themselves and others against direct and indirect electric shock. The learner will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace.

### **Learning outcomes**

There are **two** learning outcomes to this unit. The learner will be able to:

1. Install communication-electronic systems
2. Know how to install communication-electronic systems

### **Guided learning hours**

It is recommended that **81** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 59: Installing Communication-Electronic Systems (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

## **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

**Assessment Criteria**

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the installation activity:
  - obtain and use the correct issue of company publications and planning documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - check the calibration dates of tools and test equipment to be used
  - use approved deployment/installation techniques and procedures at all times
  - provide and maintain 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
3. install systems that contain four communication-electronic subsystems 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, subsystem 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, subsystem 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)

4. follow all relevant drawings and specifications for the installation being carried out
5. carry out installations which comply with one of the following:
  - customer standards and requirements
  - company standards and requirements
  - BS, ISO and/or BSEN standards
  - Ministry of Defence (MOD)
  - manufacturers' standards and requirements
6. use the correct tools and equipment for the installation operations and check that they are in a safe and usable condition
7. install, position and secure the equipment and components in accordance with the specification
8. use all of the following installation methods and techniques:
  - levelling and aligning
  - earth bonding
  - taking ESSD precautions
  - securing and locking
9. make three of the following types of mechanical securing connections:
  - nuts/bolts
  - locking devices
  - screws
  - torque load bolts
  - quick-release fasteners
10. 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
11. ensure that all necessary connections to the equipment are complete
12. deal promptly and effectively with problems within their control and report those that cannot be solved
13. check that the installation is complete and that all components are free from damage
14. complete the relevant paperwork from one from the following, and pass it to the appropriate people:
  - job cards
  - specific deployment/installation report
  - build records
  - company-specific documentation

## Unit 159

### Outcome 2

## Installing Communication-Electronic Systems

Know how to install communication-electronic systems

### Assessment Criteria

The learner will be able to:

1. describe the specific safety practices and procedures that they need to observe when installing communication-electronic systems (including any specific legislation, regulations/codes of practice for the activities, equipment or materials)
2. describe the health and safety requirements of the work area where they are carrying out the installation activities, and the responsibility these requirements place on the learner
3. describe the hazards associated with installing communication-electronic systems, and how to minimise them and reduce any risks
4. describe the personal protective equipment that they need to use during the installation activities
5. describe the interpretation of drawings, standards, quality control procedures and specifications used for installation
6. describe the components, communication-electronic systems, subsystems and assemblies to be installed, and their function within the particular communication-electronic systems
7. describe the various mechanical fasteners that will be used, and their method of installation
8. describe the importance of using the specified fasteners for the particular installation, and why they must not substitute others
9. explain what the torque loading requirements are on the fasteners, and what to do if these loadings are exceeded or not achieved
10. describe the quality control procedures to be followed during the installation operations
11. describe the procedures for ensuring that they have the correct tools, equipment, components and fasteners for the activities
12. describe the techniques used to position, align, adjust and secure the components of the communication-electronic systems without damage
13. describe the methods of lifting, handling and supporting the components/equipment during the installation activities
14. explain why electrical bonding is critical, and why it must be both mechanically and electrically secure
15. describe the procedure for the safe disposal of waste materials
16. explain how to conduct any necessary checks to ensure that the system integrity, functionality, accuracy and quality of the installation
17. describe the tools and equipment used in the installation activities, and their calibration/care and control procedures
18. explain 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
19. describe the problems that can occur with the installation operations, and how these can be overcome
20. describe the recording documentation to be completed for the installation activities undertaken
21. describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve

**Level:** 3  
**Credit value:** 50  
**UAN number:** A/600/5601

### Unit aim

This unit covers the skills and knowledge needed to prove the competences required to carry out efficient and effective fault diagnosis on medical equipment, in accordance with approved procedures. The learner 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.

The learner 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, the learner will be expected to identify the fault and its probable cause, and to suggest appropriate action to remedy the problem.

The learner's responsibilities will require them 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 they cannot personally resolve or that are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking full responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying fault diagnostic procedures to medical equipment. The learner will understand the various fault diagnostic methods and techniques used, and their application. The learner 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.

The learner will understand the safety precautions required when carrying out the servicing activities, especially those for isolating the equipment. The learner will also understand their responsibilities for safety, and the importance of taking the necessary safeguards to protect themselves and others in the workplace.

### Learning outcomes

There are **two** learning outcomes to this unit. The learner will be able to:

1. Carry out fault diagnosis on medical equipment
2. Know how to carry out fault diagnosis on medical equipment

### **Guided learning hours**

It is recommended that **60** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 60: Carrying Out Fault Diagnosis on Medical Equipment (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**



## Unit 160

# Carrying Out Fault Diagnosis on Medical Equipment

### Outcome 1

Carry out fault diagnosis on medical equipment

#### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. 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
  - obtain and use the correct issue of company and/or manufacturer's drawings and maintenance documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - 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 and maintain 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
3. 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
4. find faults that have resulted in two of the following breakdown categories:
  - intermittent problem
  - partial failure/out-of-specification output
  - complete breakdown
5. review and use all relevant information on the symptoms and problems associated with the products or assets
6. investigate and establish the most likely causes of the faults
7. select, use and apply diagnostic techniques, tools and aids to locate faults

8. 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
  
9. use a range of fault diagnostic techniques, to include two of the following:
  - six point technique
  - emergent sequence
  - input/output technique
  - half-split technique
  - equipment self diagnostics
  - unit substitution
  - function/performance testing
  - injection and sampling
  
10. 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
  
11. 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)
  
12. 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

13. complete the fault diagnosis within the agreed time and inform the appropriate people when this cannot be achieved
14. determine the implications of the fault for other work and for safety considerations
15. use the evidence gained to draw valid conclusions about the nature and probable cause of the fault
16. record details on the extent and location of the faults in an appropriate format
17. 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 160

# Carrying Out Fault Diagnosis on Medical Equipment

### Outcome 2

Know how to carry out fault diagnosis on medical equipment

#### Assessment Criteria

The learner will be able to:

1. describe 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 the learner
2. describe the statutory and advisory documentation relating to medical devices (such as warnings and guidance from the regulatory authority, and British and European standards)
3. describe the importance of reporting any equipment adverse incidents to the regulatory authority
4. describe the isolation procedure or permit-to-work procedure that applies
5. explain 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. describe the importance of wearing protective clothing and other appropriate safety equipment during the fault diagnostic activities
7. describe the hazards associated with carrying out fault diagnosis on electronic equipment (such as mains electricity, stored capacitive/inductive/electrostatic energy, misuse of tools), and how to minimise them and reduce any risks
8. describe the basic principles of how the medical equipment functions, its operating sequence, the function/purpose of individual units/components, and how they interact
9. explain 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. describe the procedure to be adopted to establish the background of the fault
11. explain how to evaluate the various types of information available for fault diagnosis
12. explain how to use the various aids and reports available for fault diagnosis
13. explain how to use various types of fault diagnostic equipment to investigate the problem
14. describe the digital circuits and their operation (including logic truth tables and Boolean algebra for AND, OR, NAND, NOR, NOT and EXCLUSIVE-OR gates)
15. describe the various fault finding techniques that can be used (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), and how they are applied
16. explain how to evaluate sensory conditions (sight, sound, smell, touch)
17. explain how to analyse evidence and evaluate possible characteristics and causes of specific faults/problems
18. explain how to relate previous reports/records of similar fault conditions
19. describe the care, handling and application of electronic test instruments (such as multimeter, logic probes, oscilloscopes, signal tracers, signal generators)
20. explain how to calibrate test instruments and check that they are free from damage and defects
21. describe the precautions (such as use of wrist straps, special packaging and handling areas) to be taken to prevent electrostatic discharge (esd) damage to electronic circuits and components
22. explain how to evaluate the likely risk to themselves and others, and the effects that the fault could have on the overall system or process
23. explain how to prepare and produce a risk analysis report, where appropriate
24. explain how to prepare a report, or take follow-up action, on conclusion of the fault diagnosis, in accordance with company policy
25. describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve

**Level:** 3  
**Credit value:** 50  
**UAN number:** H/600/5608

## Unit aim

This unit covers the skills and knowledge needed to prove the competences required to carry out inspections and tests on medical equipment, in accordance with approved procedures. The learner 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.

The learner 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.

The learner's responsibilities will require them to comply with organisational policy and procedures for carrying out the testing activities, and to report any problems with these activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's 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. The learner 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, correcting faults, and ensuring that the equipment operates safely and correctly to the required specification and remains compliant with all standards and regulations. In addition, the learner 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.

The learner 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 themselves and others against direct and indirect electric shock. The learner will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace.

## Learning outcomes

There are **two** learning outcomes to this unit. The learner will be able to:

1. Test medical equipment
2. Know how to test medical equipment

### **Guided learning hours**

It is recommended that **60** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 61: Testing Medical Equipment (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

**Assessment Criteria**

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the testing activities:
  - plan the inspection and testing activities so as to minimise disruption to normal working
  - obtain and use the correct issue of company and/or manufacturers' drawings and maintenance documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - ensure that the correct equipment decontamination procedure has been adhered to before and after testing
  - ensure the safe isolation of equipment
  - provide and maintain 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
3. 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
4. follow the appropriate procedures for use of tools and equipment to carry out the required tests
5. set up and carry out the tests using the correct procedures and within agreed timescales
6. 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

7. 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

8. 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

9. record the results of the tests in the appropriate format

10. 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

11. review the results and carry out further tests if necessary



**Assessment Criteria**

The learner will be able to:

1. describe 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 the learner
2. describe the statutory and advisory documentation relating to medical devices (such as warnings and guidance from the regulatory authority, and British and European standards)
3. describe the importance of reporting any equipment adverse incidents to the regulatory authority
4. describe their responsibilities under regulations relevant to the medical equipment testing activities being undertaken
5. describe 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. describe the isolation procedure(s) specific to the medical equipment being tested
7. describe the specific safety precautions to be taken when carrying out formal inspection, safety and circuit testing of medical equipment
8. describe the hazards associated with testing medical equipment, and with the equipment that is used, and how to minimise them and reduce any risks
9. describe the importance of wearing protective clothing, and other appropriate safety equipment, during the testing activities
10. describe the importance of keeping the work area clean, tidy and free from waste and surplus materials
11. explain how the testing activities may affect the work of others, and the procedure for informing them of the work to be carried out
12. describe the procedures and precautions to be adopted to eliminate/protect against electrostatic discharge (ESD) when working on sensitive equipment or devices
13. explain 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. describe the basic principles of how the medical equipment functions, its operating sequence, the function/purpose of individual units/components, and how they interact
15. explain how to determine the most suitable test points within the equipment
16. explain how to set up and apply the appropriate test equipment
17. explain 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. explain how to ensure that the test equipment used is within current calibration dates
19. explain how to set up the test equipment for the particular tests being carried out
20. describe the various testing methods and procedures, and how to apply them to different equipment and operating conditions
21. describe the importance of carrying out tests in the specified sequence, and what could happen if they do not
22. describe the things that may cause errors or discrepancies with the test results, and how to avoid these
23. explain whom to seek authorisation from if they need to alter or change the test procedures

24. explain how to record the results of each individual test, and the documentation that must be used
25. explain how to analyse test results and make valid decisions about the acceptability of the equipment
26. describe the types and limits of adjustments that can be made to the equipment on completion of the testing activity
27. describe the procedure to be followed if the equipment fails to meet the test specification
28. describe the environmental control requirements and company operating procedures relating to functional testing
29. describe the documentation required, and the procedures to be followed, at the conclusion of the test
30. describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve

**Level:** 3  
**Credit value:** 38  
**UAN number:** A/600/5484

**Unit aim**

This unit covers the skills and knowledge needed to prove the competences required to carry out scheduled servicing activities on medical equipment, in accordance with approved procedures. The learner 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.

The learner's responsibilities will require them 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 they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner 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. The learner will be expected to work with minimal supervision, taking full responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying scheduled servicing procedures to medical equipment. The learner 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 servicing activities, correcting faults and ensuring that the serviced equipment functions to the required specification and remains compliant with all standards and regulations. In addition, the learner will be expected to report where the outcome identifies the need for further investigation or maintenance work.

The learner will understand the safety precautions required when carrying out the servicing activities, especially those for isolating the equipment. The learner will also understand their responsibilities for safety and the importance of taking the necessary safeguards to protect themselves and others in the workplace.

**Learning outcomes**

There are **two** learning outcomes to this unit. The learner will be able to:

1. Carry out scheduled servicing on medical equipment
2. Know how to carry out scheduled servicing on medical equipment

### **Guided learning hours**

It is recommended that **74** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 62: Carrying Out Scheduled Servicing on Medical Equipment (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

## Unit 162

# Carrying Out Scheduled Servicing on Medical Equipment

### Outcome 1

Carry out scheduled servicing on medical equipment

#### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following scheduled servicing activities:
  - plan and communicate the servicing activities so as to minimise disruption to normal working
  - obtain and use the correct issue of company and/or manufacturers' drawings and servicing documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - 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 and maintain 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
3. 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
4. follow the relevant servicing schedules to carry out the required work
5. ensure that the serviced equipment meets all of the following:
  - 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
  - the equipment remains compliant with all standards and regulations
  - all potential defects are identified and reported for future action
6. carry out the servicing activities within the limits of their personal authority
7. carry out the servicing activities in the specified sequence and in an agreed timescale

8. carry out all of the following scheduled servicing activities:
  - visual examination of condition and security of enclosures
  - checking and replacing 'lived' 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/deterioration 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
9. report any instances where the servicing activities cannot be fully met or where there are identified defects outside the planned schedule
10. complete the relevant servicing records accurately, to include one of the following, and pass them on to the appropriate person:
  - job cards
  - servicing log or report
  - permit to work/formal risk assessment and/or sign-on/off procedures
  - company-specific documentation
11. dispose of waste materials in accordance with safe working practices and approved procedures

## Unit 162

# Carrying Out Scheduled Servicing on Medical Equipment

### Outcome 2

Know how to carry out scheduled servicing on medical equipment

#### Assessment Criteria

The learner will be able to:

1. describe 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 the learner
2. describe the statutory and advisory documentation relating to medical devices (such as warnings and guidance from the regulatory authority and British and European standards)
3. describe the importance of reporting any equipment adverse incidents to the regulatory authority
4. describe 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. describe the specific health and safety precautions to be applied during the scheduled servicing activities, and their effects on others
6. describe the importance of wearing protective clothing and other appropriate safety equipment during the servicing activities
7. explain 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. describe the working practices of, and the need to respect the hospital ward and/or patient environment
9. describe the hazards associated with carrying out scheduled servicing activities on medical equipment (such as exposure to live conductors, misuse of tools), and how to minimise them and reduce any risks
10. explain 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. describe the servicing schedules and methods to be followed, in order to comply with company procedures for scheduled servicing activities on medical equipment
12. describe the basic principle of operation of the medical equipment/circuits being serviced, and the function/purpose of individual components within the equipment/circuit
13. describe the human physiology directly associated with the medical equipment being serviced
14. describe the risks to the human body from external energy sources associated with the equipment being serviced
15. describe 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. describe the different types of control system, their various components and maintenance requirements
17. describe 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. describe the methods of checking that components are fit for purpose, and the need to replace 'lived' items (such as hoses, seals, filters, masks and overload protection devices)
19. describe the procedures and precautions to be adopted to eliminate/protect against electrostatic discharge (ESD) when working on sensitive equipment or devices

20. explain how to make sensory checks (by sight, sound, smell, touch)
21. explain 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. describe the procedure for obtaining the consumables to be used during the scheduled servicing activity
23. describe the importance of carrying out electrical safety tests on medical equipment, and the implications if this is not carried out
24. explain how to complete servicing records/logs/reports that comply with company policy and procedures
25. describe the equipment operating and control procedures, and how to apply them in order to carry out scheduled servicing
26. describe the problems that can occur whilst carrying out the scheduled servicing activities, and how they can be avoided
27. describe the organisational procedure to be adopted for the safe disposal of waste of all types of material
28. describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve



**Level:** 3  
**Credit value:** 70  
**UAN number:** R/600/5491

## Unit aim

This unit covers the skills and knowledge needed to prove the competences required to carry out servicing activities on cardiovascular equipment, in accordance with approved procedures. The learner 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. The learner 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.

The learner's responsibilities will require them to comply with organisational policy and procedures for the servicing activities undertaken, and to report any problems with the activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner 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. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the correct servicing procedures. The learner will understand the dismantling and reassembly methods and procedures used, and their application. The learner 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 and remains compliant with all standards and regulations.

The learner will understand the safety precautions required when carrying out the servicing activities, especially those for isolating the equipment. The learner will also understand their responsibilities for safety, and the importance of taking the necessary safeguards to protect themselves and others in the workplace.

## Learning outcomes

There are **two** learning outcomes to this unit. The learner will be able to:

1. Service cardiovascular equipment
2. Know how to service cardiovascular equipment

## Guided learning hours

It is recommended that **119** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 63: Servicing Cardiovascular Equipment (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

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**Assessment Criteria**

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the servicing activities:
  - plan and communicate the servicing activities so as to minimise disruption to normal working
  - obtain and use the correct issue of company and/or manufacturers' drawings and servicing documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - 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 and maintain 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
3. carry out servicing on four of the following types of cardiovascular equipment:
  - electrocardiograph (ECG)
  - pacemaker
  - pulse oximeters
  - defibrillators
  - blood pressure devices
4. follow the relevant servicing schedules to carry out the required work
5. service cardiovascular equipment, in compliance with all of the following:
  - 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
  - the equipment remains compliant with all standards and regulations
  - all potential defects are identified and reported for future action
6. carry out the servicing activities within the limits of their personal authority
7. carry out the servicing activities in the specified sequence and in an agreed timescale

8. 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 'lifer' 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
  
9. remove and replace/refit 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)
  
10. report any instances where the servicing activities cannot be fully met or where there are identified defects outside the planned schedule
  
11. complete the relevant servicing records accurately, to include one of the following, and pass them on to the appropriate person:
  - job cards
  - servicing logs or reports
  - company-specific documentation
  
12. dispose of waste materials in accordance with safe working practices and approved procedures

**Assessment Criteria**

The learner will be able to:

1. describe 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 the learner
2. describe the statutory and advisory documentation relating to medical devices (such as warnings and guidance from the regulatory authority, British and European standards)
3. Describe the importance of reporting any equipment adverse incidents to the regulatory authority
4. describe the isolation procedure that applies to the servicing activities (such as electrical isolation, removal of fuses, placing of maintenance warning notices)
5. explain 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. describe the importance of wearing protective clothing and other appropriate safety equipment
7. explain 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. describe the working practices of, and the need to respect the hospital ward and/or patient environment
9. describe the hazards associated with carrying out servicing activities on cardiovascular equipment (such as exposure to live conductors, misuse of tools), and how to minimise them and reduce any risks
10. describe the basic principles of operation of the cardiovascular equipment being serviced, and the function of individual components
11. describe the human physiology directly associated with the cardiovascular equipment being serviced
12. describe the associated risks to the human body from external energy sources on the cardiovascular equipment
13. describe 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. describe the care, handling and application of ohmmeters, multimeters and other electrical measuring instruments (including dedicated test equipment)
15. describe the 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. explain 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. describe the techniques used to dismantle/assemble cardiovascular equipment (such as unplugging, de-soldering, removal of screwed, clamped and crimped connections, removal of pipes, hoses and mechanical components)
18. describe the methods of removing and replacing components without causing damage to the equipment or other components

19. describe the procedures and precautions to be adopted to eliminate/protect against electrostatic discharge (ESD) when working on sensitive equipment or devices
20. describe 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. describe the use of BS 7671/IEE wiring, and other, regulations when replacing wires and cables
22. describe the methods of attaching identification markers/labels to removed components or cables to assist with re-assembly
23. describe the tools and equipment used in the servicing activities (including the use of cable stripping tools, crimping tools, soldering irons)
24. describe the methods of checking that components are fit for purpose, and the need to replace 'lived' items
25. explain how to make adjustments to components/assemblies to ensure that they function correctly
26. explain 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. describe the importance of carrying out electrical safety tests on cardiovascular equipment, and the implications if this is not carried out
28. describe the importance of making visual checks before proving the equipment with the electrical supply on
29. describe the generation of documentation and/or reports following the servicing activity
30. describe the equipment operating and control procedures to be applied during the servicing activity
31. describe the problems that can occur during the servicing activity, and how they can be overcome
32. describe the organisational procedure(s) to be adopted for the safe disposal of waste of all types of material
33. describe the extent of their own authority and to whom they should report if they have a problem that they cannot resolve

**Level:** 3  
**Credit value:** 70  
**UAN number:** F/600/5499

**Unit aim**

This unit covers the skills and knowledge needed to prove the competences required to carry out servicing activities on physiological monitoring and infusion equipment, in accordance with approved procedures. The learner 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. The learner 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.

The learner's responsibilities will require them to comply with organisational policy and procedures for the servicing activities undertaken, and to report any problems with the activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner 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. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the correct servicing procedures. The learner will understand the dismantling and reassembly methods and procedures used, and their application. The learner 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 and remains compliant with all standards and regulations.

The learner will understand the safety precautions required when carrying out the servicing activities, especially those for isolating the equipment. The learner will also understand their responsibilities for safety, and the importance of taking the necessary safeguards to protect themselves and others in the workplace.

**Learning outcomes**

There are **two** learning outcomes to this unit. The learner will be able to:

1. Service physiological monitoring and infusion equipment
2. Know how to service physiological monitoring and infusion equipment

### **Guided learning hours**

It is recommended that **119** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 64: Servicing Physiological Monitoring and Infusion Equipment (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**



## Unit 164

# Servicing Physiological Monitoring and Infusion Equipment

### Outcome 1

Service physiological monitoring and infusion equipment

#### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the servicing activities:
  - plan and communicate the servicing activities so as to minimise disruption to normal working
  - obtain and use the correct issue of company and/or manufacturers' drawings and servicing documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - 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 and maintain 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
3. 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
4. follow the relevant servicing schedules to carry out the required work
5. service physiological monitoring and infusion equipment, in compliance with all of the following:
  - 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
  - the equipment remains compliant with all standards and regulations
  - all potential defects are identified and reported for future action
6. carry out the servicing activities within the limits of their personal authority
7. carry out the servicing activities in the specified sequence and in an agreed timescale

8. 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 'lived' 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
  
9. remove and replace/refit 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)
  
10. report any instances where the servicing activities cannot be fully met or where there are identified defects outside the planned schedule
11. complete the relevant servicing records accurately, to include one of the following, and pass them on to the appropriate person:
  - job cards
  - servicing logs or reports
  - company-specific documentation
  
12. dispose of waste materials in accordance with safe working practices and approved procedures

## Unit 164

# Servicing Physiological Monitoring and Infusion Equipment

### Outcome 2

Know how to service physiological monitoring and infusion equipment

#### Assessment Criteria

The learner will be able to:

1. describe 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 the learner
2. describe the statutory and advisory documentation relating to medical devices (such as warnings and guidance from the regulatory authority and British and European standards)
3. describe the importance of reporting any equipment adverse incidents to the regulatory authority
4. describe the isolation procedure that applies to the servicing activities (such as electrical isolation, removal of fuses, placing of maintenance warning notices)
5. explain 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. describe the importance of wearing protective clothing and other appropriate safety equipment during the servicing activities
7. explain 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. describe the working practices of, and the need to respect the hospital ward and/or patient environment
9. describe the hazards associated with carrying out servicing activities on physiological monitoring and infusion equipment (such as exposure to live conductors, misuse of tools), and how to minimise them and reduce any risk
10. describe the basic principles of operation of the physiological monitoring and infusion equipment being serviced, and the function of individual components
11. describe the human physiology directly associated with the infusion and monitoring equipment being serviced
12. describe the risks on the human body from external energy sources associated with physiological monitoring and infusion equipment
13. describe 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. describe the care, handling and application of ohmmeters, multimeters and other electrical measuring instruments (including dedicated test equipment)
15. describe the 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. explain 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)

17. describe 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)
18. describe the methods of removing and replacing components without causing damage to the equipment or components
19. describe the procedures and precautions to be adopted to eliminate/protect against electrostatic discharge (ESD) when working on sensitive equipment or devices
20. describe 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. describe the use of BS7671/IEE wiring, and other, regulations when replacing wires and cables
22. describe the methods of attaching identification markers/labels to removed components or cables to assist with re-assembly
23. describe the tools and equipment used in the servicing activities (including the use of cable stripping tools, crimping tools, soldering irons)
24. describe the methods of checking that components are fit for purpose, and the need to replace 'lived' items
25. explain how to make adjustments to components/assemblies to ensure that they function correctly
26. explain 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. describe the importance of carrying out electrical safety tests on equipment, and the implications if this is not carried out
28. describe the importance of making visual checks before proving the equipment with the electrical supply on
29. describe the generation of documentation and/or reports following the servicing activity
30. describe the equipment operating and control procedures to be applied during the servicing activity
31. describe the problems that can occur during the servicing activity, and how they can be overcome
32. describe the organisational procedure(s) to be adopted for the safe disposal of waste of all types of materials
33. describe the extent of their own authority and to whom they should report if they have a problem that they cannot resolve

**Level:** 3  
**Credit value:** 70  
**UAN number:** Y/600/5508

**Unit aim**

This unit covers the skills and knowledge needed to prove the competences required to carry out servicing activities on anaesthetic and ventilation equipment, in accordance with approved procedures. The learner 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. The learner 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.

The learner's responsibilities will require them to comply with organisational policy and procedures for the servicing activities undertaken, and to report any problems with the activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner 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. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the correct servicing procedures. The learner will understand the dismantling and reassembly methods and procedures used, and their application. The learner 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 and remains compliant with all standards and regulations.

The learner will understand the safety precautions required when carrying out the servicing activities, especially those for isolating the equipment. The learner will also understand their responsibilities for safety, and the importance of taking the necessary safeguards to protect themselves and others in the workplace.

**Learning outcomes**

There are **two** learning outcomes to this unit. The learner will be able to:

1. Service anaesthetic and ventilation equipment
2. Know how to service anaesthetic and ventilation equipment

**Guided learning hours**

It is recommended that **119** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 65: Servicing Anaesthetic and Ventilation Equipment (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

## Unit 165

# Servicing Anaesthetic and Ventilation Equipment

## Outcome 1

### Service anaesthetic and ventilation equipment

#### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the servicing activities:
  - plan and communicate the servicing activities so as to minimise disruption to normal working
  - obtain and use the correct issue of company and/or manufacturers' drawings and servicing documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - 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 and maintain 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
3. 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
4. follow the relevant servicing schedules to carry out the required work
5. service anaesthetic and ventilation equipment, in compliance with all of the following:
  - 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
  - the equipment remains compliant with all standards and regulations
  - all potential defects are identified and reported for future action
6. carry out the servicing activities within the limits of their personal authority
7. carry out the servicing activities in the specified sequence and in an agreed timescale
8. 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 all 'lived' 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
- replacing damaged/defective components

9. remove and replace/refit 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
- potentiometers
- gauges
- display units
- indicators (lamps, LEDs)
- valves
- pumps
- motors
- hoses/pipework
- bellows
- structural components

10. report any instances where the servicing activities cannot be fully met or where there are identified defects outside the planned schedule

11. complete the relevant servicing records accurately, to include one of the following, and pass them on to the appropriate person:

- job cards
- servicing logs or reports
- company-specific documentation

12. dispose of waste materials in accordance with safe working practices and approved procedures



## Unit 165

# Servicing Anaesthetic and Ventilation Equipment

### Outcome 2

Know how to service anaesthetic and ventilation equipment

#### Assessment Criteria

The learner will be able to:

1. describe 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 the learner
2. describe the statutory and advisory documentation relating to medical devices (such as warnings and guidance from the regulatory authority british and european standards)
3. describe the importance of reporting any equipment adverse incidents to the regulatory authority
4. describe the isolation procedure that applies to the servicing activities (such as electrical isolation, removal of fuses, placing of maintenance warning notices)
5. explain 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. describe the importance of wearing protective clothing and other appropriate safety equipment during the servicing activities
7. explain 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. describe the working practices of, and the need to respect the hospital ward and/or patient environment
9. describe the hazards associated with carrying out servicing activities on anaesthetic and ventilation equipment (such as exposure to live conductors, misuse of tools), and how to minimise them and reduce any risk
10. describe the basic principle of operation of the anaesthetic and ventilation equipment being serviced, and the function of individual components
11. describe the human physiology directly associated with the anaesthetic and ventilation equipment being serviced
12. describe the risks to the human body from external energy sources associated with anaesthetic and ventilation equipment
13. describe 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. describe the care, handling and application of ohmmeters, multimeters and other electrical measuring instruments (including dedicated test equipment)
15. describe the 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. explain 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)

17. describe 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)
18. describe the methods of removing and replacing components without causing damage to the equipment or other components
19. describe the procedures and precautions to be adopted to eliminate/protect against electrostatic discharge (ESD) when working on sensitive equipment or devices
20. describe 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. describe the use of BS7671/IEE wiring, and other, regulations when replacing wires and cables
22. describe the methods of attaching identification markers/labels to removed components or cables to assist with re-assembly
23. describe the tools and equipment used in the servicing activities (including the use of cable stripping tools, crimping tools, soldering irons)
24. describe the methods of checking that components are fit for purpose, and the need to replace 'lived' items
25. explain how to make adjustments to components/assemblies to ensure that they function correctly
26. explain 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. describe the importance of carrying out electrical safety tests on anaesthetic and ventilation equipment, and the implications if this is not carried out
28. describe the importance of making visual checks before proving the equipment with the electrical supply on
29. describe the generation of documentation and/or reports following the servicing activity
30. describe the equipment operating and control procedures to be applied during the servicing activity
31. describe the problems that can occur during the servicing activity, and how they can be overcome
32. describe the organisational procedure(s) to be adopted for the safe disposal of waste of all types of materials
33. describe the extent of their own authority and to whom they should report if they have a problem that they cannot resolve

**Level:** 3  
**Credit value:** 70  
**UAN number:** F/600/5518

**Unit aim**

This unit covers the skills and knowledge needed to prove the competences required to carry out servicing activities on operating theatre and surgical equipment, in accordance with approved procedures. The learner 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. The learner 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.

The learner's responsibilities will require them to comply with organisational policy and procedures for the servicing activities undertaken, and to report any problems with the activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner 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. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the correct servicing procedures. The learner will understand the dismantling and reassembly methods and procedures used, and their application. The learner 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 and remains compliant with all standards and regulations.

The learner will understand the safety precautions required when carrying out the servicing activities, especially those for isolating the equipment. The learner will also understand their responsibilities for safety, and the importance of taking the necessary safeguards to protect themselves and others in the workplace.

**Learning outcomes**

There are **two** learning outcomes to this unit. The learner will be able to:

1. Service operating theatre and surgical equipment
2. Know how to service operating theatre and surgical equipment

### **Guided learning hours**

It is recommended that **119** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 66: Servicing Operating Theatre and Surgical Equipment (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

## Unit 166

# Servicing Operating Theatre and Surgical Equipment

## Outcome 1

### Service operating theatre and surgical equipment

#### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the servicing activities:
  - plan and communicate the servicing activities so as to minimise disruption to normal working
  - obtain and use the correct issue of company and/or manufacturers' drawings and servicing documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - 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 and maintain 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
3. 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
4. follow the relevant servicing schedules to carry out the required work
5. service operating theatre and surgical equipment, in compliance with all of the following:
  - 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
  - the equipment remains compliant with all standards and regulations
  - all potential defects are identified and reported for future action
6. carry out the servicing activities within the limits of their personal authority
7. carry out the servicing activities in the specified sequence and in an agreed timescale

8. 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 'lifer' 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
  
9. remove and replace/refit 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
  
10. report any instances where the servicing activities cannot be fully met or where there are identified defects outside the planned schedule

11. complete the relevant servicing records accurately from one of the following and pass them on to the appropriate person:
  - job cards
  - servicing logs or reports
  - company-specific documentation
12. dispose of waste materials in accordance with safe working practices and approved procedures

## Unit 166

# Servicing Operating Theatre and Surgical Equipment

## Outcome 2

Know how to service operating theatre and surgical equipment

### Assessment Criteria

The learner will be able to:

1. describe 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 the learner
2. describe the statutory and advisory documentation relating to medical devices (such as warnings and guidance from the regulatory authority British and European standards)
3. describe the importance of reporting any equipment adverse incidents to the regulatory authority
4. describe the isolation procedure that applies to the servicing activities (such as electrical isolation, removal of fuses, placing of maintenance warning notices)
5. explain 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. describe the importance of wearing protective clothing and other appropriate safety equipment during the servicing activities
7. explain 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. describe the working practices of, and the need to respect the hospital theatre, ward and/or patient environment
9. describe the hazards associated with carrying out servicing activities on operating theatre equipment (such as exposure to live conductors, misuse of tools), and how to minimise them and reduce any risks
10. describe the basic principles of operation of the operating theatre and surgical equipment being serviced, and the function of individual components
11. describe the human physiology directly associated with the operating theatre and surgical equipment being serviced
12. describe the risks on the human body from external energy sources associated with operating theatre and surgical equipment
13. describe 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. describe the care, handling and application of ohmmeters, multimeters and other electrical measuring instruments (including dedicated test equipment)
15. describe the 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. explain 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)



17. describe 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)
18. describe the methods of removing and replacing components without causing damage to the equipment or components
19. describe the procedures and precautions to be adopted to eliminate/protect against electrostatic discharge (ESD) when working on sensitive equipment or devices
20. describe 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. describe the use of BS7671/IEE wiring, and other, regulations when replacing wires and cables
22. describe the methods of attaching identification markers/labels to removed components or cables to assist with re-assembly
23. describe the tools and equipment used in the servicing activities (including the use of cable stripping tools, crimping tools, soldering irons)
24. describe the methods of checking that components are fit for purpose, and the need to replace 'lived' items
25. explain how to make adjustments to components/assemblies to ensure that they function correctly
26. explain 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. describe the importance of carrying out electrical safety tests on operating theatre and surgical equipment, and the implications if this is not carried out
28. describe the importance of making visual checks before proving the equipment with the electrical supply on
29. describe the generation of documentation and/or reports following the servicing activity
30. describe the equipment operating and control procedures to be applied during the servicing activity
31. describe the problems that can occur during the servicing activity, and how they can be overcome
32. describe the organisational procedure(s) to be adopted for the safe disposal of waste of all types of material
33. describe the extent of their own authority and to whom they should report if they have a problem that they cannot resolve

**Level:** 3  
**Credit value:** 70  
**UAN number:** T/600/5581

**Unit aim**

This unit covers the skills and knowledge needed to prove the competences required to carry out servicing activities on medical imaging equipment, in accordance with approved procedures. The learner 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. The learner 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.

The learner's responsibilities will require them to comply with organisational policy and procedures for the servicing activities undertaken, and to report any problems with the activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner 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. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the correct servicing procedures. The learner will understand the dismantling and reassembly methods and procedures used, and their application. The learner 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 and remains compliant with all standards and regulations.

The learner will understand the safety precautions required when carrying out the servicing activities, especially those for isolating the equipment. The learner will also understand their responsibilities for safety, and the importance of taking the necessary safeguards to protect themselves and others in the workplace.

**Learning outcomes**

There are **two** learning outcomes to this unit. The learner will be able to:

1. Service medical imaging equipment
2. Know how to service medical imaging equipment

**Guided learning hours**

It is recommended that **119** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 67: Servicing Medical Imaging Equipment (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

**Assessment Criteria**

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the servicing activities:
  - plan and communicate the servicing activities so as to minimise disruption to normal working
  - obtain and use the correct issue of company and/or manufacturers' drawings and servicing documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - 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 and maintain 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
3. 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
4. follow the relevant servicing schedules to carry out the required work
5. service medical imaging equipment, in compliance with all of the following:
  - 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
  - the equipment remains compliant with all standards and regulations
  - all potential defects are identified and reported for future action
6. carry out the servicing activities within the limits of their personal authority
7. carry out the servicing activities in the specified sequence and in an agreed timescale

8. 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 all 'lived' 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
  - replacing damaged/defective components
9. remove and replace/refit 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
  - 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
  - potentiometers
10. report any instances where the servicing activities cannot be fully met or where there are identified defects outside the planned schedule
11. complete the relevant servicing records accurately, to include one of the following, and pass them on to the appropriate person:
  - job cards
  - servicing logs or reports
  - company-specific documentation
12. dispose of waste materials in accordance with safe working practices and approved procedures

**Assessment Criteria**

The learner will be able to:

1. describe 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 the learner
2. describe the statutory and advisory documentation relating to medical imaging equipment (such as warnings and guidance from the regulatory authority British and European standards)
3. describe the ionising and radiation regulations, and the responsibility they place upon them when servicing medical imaging equipment
4. describe the importance of reporting any equipment adverse incidents to the regulatory authority
5. describe the isolation procedure that applies to servicing activities (such as electrical isolation, removal of fuses, placing of maintenance warning notices)
6. explain 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. describe the importance of wearing protective clothing and other appropriate safety equipment during the servicing activities
8. explain 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. describe the working practices of, and the need to respect the medical imaging department/environment
10. describe the hazards associated with carrying out servicing activities on medical imaging equipment (such as exposure to live conductors, misuse of tools), and how to minimise them and reduce any risks
11. describe the basic principles of operation of the medical imaging equipment being serviced, and the function of individual components
12. describe the human physiology directly associated with medical imaging radiation
13. describe the risks to the human body from x-ray radiation and other energy sources associated with medical imaging equipment
14. describe 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)
15. describe the care, handling and application of ohmmeters, multimeters and other electrical measuring instruments (including dedicated test equipment)
16. describe the company policy on the repair/replacement of components, and the procedure for obtaining replacement parts, materials and other consumables necessary for the servicing activities
17. explain 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)
18. describe 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)

19. describe the methods of removing and replacing components without causing damage to the equipment or other components
20. describe the procedures and precautions to be adopted to eliminate/protect against electrostatic discharge (ESD) when working on sensitive equipment or devices
21. describe the different types of cabling (such as multicore cables, single core cables, steel wire armoured (SWA), mineral insulated (MI), screened cables), and their application
22. describe the use of BS7671/IEE wiring, and other, regulations when replacing wires and cables
23. describe the methods of attaching identification markers/labels to removed components or cables to assist with re-assembly
24. describe the tools and equipment used in the servicing activities (including the use of cable stripping tools, crimping tools, soldering irons)
25. describe the methods of checking that components are fit for purpose, and the need to replace 'lifer' items
26. explain how to make adjustments to components/assemblies to ensure that they function correctly
27. explain 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
28. describe the importance of carrying out electrical safety tests on medical imaging equipment, and the implications if this is not carried out
29. describe the importance of making visual checks before proving the equipment with the electrical supply on
30. describe the generation of documentation and/or reports following the servicing activity
31. describe the equipment operating and control procedures to be applied during the servicing activity
32. describe the problems that can occur during the servicing activity, and how they can be overcome
33. describe the organisational procedure(s) to be adopted for the safe disposal of waste of all types of material
34. describe the extent of their own authority and to whom they should report if they have a problem that they cannot resolve

**Level:** 3  
**Credit value:** 70  
**UAN number:** R/600/5586

## Unit aim

This unit covers the skills and knowledge needed to prove the competences required to carry out servicing activities on laboratory equipment, in accordance with approved procedures. The learner 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. The learner 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.

The learner's responsibilities will require them to comply with organisational policy and procedures for the servicing activities undertaken, and to report any problems with the activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner 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. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the correct servicing procedures. The learner will understand the dismantling and reassembly methods and procedures used, and their application. The learner 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 and remains compliant with all standards and regulations.

The learner will understand the safety precautions required when carrying out the servicing activities, especially those for isolating the equipment. The learner will also understand their responsibilities for safety, and the importance of taking the necessary safeguards to protect themselves and others in the workplace.

## Learning outcomes

There are **two** learning outcomes to this unit. The learner will be able to:

1. Service laboratory equipment
2. Know how to service laboratory equipment

## Guided learning hours

It is recommended that **119** hours should be allocated for this unit, although patterns of delivery are likely to vary.



### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 68: Servicing Laboratory Equipment (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

**Assessment Criteria**

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the servicing activities:
  - plan and communicate the servicing activities so as to minimise disruption to normal working
  - obtain and use the correct issue of company and/or manufacturers' drawings and servicing documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - 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 and maintain 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
3. 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
4. follow the relevant servicing schedules to carry out the required work
5. service laboratory equipment, in compliance with all of the following:
  - 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
  - the equipment remains compliant with all standards and regulations
  - all potential defects are identified and reported for future action
6. carry out the servicing activities within the limits of their personal authority
7. carry out the servicing activities in the specified sequence and in an agreed time scale

8. 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 'lifer' 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
  
9. remove and replace/refit 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)
  
10. report any instances where the servicing activities cannot be fully met or where there are identified defects outside the planned schedule
11. complete relevant servicing records accurately, to include one of the following, and pass them on to the appropriate person:
  - job cards
  - servicing logs or reports
  - company-specific documentation
  
12. dispose of waste materials in accordance with safe working practices and approved procedures

## Unit 168

## Servicing Laboratory Equipment

### Outcome 2

### Know how to service laboratory equipment

#### Assessment Criteria

The learner will be able to:

1. describe 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 the learner
2. describe the statutory and advisory documentation relating to laboratory equipment (such as warnings and guidance from the regulatory authority and British and European standards)
3. describe the isolation procedure that applies to servicing activities (such as electrical isolation, removal of fuses, placing of maintenance warning notices)
4. describe the importance of reporting any equipment adverse incidents to the regulatory authority
5. explain 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. describe the importance of wearing protective clothing and other appropriate safety equipment during the servicing activities
7. explain 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. describe the working practices of, and the need to respect the laboratory environment
9. describe the hazards associated with carrying out servicing activities on laboratory equipment (such as exposure to live conductors, misuse of tools), and how to minimise them and reduce any risks
10. describe the basic principles of operation of the laboratory equipment being serviced, and the function of individual components
11. describe the human physiology directly associated with the laboratory equipment being serviced
12. describe 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. describe the care, handling and application of ohmmeters, multimeters and other electrical measuring instruments (including dedicated test equipment)
14. describe the 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. explain 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. describe the techniques used to dismantle/assemble laboratory equipment (such as unplugging, de-soldering, removal of screwed, clamped and crimped connections, removal of pipes, hoses and mechanical components)
17. describe the methods of removing and replacing components without causing damage to the equipment or other components
18. describe the procedures and precautions to be adopted to eliminate/protect against electrostatic discharge (ESD) when working on sensitive equipment or devices
19. describe 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. describe the use of BS7671/IEE wiring, and other, regulations when replacing wires and cables
21. describe the methods of attaching identification markers/labels to removed components or cables to assist with re-assembly
22. describe the tools and equipment used in the servicing activities (including the use of cable stripping tools, crimping tools, soldering irons)
23. describe the methods of checking that components are fit for purpose, and the need to replace 'lived' items
24. explain how to make adjustments to components/assemblies to ensure that they function correctly
25. explain 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. describe the importance of carrying out electrical safety tests on laboratory equipment, and the implications if this is not carried out
27. describe the importance of making visual checks before proving the equipment with the electrical supply on
28. describe the generation of documentation and/or reports following the servicing activity
29. describe the equipment operating and control procedures to be applied during the servicing activity
30. describe the problems that can occur during the servicing activity, and how they can be overcome
31. describe the organisational procedure(s) to be adopted for the safe disposal of waste of all types of material
32. describe the extent of their own authority and to whom they should report if they have a problem that they cannot resolve

**Level:** 3  
**Credit value:** 70  
**UAN number:** D/600/5591

**Unit aim**

This unit covers the skills and knowledge needed to prove the competences required to carry out servicing activities on dental equipment, in accordance with approved procedures. The learner 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. The learner 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.

The learner's responsibilities will require them to comply with organisational policy and procedures for the servicing activities undertaken, and to report any problems with the activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner 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. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the correct servicing procedures. The learner will understand the dismantling and reassembly methods and procedures used, and their application. The learner 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 and remains compliant with all standards and regulations.

The learner will understand the safety precautions required when carrying out the servicing activities, especially those for isolating the equipment. The learner will also understand their responsibilities for safety, and the importance of taking the necessary safeguards to protect themselves and others in the workplace.

**Learning outcomes**

There are **two** learning outcomes to this unit. The learner will be able to:

1. Service dental equipment
2. Know how to service dental equipment

**Guided learning hours**

It is recommended that **119** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 69: Servicing Dental Equipment (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

**Assessment Criteria**

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the servicing activities:
  - plan and communicate the servicing activities so as to minimise disruption to normal working
  - obtain and use the correct issue of company and/or manufacturers' drawings and servicing documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - 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 and maintain 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
3. 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
4. follow the relevant servicing schedules to carry out the required work
5. service dental equipment, in compliance with all of the following:
  - 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
  - the equipment remains compliant with all standards and regulations
  - all potential defects are identified and reported for future action
6. carry out the servicing activities within the limits of their personal authority
7. carry out the servicing activities in the specified sequence and in an agreed timescale



8. 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 'lified' 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
  
9. remove and replace/refit 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)
  
10. report any instances where the servicing activities cannot be fully met or where there are identified defects outside the planned schedule
11. complete the relevant servicing records accurately, to include one of the following, and pass them on to the appropriate person:
  - job cards
  - servicing logs or reports
  - company-specific documentation
  
12. dispose of waste materials in accordance with safe working practices and approved procedures

**Assessment Criteria**

The learner will be able to:

1. describe 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 the learner
2. describe the statutory and advisory documentation relating to dental equipment (such as warnings and guidance from the regulatory authority and British and European standards)
3. describe the importance of reporting any equipment adverse incidents to the regulatory authority
4. describe the isolation procedure that applies to the servicing activities (such as electrical isolation, removal of fuses, placing of maintenance warning notices)
5. explain 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. describe the importance of wearing protective clothing and other appropriate safety equipment during the servicing activities
7. explain 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. describe the working practices of, and the need to respect the dental department environment
9. describe the hazards associated with carrying out servicing activities on dental equipment (such as exposure to live conductors, misuse of tools), and how to minimise them and reduce any risks
10. describe the basic principles of operation of the dental equipment being serviced, and the function of individual components
11. describe 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. describe the care, handling and application of ohmmeters, multimeters and other electrical measuring instruments (including dedicated test equipment)
13. describe the 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. explain 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. describe the techniques used to dismantle/reassemble dental equipment (such as unplugging, de-soldering, removal of screwed, clamped and crimped connections, removal of pipes, hoses and mechanical components)
16. describe the methods of removing and replacing components without causing damage to the equipment or other components
17. describe the procedures and precautions to be adopted to eliminate/protect against electrostatic discharge (ESD) when working on sensitive equipment or devices
18. describe 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. describe the use of BS7671/IEE wiring, and other, regulations when replacing wires and cables

20. describe the methods of attaching identification markers/labels to removed components or cables to assist with re-assembly
21. describe the tools and equipment used in the servicing activities (including the use of cable stripping tools, crimping tools, soldering irons)
22. describe the methods of checking that components are fit for purpose, and the need to replace 'lived' items
23. explain how to make adjustments to components/assemblies to ensure that they function correctly
24. explain 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. describe the importance of carrying out electrical safety tests on dental equipment, and the implications if this is not carried out
26. describe the importance of making visual checks before proving the equipment with the electrical supply on
27. describe the generation of documentation and/or reports following the servicing activity
28. describe the equipment operating and control procedures to be applied during the servicing activity
29. describe the problems that can occur during the servicing activity, and how they can be overcome
30. describe the organisational procedure(s) to be adopted for the safe disposal of waste of all types of material
31. describe the extent of their own authority and to whom they should report if they have a problem that they cannot resolve

**Level:** 3

**Credit value:** 70

**UAN number:** F/600/5597

## Unit aim

This unit covers the skills and knowledge needed to prove the competences required to carry out servicing activities on medical therapeutic equipment, in accordance with approved procedures. The learner 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. The learner 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.

The learner's responsibilities will require them to comply with organisational policy and procedures for the servicing activities undertaken, and to report any problems with the activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner 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. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the correct servicing procedures. The learner will understand the dismantling and reassembly methods and procedures used, and their application. The learner 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 and remains compliant with all standards and regulations.

The learner will understand the safety precautions required when carrying out the servicing activities, especially those for isolating the equipment. The learner will also understand their responsibilities for safety, and the importance of taking the necessary safeguards to protect themselves and others in the workplace.

## Learning outcomes

There are **two** learning outcomes to this unit. The learner will be able to:

1. Service medical therapeutic equipment
2. Know how to service medical therapeutic equipment

## Guided learning hours

It is recommended that **119** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 70: Servicing Medical Therapeutic Equipment (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

**Assessment Criteria**

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the servicing activities:
  - plan and communicate the servicing activities so as to minimise disruption to normal working
  - obtain and use the correct issue of company and/or manufacturers' drawings and servicing documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - 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 and maintain 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
3. carry out servicing on five of the following types of medical therapeutic equipment:
  - nerve stimulating devices
  - interferential therapy devices
  - therapeutic ultrasound devices
  - therapeutic diathermy devices
  - traction devices
  - heater lamps
  - hydrotherapy equipment
  - exercise equipment
4. follow the relevant servicing schedules to carry out the required work
5. service medical therapeutic equipment, in compliance with all of the following:
  - 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
  - the equipment remains compliant with all standards and regulations
  - all potential defects are identified and reported for future action
6. carry out the servicing activities within the limits of their personal authority
7. carry out the servicing activities in the specified sequence and in an agreed timescale

8. 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 'lifer' 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
9. remove and replace/refit 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)
10. report any instances where the servicing activities cannot be fully met or where there are identified defects outside the planned schedule
11. complete the relevant servicing records accurately, to include one of the following, and pass them on to the appropriate person:
  - job cards
  - servicing logs or reports
  - company-specific documentation
12. dispose of waste materials in accordance with safe working practices and approved procedures

## Unit 170

### Outcome 2

# Servicing Medical Therapeutic Equipment

Know how to service medical therapeutic equipment

### Assessment Criteria

The learner will be able to:

1. describe 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 the learner
2. describe 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. describe the importance of reporting any equipment adverse incidents to the regulatory authority
4. describe the isolation procedure that applies to the servicing activities (such as electrical isolation, removal of fuses, placing of maintenance warning notices)
5. explain 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. describe the importance of wearing protective clothing and other appropriate safety equipment during the servicing activities
7. explain 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. describe the working practices of, and the need to respect the hospital ward and/or patient environment
9. describe the hazards associated with carrying out servicing activities on medical therapeutic equipment (such as exposure to live conductors, misuse of tools), and how to minimise them and reduce any risks
10. describe the basic principles of operation of the medical therapeutic equipment being serviced, and the function of individual components
11. describe the human physiology directly associated with the medical therapeutic equipment being serviced
12. describe the risks to the human body from external energy sources associated with the therapeutic equipment
13. describe 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. describe the care, handling and application of ohmmeters, multimeters and other electrical measuring instruments (including dedicated test equipment)
15. describe the company policy on the repair/replacement of components, and the procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance activities
16. explain 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)
17. describe 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)



18. describe the methods of removing and replacing components without causing damage to the equipment or other components
19. describe the procedures and precautions to be adopted to eliminate/protect against electrostatic discharge (ESD) when working on sensitive equipment or devices
20. describe 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. describe the use of BS7671/IEE wiring, and other, regulations when replacing wires and cables
22. describe the methods of attaching identification markers/labels to removed components or cables to assist with re-assembly
23. describe the tools and equipment used in the servicing activities (including the use of cable stripping tools, crimping tools, soldering irons)
24. describe the methods of checking that components are fit for purpose, and the need to replace 'lived' items
25. explain how to make adjustments to components/assemblies to ensure that they function correctly
26. explain 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. describe the importance of carrying out electrical safety tests on medical therapeutic equipment, and the implications if this is not carried out
28. describe the importance of making visual checks before proving the equipment with the electrical supply on
29. describe the generation of documentation and/or reports following the servicing activity
30. describe the equipment operating and control procedures to be applied during the servicing activity
31. describe the problems that can occur during the servicing activity, and how they can be overcome
32. describe the organisational procedure(s) to be adopted for the safe disposal of waste of all types of material
33. describe the extent of their own authority and to whom they should report if they have a problem that they cannot resolve

## Unit 171

# Servicing Mechanical and Electromechanical Assistive Technology Equipment

**Level:** 3  
**Credit value:** 70  
**UAN number:** F/600/5602

### Unit aim

This unit covers the skills and knowledge needed to prove the competences required to carry out servicing activities on mechanical and electromechanical assistive technology equipment, in accordance with approved procedures. The learner 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. The learner 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.

The learner's responsibilities will require them to comply with organisational policy and procedures for the servicing activities undertaken, and to report any problems with the activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner 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. The learner will be expected to work with minimal supervision, taking personal responsibility for their actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the correct servicing procedures. The learner will understand the dismantling and reassembly methods and procedures used, and their application. The learner 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 and remains compliant with all standards and regulations.

The learner will understand the safety precautions required when carrying out the servicing activities, especially those for isolating the equipment. The learner will also understand their responsibilities for safety, and the importance of taking the necessary safeguards to protect themselves and others in the workplace.

### Learning outcomes

There are **two** learning outcomes to this unit. The learner will be able to:

1. Service mechanical and electromechanical assistive technology equipment
2. Know how to service mechanical and electromechanical assistive technology equipment

### Guided learning hours

It is recommended that **119** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 71: Servicing Mechanical and Electromechanical Assistive Technology Equipment (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

## Unit 171

# Servicing Mechanical and Electromechanical Assistive Technology Equipment

## Outcome 1

Service mechanical and electromechanical assistive technology equipment

### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following servicing activities:
  - plan and communicate the servicing activities so as to minimise disruption to normal working
  - obtain and use the correct issue of company and/or manufacturers' drawings and servicing documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - 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 and maintain 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
3. 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
4. follow the relevant servicing schedules to carry out the required work
5. service assistive technology equipment in compliance with all of the following:
  - 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
  - the equipment remains compliant with all standards and regulations
  - all potential defects are identified and reported for future action
6. carry out the servicing activities within the limits of their personal authority
7. carry out the servicing activities in the specified sequence and in an agreed timescale

8. 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 'lified' 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
  
9. remove and replace/refit 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

10. report any instances where the servicing activities cannot be fully met or where there are identified defects outside the planned schedule
11. complete the relevant servicing records accurately, to include one of the following, and pass them on to the appropriate person:
  - job cards
  - servicing logs or reports
  - company-specific documentation
12. dispose of waste materials in accordance with safe working practices and approved procedures

## Unit 171

# Servicing Mechanical and Electromechanical Assistive Technology Equipment

### Outcome 2

Know how to service mechanical and electromechanical assistive technology equipment

#### Assessment Criteria

The learner will be able to:

1. describe 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 the learner
2. describe 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. describe the importance of reporting any equipment adverse incidents to the regulatory authority
4. describe the isolation procedure that applies to the servicing activities (such as electrical isolation, removal of fuses, placing of maintenance warning notices)
5. describe the hazards associated with carrying out servicing activities on mechanical and electromechanical assistive technology equipment (such as exposure to live conductors, misuse of tools), and how to minimise them and reduce any risks
6. explain 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. describe the importance of wearing protective clothing and other appropriate safety equipment during the servicing
8. explain 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
9. describe the appropriate working practices, and the need to respect the patient and carer in the patient environment, at home or in the community
10. describe the basic principle of operation of the assistive technology equipment being serviced, and the function of individual components
11. describe the human physiology directly associated with the assistive technology equipment being serviced
12. describe the risks to the human body from external energy sources associated with assistive technology equipment
13. describe 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)
14. describe the care, handling and application of multimeters and other measuring instruments (including dedicated test equipment)
15. describe the organisational policy on the repair/replacement of components, and the procedure for obtaining replacement parts, materials and other consumables necessary for the servicing activities
16. explain 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)

17. describe the techniques used to dismantle/reassemble AT mechanical/electromechanical equipment (such as mechanical fittings, unplugging, de-soldering, removal of crimped connections)
18. describe the methods of removing and replacing components without causing damage to the equipment or other components
19. describe the different types of cabling, and their application (such as multicore cables, single core cables, steel wire armoured (SWA), mineral insulated (MI), screened cables)
20. describe the methods of attaching identification markers/labels to removed components or cables to assist with re-assembly
21. describe the use of BS7671/IEE wiring, and other, regulations when replacing wires and cables
22. describe the tools and equipment used in the servicing activities
23. describe the methods of checking that components are fit for purpose, and the need to replace 'lived' items
24. explain how to make adjustments to components/assemblies to ensure that they function correctly
25. explain 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. describe the importance of carrying out electrical safety tests on medical equipment, and the implications if this is not carried out
27. describe the importance of making visual checks before functional testing or proving the equipment with the electrical supply on
28. describe the procedures for the generation of documentation and/or reports following the servicing activity
29. describe the equipment operating and control procedures to be applied during the servicing activity
30. describe the problems that can occur during the servicing activity, and how they can be overcome
31. describe the organisational procedure(s) to be adopted for the safe disposal of waste of all types of materials
32. describe the extent of their own authority and to whom they should report if they have a problem that they cannot resolve



**Level:** 3  
**Credit value:** 70  
**UAN number:** K/600/5609

**Unit aim**

This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on medical device and surgical instrument decontamination equipment, in accordance with approved procedures. The learner 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.

The learner's responsibilities will require them to comply with organisational policy and procedures for the maintenance activities undertaken, and to report any problems with the activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner 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. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the correct maintenance procedures. The learner will understand the dismantling and reassembly methods and procedures used, and their application. The learner 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 and remains compliant with all standards and regulations.

The learner will understand the safety precautions required when carrying out the maintenance activities, especially those for isolating the equipment. The learner will also understand their responsibilities for safety and the importance of taking the necessary safeguards to protect themselves and others in the workplace.

**Learning outcomes**

There are **two** learning outcomes to this unit. The learner will be able to:

1. Maintain medical device and surgical instrument decontamination equipment
2. Know how to maintain medical device and surgical instrument decontamination equipment

**Guided learning hours**

It is recommended that **119** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 72: Maintaining Medical Device and Surgical Instrument Decontamination Equipment (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

## Unit 172

# Maintaining Medical Device and Surgical Instrument Decontamination Equipment

### Outcome 1

Maintain medical device and surgical instrument decontamination equipment

#### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the maintenance activities:
  - plan and communicate the maintenance activities so as to minimise disruption to normal working
  - obtain and use the correct issue of company and/or manufacturers' drawings and maintenance documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, relevant health technical memorandums (HTM) personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - 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 and maintain 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
3. 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 washersPlus 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)
4. follow the relevant maintenance schedules to carry out the required work
5. maintain medical decontamination equipment, in compliance with all of the following:
  - 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/IEEWiring regulations
  - the equipment functions to specification
  - the equipment remains compliant with all standards and regulations
  - all potential defects are identified and reported for future action



6. carry out the maintenance activities within the limits of their personal authority
7. carry out the maintenance activities in the specified sequence and in an agreed timescale
8. 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
  - replacing all 'lived' 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
  - checking components for serviceability
  - 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
9. remove and replace/refit 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
  - calorifiers
  - 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
10. report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule

11. complete relevant maintenance records accurately, to include one of the following, and pass them on to the appropriate person:
  - job cards
  - servicing logs or reports
  - permit to work
  - company-specific documentation
  
12. dispose of waste materials in accordance with safe working practices and approved procedures

## Unit 172

# Maintaining Medical Device and Surgical Instrument Decontamination Equipment

### Outcome 2

Know how to maintain medical device and surgical instrument decontamination equipment

#### Assessment Criteria

The learner will be able to:

1. describe 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 the learner
2. describe 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. describe the importance of reporting any equipment adverse incidents to the regulatory authority
4. describe the isolation and lock-off procedures or permit-to-work procedure that applies to the decontamination equipment being maintained
5. explain 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. describe the importance of wearing protective clothing and other appropriate safety equipment
7. describe the hazards associated with carrying out maintenance activities on decontamination equipment, and how to minimise them and reduce any risks
8. describe the importance of working safely with steam supply systems
9. explain 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. describe the working practices of, and the need to respect the department where the maintenance is being carried out
11. describe the basic principles of operation of the decontamination equipment being maintained, and the function of individual components
12. describe the basic principles of the different types of decontamination process, and how this effects the selection of decontamination equipment
13. describe the basic understanding of reverse osmosis (RO) water systems, and its importance for the decontamination process
14. explain how to use and interpret equipment performance against steam tables
15. describe the sequence to be adopted for the dismantling/reassembly of various types of decontamination equipment
16. describe the care, handling and application of appropriate measuring instruments and test equipment
17. describe 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. explain how to check that replacement components meet the required specification/operating conditions
19. describe the techniques used to dismantle/reassemble decontamination equipment

20. describe the methods of removing and replacing components without causing damage to the equipment or other components
21. describe the methods of attaching identification markers/labels to removed components or cables to assist with re-assembly
22. describe the tools and equipment used in the maintenance activities
23. describe the methods of checking that components are fit for purpose, and the need to replace 'lived' items
24. explain how to make adjustments to components/assemblies to ensure that they function correctly
25. explain 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. describe the importance of making visual checks before proving the equipment
27. describe the generation of documentation and/or reports following the maintenance activity
28. describe the equipment operating and control procedures to be applied during the maintenance activity
29. describe the problems that can occur during the maintenance activity, and how they can be overcome
30. describe the organisational procedure(s) to be adopted for the safe disposal of waste of all types of material
31. describe the extent of their own authority and to whom they should report if they have a problem that they cannot resolve



**Level:** 3  
**Credit value:** 70  
**UAN number:** J/600/5617

**Unit aim**

This unit covers the skills and knowledge needed to prove the competences required to carry out maintenance activities on medical gas pipeline systems and equipment, in accordance with approved procedures. The learner 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.

The learner's responsibilities will require them to comply with organisational policy and procedures for the maintenance activities undertaken, and to report any problems with the activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner 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. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying the correct maintenance procedures. The learner will understand the dismantling and reassembly methods and procedures used, and their application. The learner 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 and remains compliant with all standards and regulations.

The learner will understand the safety precautions required when carrying out the maintenance activities, especially those for isolating the equipment. The learner will also understand their responsibilities for safety, and the importance of taking the necessary safeguards to protect themselves and others in the workplace.

**Learning outcomes**

There are **two** learning outcomes to this unit. The learner will be able to:

1. Maintain medical gas pipeline systems and equipment
2. Know how to maintain medical gas pipeline systems and equipment

### **Guided learning hours**

It is recommended that **119** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 73: Maintaining Medical Gas Pipeline Systems and Equipment (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

## Unit 173

# Maintaining Medical Gas Pipeline Systems and Equipment

## Outcome 1

Maintain medical gas pipeline systems and equipment

### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the maintenance activities:
  - plan and communicate the maintenance activities so as to minimise disruption to normal working
  - obtain and use the correct issue of company and/or manufacturers' drawings and maintenance documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, relevant health technical memorandums (HTM) personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
  - comply with permit-to-work procedures at all times
  - ensure the safe isolation of equipment (such as electricity, mechanical, gas, air or fluids)
  - provide and maintain 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
3. 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
4. follow the relevant maintenance schedules to carry out the required work
5. maintain medical gas pipeline systems, in compliance with all of the following:
  - 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
  - the equipment remains compliant with all standards and regulations
  - all potential defects are identified and reported for future action
6. carry out the maintenance activities within the limits of their personal authority
7. carry out the maintenance activities in the specified sequence and in an agreed timescale
8. 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)
- proofmarking/labelling of removed components
- visually checking components for serviceability
- replacing all 'lived' 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

9. remove and replace/refit 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

10. report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule

11. complete the relevant maintenance records accurately, to include one of the following, and pass them on to the appropriate person:

- job cards
- servicing logs or reports
- permit to work
- company-specific documentation

12. dispose of waste materials in accordance with safe working practices and approved procedures

## Unit 173

# Maintaining Medical Gas Pipeline Systems and Equipment

### Outcome 2

Know how to maintain medical gas pipeline systems and equipment

#### Assessment Criteria

The learner will be able to:

1. describe 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 the learner
2. describe 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. describe the importance of reporting any equipment adverse incidents to the regulatory authority
4. describe the permit-to-work procedure that applies to the gas pipeline system being maintained
5. explain 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. describe the importance of wearing protective clothing and other appropriate safety equipment
7. describe the hazards associated with carrying out maintenance activities on medical gas pipeline systems and equipment, and how to minimise them and reduce any risks
8. explain 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. describe the working practices of, and the need to respect the hospital ward and/or patient environment
10. describe the basic principles of operation of the medical gas pipeline system and equipment being maintained, and the function of individual components
11. describe the identification and application of different types of valve (such as poppet, spool, piston, disc, ball)
12. describe the identification and application of different types of sensor and actuator (such as rotary, linear, mechanical, electrical)
13. describe the identification and application of different types of compressor (such as single acting, double acting)
14. describe the identification and application of different types of pump (such as positive and dynamic, reciprocating, screw and claw)
15. describe the sequence to be adopted for the dismantling/reassembly of various types of medical gas pipeline system
16. describe the care, calibration, handling and application of appropriate measuring instruments and test equipment
17. describe 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. explain how to check that replacement components meet the required specification/operating conditions

19. describe the techniques used to dismantle/reassemble medical gas pipeline systems and equipment
20. describe the methods of removing and replacing components without causing damage to the equipment or other components
21. describe the methods of attaching identification markers/labels to removed components or cables to assist with re-assembly
22. describe the tools and equipment used in the maintenance activities
23. describe the methods of checking that components are fit for purpose, and the need to replace 'lived' items
24. explain how to make adjustments to components/assemblies to ensure that they function correctly
25. describe the methods used to label and identify different pipework systems (including colour coding/warning signs)
26. explain 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. describe 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. describe the importance of making visual checks before proving the equipment
29. describe the generation of documentation and/or reports following the maintenance activity
30. describe the equipment operating and control procedures to be applied during the maintenance activity
31. describe the problems that can occur during the maintenance activity, and how they can be overcome
32. describe the organisational procedure(s) to be adopted for the safe disposal of waste of all types of material
33. describe the extent of their own authority and to whom they should report if they have a problem that they cannot resolve

## Unit 174

# Carrying Out Fault Diagnosis on Instrumentation and Control Equipment and Circuits

**Level:** 3  
**Credit value:** 50  
**UAN number:** Y/600/5637

### Unit aim

This unit covers the skills and knowledge needed to prove the competences required to carry out efficient and effective fault diagnosis on instrumentation and control equipment and circuits, in accordance with approved procedures. The learner will be required to diagnose faults on a range of instrumentation and control equipment, such as pressure, flow, level and temperature instruments; fiscal monitoring equipment; smoke, heat, gas, water, chemical and metal detection and alarm systems; industrial weighing systems; linear and rotational speed measurement; vibration monitoring equipment; photo-optic instruments; nucleonic and radiation measurement; analysers, recorders and indicators; telemetry systems; emergency shutdown systems and other specific instrumentation, both at assembly and component level. The learner 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, the learner will be expected to identify the fault and its probable cause, and to determine appropriate action to remedy the problem.

The learner's responsibilities will require them 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 they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying fault diagnostic procedures on instrumentation and control equipment and circuits. The learner will understand the various fault diagnostic methods and techniques used, and their application. The learner 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.

The learner will understand the safety precautions required when carrying out the fault diagnostic activities, especially those for isolating the equipment. The learner will also understand their responsibilities for safety and the importance of taking the necessary safeguards to protect themselves and others in the workplace.

### Learning outcomes

There are **two** learning outcomes to this unit. The learner will be able to:

1. Carry out fault diagnosis on instrumentation and control equipment and circuits.
2. Know how to carry out fault diagnosis on instrumentation and control equipment and circuits.

### **Guided learning hours**

It is recommended that **60** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 74: Carrying Out Fault Diagnosis on Instrumentation and Control Equipment and Circuits (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

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# Unit 174      **Carrying Out Fault Diagnosis on Instrumentation and Control Equipment and Circuits**

Outcome 1      Carry out fault diagnosis on instrumentation and control equipment and circuits.

## **Assessment Criteria**

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the fault diagnostic activity:
  - plan the fault diagnosis using available information about the fault
  - obtain and use the correct issue of company and/or manufacturers' drawings and maintenance documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations
  - where appropriate, ensure the insertion, or program override, of any relevant system trip defeats (such as fire extinguishant, emergency shutdown)
  - provide and maintain safe access and working arrangements for the fault finding/maintenance area
  - where appropriate, use electrostatic discharge (ESD) precautions
  - carry out the fault diagnostic activities, using appropriate procedures
  - collect equipment fault diagnostic 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
3. carry out fault diagnosis on four of the following types of instrumentation and control equipment:
  - pressure (such as absolute, gauge, vacuum)
  - flow (such as orifice plate, venturi tube, electromagnetic, ultrasonic, differential pressure cell, positive displacement)
  - level (such as floats, displacer, differential pressure cells, load cells, ultrasonic, conductivity)
  - temperature (such as bi-metallic, thermocouples, resistance, infra-red, thermal imaging)
  - weight (such as mechanical systems, load cells/strain gauges, transducers)
  - fiscal metering (such as gas, electricity, water, fuel)
  - detection and alarm (such as smoke, heat, gas, chemical, water, metal)
  - speed measurement (such as mechanical, electrical, stroboscopic)
  - emergency shutdown
  - speed control (such as mechanical governors, electrical governors, DC speed controller, AC motor control systems, stepper motors, invertors)
  - vibration monitoring (such as vibration switches, proximity probes, seismic velocity transducer, linear variable differential transformers, portable data collectors)
  - nucleonic and radiation (such as Geiger-Muller tube, neutron counter, photomultiplier tube, proportional counter)
  - analysers (such as gas detection, spectroscopy, oxygen analyser, water analysis, moisture measurement, density)
  - recorders and indicators
  - telemetry systems (such as master station, outstation, stand-alone systems)
  - valves and valve mechanisms (such as control valves, valve actuators and positioners)
  - other specific instrumentation or control equipment

4. find faults that have resulted in two of the following breakdown categories:
  - intermittent action or circuit failure
  - partial failure or reduced performance
  - complete breakdown
5. review and use all relevant information on the symptoms and problems associated with the product or asset
6. investigate and establish the most likely causes of the fault or faults
7. select, use and apply diagnostic techniques, tools and aids to locate faults
8. collect fault diagnostic 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 outputs/computer display (such as pressure, flow, temperature)
  - sensory input (sight, sound, smell, touch)
  - equipment self-diagnosis
  - recording devices
  - plant/equipment records
  - equipment outputs
9. use a range of fault diagnostic techniques, to include two of the following:
  - half-split technique
  - input/output technique
  - six point technique
  - unit substitution
  - equipment self-diagnostics
  - injection and sampling
  - emergent sequence
  - function/performance testing
10. 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
  - troubleshooting guides
  - electronic aids
11. use all of the following fault diagnostic procedures:
  - inspection (such as breakages, wear/deterioration, signs of overheating, loose connections/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)

12. use four of the following types of test equipment to aid fault diagnosis:
  - multimeter
  - oscilloscope
  - signal sources/generator
  - current injection devices
  - logic probe
  - signal tracer
  - pressure sources
  - digital pressure indicators
  - standard test gauges
  - special purpose test equipment
  - other specific test equipment
13. complete the fault diagnosis within the agreed time and inform the appropriate people when this cannot be achieved
14. determine the implications of the fault or faults for other work and for safety considerations
15. use the evidence gained to draw valid conclusions about the nature and probable cause of the fault or faults
16. record details on the extent and location of the faults in an appropriate format
17. provide a record of the outcome of the fault diagnosis, using one of the following:
  - company-specific reporting procedure
  - step-by-step analytical report
  - preventative maintenance log/report
  - corrective action report

## Unit 174

# Carrying Out Fault Diagnosis on Instrumentation and Control Equipment and Circuits

### Outcome 2

Know how to carry out fault diagnosis on instrumentation and control equipment and circuits.

#### Assessment Criteria

The learner will be able to:

1. describe the health and safety requirements of the area in which the fault diagnostic activity is to take place, and the responsibility these requirements place on the learner
2. describe the isolation and lock-off procedure or permit-to-work procedure that applies
3. explain 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. describe the importance of wearing protective clothing and other appropriate safety equipment during the fault diagnostic activities
5. describe the hazards associated with carrying out fault diagnosis on instrumentation and control equipment (such as contact with live electrical connections; stored energy such as pneumatic, hydraulic, capacitive/inductive/electrostatic; misuse of tools), and how to minimise them to reduce any risks
6. describe the procedure to be adopted to establish the background of the fault
7. explain how to evaluate the various types of information available for fault diagnosis
8. explain how to use the various aids and reports available for fault diagnosis
9. explain how to use various types of fault diagnostic equipment needed to investigate the problem
10. describe the various fault finding techniques that can be used (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), and how they are applied
11. explain how to evaluate sensory conditions (by sight, sound, smell, touch)
12. explain how to analyse evidence and evaluate possible characteristics and causes of specific faults/problems
13. explain how to relate previous reports/records of similar fault conditions
14. describe the care, handling and application of instrumentation test instruments (such as multimeters, logic probes, oscilloscopes, signal tracers, signal generators)
15. explain how to check that test instruments are within current calibration dates, and that they are free from damage and defects
16. describe the precautions to be taken to prevent electrostatic discharge (ESD) damage to electronic circuits and components
17. explain how to obtain instrumentation drawings, circuit and physical layouts, charts, specifications, manufacturers' manuals, history/maintenance reports, and other documents needed in the fault diagnostic activities
18. describe the basic principles of how the instrumentation and control circuit functions, its operating sequence, the working purpose of individual units/components and how they interact
19. describe the reasons for making sure that control systems are isolated or put into manual control, and appropriate trip locks, keys or program overrides are inserted, before isolating any sensors or instruments from the system
20. explain how to evaluate the likely risk to themselves and others, and the effects the fault could have on the overall system or process
21. explain how to prepare a report, or take follow-up action, on conclusion of the fault diagnosis, in accordance with company policy
22. describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve

**Level:** 3  
**Credit value:** 70  
**UAN number:** L/600/5621

**Unit aim**

This unit covers the skills and knowledge needed to prove the competences required to carry out corrective maintenance activities on instrumentation and control equipment and circuits, in accordance with approved procedures. The learner will be required to maintain a range of instrumentation and control equipment such as pressure, flow, level and temperature instruments; fiscal monitoring equipment; smoke, heat, gas, water, chemical and metal detection and alarm systems; industrial weighing systems; linear and rotational speed measurement and control; vibration monitoring equipment; photo-optic instruments; nucleonic and radiation measurement; analysers recorders and indicators; telemetry systems; emergency shutdown systems and other specific instrumentation. This will involve dismantling, removing and replacing a range of instruments and faulty peripheral components down to unit and board/component level, as appropriate.

The learner's responsibilities will require them to comply with organisational policy and procedures for the maintenance activities undertaken, and to report any problems with the activities, instrument system, tools or equipment used, that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying maintenance procedures to instrumentation and control equipment and circuits. The learner 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 that the equipment operates to the required specification and remains compliant with all standards and regulations. The learner 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.

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

**Learning outcomes**

There are **two** learning outcomes to this unit. The learner will be able to:

1. Maintain instrumentation and control equipment and circuits
2. Know how to maintain instrumentation and control equipment and circuits

### **Guided learning hours**

It is recommended that **119** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 75: Maintaining Instrumentation and Control Equipment and Circuits (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

## Unit 175

# Maintaining Instrumentation and Control Equipment and Circuits

### Outcome 1

Maintain instrumentation and control equipment and circuits

#### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the maintenance activities:
  - plan and communicate the maintenance activities so as to minimise any disruption to the process/system operation
  - obtain and use the correct issue of company and/or manufacturers' drawings and maintenance documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations
  - where appropriate, ensure the insertion, or program override, of any relevant system trip defeats (such as fire extinguishant, emergency shutdown)
  - ensure the safe isolation of instruments (such as process, electrical, hydraulic, pneumatic, mechanical)
  - where applicable, ensure that appropriate decontamination procedures are used for instruments that have been used with hazardous (such as toxic, corrosive, inflammable, explosive, radioactive) substances
  - provide and maintain 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
3. carry out maintenance activities on four of the following types of instrumentation and control equipment:
  - pressure (such as absolute, gauge, vacuum)
  - flow (such as orifice plate, venturi tube, electromagnetic, ultrasonic, differential pressure cell, positive displacement)
  - level (such as floats, displacer, differential pressure cells, load cells, ultrasonic, conductivity)
  - temperature (such as bi-metallic, thermocouples, resistance, infra-red, thermal imaging)
  - weight (such as mechanical systems, load cells/strain gauges, transducers)
  - fiscal metering (such as gas, electricity, water, fuel)
  - detection and alarm (such as smoke, heat, gas, chemical, water, metal)
  - speed measurement (such as mechanical, electrical, stroboscopic)
  - emergency shutdown
  - speed control (such as mechanical governors, electrical governors, DC speed controller, AC motor control systems, stepper motors, invertors)
  - vibration monitoring (such as vibration switches, proximity probes, seismic velocity transducer, linear variable differential transformers, portable data collectors)
  - nucleonic and radiation (such as Geiger-Muller tube, neutron counter, photomultiplier tube, proportional counter)
  - analysers (such as gas detection, spectroscopy, oxygen analyser, water analysis, moisture measurement, density)
  - recorders and indicators
  - telemetry systems (such as master station, outstation, stand alone systems)
  - valves and valve mechanisms (such as control valves, valve actuators and positioners)
  - other specific instrumentation

4. follow the relevant maintenance schedules to carry out the required work
5. maintain instrumentation and control equipment in compliance with one of the following:
  - company and/or customer standards and procedures
  - BS 7671/IEE wiring regulations
  - BS, ISO or BSEN standards and procedures
  - equipment manufacturer's operation range
6. carry out the maintenance activities within the limits of their personal authority
7. carry out the maintenance activities in the specified sequence and in an agreed timescale
8. carry out ten of the following maintenance activities, as appropriate to the equipment being maintained:
  - disconnecting electrical/pneumatic supply
  - disconnecting signal transmission
  - disconnecting process pipework
  - removing instruments from the system
  - replacing mechanical components
  - replacing electrical components
  - replacing complete instruments
  - tightening fastenings to the required torque
  - replacing peripherals (such as sensors, actuators, relays, switches)
  - replacing 'lived' items (such as seals, gaskets, batteries)
  - proof marking/labelling of removed wires or components
  - taking electrostatic discharge (ESD) precautions when handling components and circuit boards
  - setting, aligning and adjusting replaced instruments
9. use four of the following types of test equipment:
  - analogue or digital meters
  - signal sources/generator
  - current injection devices
  - logic probes
  - signal tracer
  - oscilloscope
  - standard test gauges
  - pressure sources
  - digital pressure indicators
  - special purpose test equipment
10. 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 (such as electrical, electronic, pneumatic, mechanical)
  - confirming that signal measurement and transmission are satisfactory
  - final re-commissioning of the system and removal of any trip defeats
11. report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
12. complete the relevant maintenance records accurately, to include one of the following, and pass them on to the appropriate person:
  - job cards
  - maintenance log or report
  - permits to work/formal risk assessment
  - company-specific documentation
13. dispose of waste materials in accordance with safe working practices and approved procedures



## Unit 175

# Maintaining Instrumentation and Control Equipment and Circuits

### Outcome 2

Know how to maintain instrumentation and control equipment and circuits

#### Assessment Criteria

The learner will be able to:

1. describe the health and safety requirements of the area in which the maintenance activity is to take place, and the responsibility they place on the learner
2. describe 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. describe the specific health and safety precautions to be applied during the maintenance process, and their effects on others
4. explain 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. describe the importance of wearing protective clothing and other appropriate safety equipment during the maintenance activities, and where this can be obtained
6. describe the procedures and precautions to be adopted to eliminate electrostatic discharge (ESD)
7. describe the hazards associated with carrying out maintenance activities on instrumentation and control systems (such as 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 and reduce any risks
8. explain 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. describe the basic principles of operation of the instrumentation and control equipment being maintained, how the system functions, its operating sequence, the working purpose of individual units/components and how they interact
10. describe the reasons for making sure that control systems are isolated or put into manual control, and appropriate trip locks, keys or program overrides are inserted, before removing any sensors or instruments from the system
11. describe the identification and selection of instrument sensors (including how to identify their markings, calibration information, component values, operating parameters and working range)
12. describe 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)
13. describe the correct and tidy installation and connection of external wiring and components, to avoid electronic interference or mechanical damage
14. explain how to carry out visual checks of the instruments (such as checking for leaks, security of joints and physical damage)
15. describe the procedure for obtaining replacement parts, materials and other consumables necessary for the maintenance process
16. describe the company policy on the repair/replacement of components during the maintenance process

17. describe the techniques used to dismantle/assemble integrated equipment (such as release of pressures/force, proof marking to aid reassembly, plugging exposed pipe/component openings, dealing with soldered joints, screwed, clamped and crimped connections)
18. describe the methods of attaching identification marks/labels to removed components or cables, to assist with reassembly
19. describe the methods of checking that components are fit for purpose, and the need to replace electronic modules, sensors, transmitters, transducers, electronic boards and other failed items
20. explain 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
21. describe the generation of appropriate documentation and/or reports following the maintenance activity
22. describe the equipment operating and control procedures to be applied during the maintenance activity
23. describe the problems that can occur during the maintenance of the instrumentation and control system, and how they can be overcome
24. describe the organisational procedure to be adopted for the safe disposal of waste of all types of material
25. describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve

## Unit 176

# Carrying Out Preventative Planned Maintenance on Instrumentation and Control Equipment

**Level:** 3

**Credit value:** 38

**UAN number:** T/600/5628

### Unit aim

This unit covers the skills and knowledge needed to prove the competences required to carry out preventative planned maintenance activities on instrumentation and control equipment, in accordance with approved procedures. The learner will be required to carry out the planned maintenance activities on instrumentation and control equipment such as pressure, flow, level and temperature instruments; fiscal monitoring equipment; smoke, heat, gas, water, chemical and metal detection and alarm systems; industrial weighing systems; linear and rotational speed measurement and control; vibration monitoring equipment; photo-optic instruments; nucleonic and radiation measurement; analysers recorders and indicators; telemetry systems; emergency shutdown systems and other specific instrumentation. This will involve checking and maintaining a range of equipment and components such as valves, actuators, sensors, switches, transmitters, transducers, transponders, wires/cables, pipework and hoses, in order to minimise down time, and to ensure that the instrumentation and control equipment perform at optimum level and function to specification.

The learner's responsibilities will require them 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 they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner 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.

The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying planned maintenance procedures to instrumentation and control equipment. The learner 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 that the system is maintained to the required specification and remains compliant with all standards and regulations. In addition, the learner will be expected to report where the outcome of the maintenance activity identifies the need for further investigation or maintenance work.

The learner 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 themselves and others in the workplace. The learner will be required to demonstrate safe working practices throughout.

### **Learning outcomes**

There are **two** learning outcomes to this unit. The learner will be able to:

1. Carry out preventative planned maintenance on instrumentation and control equipment
2. Know how to carry out preventative planned maintenance on instrumentation and control equipment

### **Guided learning hours**

It is recommended that **74** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 76: Carrying Out Preventative Planned Maintenance on Instrumentation and Control Equipment (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

## Unit 176

# Carrying Out Preventative Planned Maintenance on Instrumentation and Control Equipment

## Outcome 1

Carry out preventative planned maintenance on instrumentation and control equipment

### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the planned maintenance activities:
  - plan and communicate the maintenance activities so as to minimise any disruption to normal working
  - obtain and use the correct issue of company and/or manufacturers' drawings and maintenance documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations
  - where appropriate, ensure the insertion, or program override, of any relevant system trip defeats (such as fire extinguishant, emergency shutdown)
  - ensure the safe isolation of instruments (such as process, electrical, hydraulic, pneumatic, mechanical)
  - provide and maintain 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
3. carry out planned maintenance activities on four of the following types of instrumentation and control equipment:
  - pressure (such as absolute, gauge, vacuum)
  - flow (such as orifice plate, venturi tube, electromagnetic, ultrasonic, differential pressure cell, positive displacement)
  - level (such as floats, displacer, differential pressure cells, load cells, ultrasonic, conductivity)
  - temperature (such as bi-metallic, thermocouples, resistance, infra-red, thermal imaging)
  - weight (such as mechanical systems, load cells/strain gauges, transducers)
  - fiscal metering (such as gas, electricity, water, fuel)
  - detection and alarm (such as smoke, heat, gas, chemical, water, metal)
  - speed measurement (such as mechanical, electrical, stroboscopic)
  - emergency shutdown
  - speed control (such as mechanical governors, electrical governors, DC speed controller, AC motor control systems, stepper motors, invertors)
  - vibration monitoring (such as vibration switches, proximity probes, seismic velocity transducer, linear variable differential transformers, portable data collectors)
  - nucleonic and radiation (such as Geiger-Muller tube, neutron counter, photomultiplier tube, proportional counter)
  - analysers (such as gas detection, spectroscopy, oxygen analyser, water analysis, moisture measurement, density)
  - recorders and indicators
  - telemetry systems (such as master station, outstation, stand alone systems)
  - valves and valve mechanisms (such as control valves, valve actuators and positioners)
  - other specific instrumentation

4. follow the relevant maintenance schedules to carry out the required work
5. carry out planned maintenance activities, using one of the following types of maintenance schedule:
  - condition based maintenance
  - preventative planned maintenance
  - scheduled maintenance
  - total preventative maintenance (TPM)
6. carry out the maintenance activities within the limits of their personal authority
7. carry out the maintenance activities in the specified sequence and in an agreed timescale
8. carry out twelve of the following planned maintenance activities:
  - removal of excessive dirt and grime from instruments and sensing elements
  - visual examination and testing of the instrumentation against the maintenance schedule
  - checking condition of all pipework and connections (such as free from damage, correctly secured, leak free)
  - checking condition of all cables/wires and connectors (such as free from damage, correctly clipped up)
  - checking correct operation of all gauges and sensors
  - checking correct operation of warning and alarm systems (such as smoke detectors, alarms and lights)
  - monitoring of component condition/deterioration
  - replacing 'lived' consumables (such as filters, fluids, back-up batteries)
  - making routine adjustments (such as setting working clearance, adjusting actuator mechanisms)
  - making sensory checks (such as sight, sound, smell, touch)
  - carrying out system self-analysis checks
  - carrying out leak checks on all connections
  - testing and reviewing system operation
  - confirming that signal measurement and transmission are satisfactory
  - recording the results of the maintenance, and reporting any defects found
9. ensure that the maintained instrumentation and control equipment/system meets all of the following:
  - equipment remains compliant with appropriate regulations and safety requirements
  - all planned maintenance activities have been completed to the required schedule
  - instrumentation and control equipment operates within acceptable limits for successful continuous operation
  - any potential defects are identified and reported for future action
10. report any instances where the maintenance activities cannot be fully met or where there are identified defects outside the planned schedule
11. complete the relevant maintenance records accurately, to include one of the following, and pass them on to the appropriate person:
  - maintenance log or report
  - company-specific documentation
  - job cards
  - permit to work/formal risk assessment and/or sign-on/off procedures
12. dispose of waste materials in accordance with safe working practices and approved procedures

## Unit 176

# Carrying Out Preventative Planned Maintenance on Instrumentation and Control Equipment

## Outcome 2

Know how to carry out preventative planned maintenance on instrumentation and control equipment

### Assessment Criteria

The learner will be able to:

1. describe 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 the learner
2. describe the isolation procedures or permit-to-work procedure that applies to the instrumentation and control equipment being maintained
3. describe the specific health and safety precautions to be applied during the planned maintenance activities, and their effects on others
4. explain 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. describe the importance of wearing protective clothing and other appropriate safety equipment during the maintenance activities
6. describe the 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 to minimise these and reduce any risks
7. explain how to make sensory checks (by sight, sound, smell, touch)
8. explain 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
9. describe the various planned maintenance schedules that are generally used (such as condition based maintenance, scheduled maintenance and total preventative maintenance (TPM))
10. describe the schedules and methods to be followed, in compliance with company procedures for planned maintenance on instrumentation and control equipment
11. describe the basic principles of how the system functions, its operating sequence, the working purpose of individual units/components and how they interact
12. describe the equipment operating and control procedures, and how to apply them along with the planned maintenance procedures
13. describe the reasons for making sure that control systems are isolated or put into manual control, and appropriate trip locks, keys or program overrides are inserted, before removing any sensors or instruments from the system
14. describe the identification of instrument sensors (including how to identify their markings, calibration information, operating parameters and working range)
15. describe the methods of checking and calibrating instruments, and the type and range of equipment that can be used
16. describe the testing methods and procedures to be used to check that the system conforms within acceptable limits
17. describe the procedure for obtaining consumables and 'lived' items that will require replacing during the planned maintenance activity

18. describe the company policy on the repair/replacement of components during the maintenance process
19. explain how to make adjustments to components/assemblies to ensure that they function to specification
20. explain how to compile planned maintenance records/logs/reports, which comply with company policy and procedures
21. describe the problems that can occur whilst carrying out planned maintenance activities, and how they can be avoided
22. describe the organisational procedure to be adopted for the safe disposal of waste of all types of material
23. describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve



**Level:** 3  
**Credit value:** 47  
**UAN number:** M/600/5644

**Unit aim**

This unit covers the skills and knowledge needed to prove the competences required to carry out repairs or overhauling activities on instrumentation and control equipment, in accordance with approved procedures. The instrumentation to be repaired or overhauled will have been removed from service, and the overhauling activities may take place in a workshop or the equipment may have been returned to the manufacturer for overhaul. This unit covers instrumentation equipment such as pressure, flow, level and temperature instruments; fiscal monitoring equipment; smoke, heat, gas, water, chemical and metal detection and alarm systems; industrial weighing systems; linear and rotational speed measurement and control; vibration monitoring equipment; photo-optic instruments; nucleonic and radiation measurement; analysers recorders and indicators; telemetry systems; emergency shutdown systems and other specific instrumentation.

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

The learner's responsibilities will require them to comply with organisational policy and procedures for the repair or overhauling activities undertaken, and to report any problems with these activities, or with the tools and equipment used that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner must ensure that all tools, equipment and materials used in the repair/overhaul activities are returned to their designated locations on completion of the activities, and that all necessary servicing, testing and calibration documentation is completed accurately and legibly. The learner will be expected to work with a minimum of supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of their work, and will provide an informed approach to applying repair/overhauling procedures to instrumentation and control equipment. The learner will understand the dismantling, inspection reassembly and testing methods and procedures used, and their application. The learner will know how the equipment functions, the common faults encountered, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the repair/overhaul and for ensuring that the repaired/overhauled equipment meets the required specification and remains compliant with all standards and regulations.

The learner will understand the safety precautions required when carrying out the repair/overhauling activities, especially those for ensuring the correct decontamination of the instruments. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

### **Learning outcomes**

There are **two** learning outcomes to this unit. The learner will be able to:

1. Repair/overhaul instrumentation and control equipment
2. Know how to repair/overhaul instrumentation and control equipment

### **Guided learning hours**

It is recommended that **91** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 77: Repairing/Overhauling Instrumentation and Control Equipment (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

## Unit 177

# Repairing/Overhauling Instrumentation and Control Equipment

## Outcome 1

Repair/overhaul instrumentation and control equipment

### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the repair/overhauling activity:
  - obtain and use the correct equipment repair/overhauling documentation (such as manuals, drawings, maintenance records)
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations
  - provide and maintain safe access and working arrangements for the repair/overhauling area
  - where applicable, ensure that appropriate decontamination procedures are used for instruments that have been used with hazardous (such as toxic, corrosive, inflammable, explosive, radioactive) substances
  - where appropriate, apply electrostatic discharge (ESD) protection procedures
  - carry out the repair/overhauling activities, using appropriate techniques and procedures
  - ensure that the equipment is maintained free from damage and foreign objects
  - return all tools and equipment to the correct location on completion of the activities
  - leave the work area in a clean and safe condition on completion of the activities
3. carry out the repair/overhauling activities on four of the following types of instrumentation and control equipment:
  - pressure (such as absolute, gauge, vacuum)
  - flow (such as orifice plate, venturi tube, electromagnetic, ultrasonic, differential pressure cell, positive displacement)
  - level (such as floats, displacer, differential pressure cells, load cells, ultrasonic, conductivity)
  - temperature (such as bi-metallic, thermocouples, resistance, infra-red, thermal imaging)
  - weight (such as mechanical systems, load cells/strain gauges, transducers)
  - fiscal metering (such as gas, electricity, water, fuel)
  - detection and alarm (such as smoke, heat, gas, chemical, water, metal)
  - speed measurement (such as mechanical, electrical, stroboscopic)
  - emergency shutdown
  - speed control (such as mechanical governors, electrical governors, DC speed controller, AC motor control systems, stepper motors, invertors)
  - vibration monitoring (such as vibration switches, proximity probes, seismic velocity transducer, linear variable differential transformers, portable data collectors)
  - nucleonic and radiation (such as Geiger-Muller tube, neutron counter, photomultiplier tube, proportional counter)
  - analysers (such as gas detection, spectroscopy, oxygen analyser, water analysis, moisture measurement, density)
  - recorders and indicators
  - telemetry systems (such as master station, outstation, stand alone systems)
  - valves and valve mechanisms (such as control valves, valve actuators and positioners)
  - other specific instrumentation

4. follow the relevant repair/overhauling schedules to carry out the required work
5. repair/overhaul instrumentation and control equipment in compliance with one or more of the following:
  - company standards and procedures
  - BS, ISO and/or BSEN standards
  - customer standards and requirements
  - instrument manufacturer's requirements
6. establish and, where appropriate, mark/label components to aid re-assembly
7. carry out the repair/overhaul to the agreed level, using the correct tools and techniques
8. carry out all of the following activities, as applicable to the instrumentation/control equipment being repaired or overhauled:
  - cleaning parts prior to dismantling
  - carrying out pre-disassembly checks and tests
  - disconnecting and/or de-soldering electrical connections
  - removing cable securing devices
  - removing bolt securing devices and mechanical fasteners
  - dismantling equipment to unit/sub-assembly level
  - dismantling units to component level
  - marking/labelling of components to aid reassembly
  - checking components for serviceability
  - replacing all 'lived' items (such as seals, gaskets, batteries)
  - replacing all damaged or defective components
  - reassembling equipment
  - making mechanical connections (such as pipes)
  - making electrical connections (such as crimping, soldering, heat shrinking)
  - setting and adjusting/calibrating replaced components
  - securing components by using mechanical fasteners and threaded devices
  - applying locking and retaining devices (such as circlips, pins, wire locking, cable securing devices)
9. ensure that all removed components are correctly identified and stored in the correct location
10. replace a range of instrumentation components, to include eight of the following:
  - printed circuit boards/electronic cards
  - electronic modules
  - relays
  - electronic components (such as resistors, capacitors diodes)
  - transmitters
  - transducers
  - load cells
  - thermocouples
  - wires/cables
  - plugs/sockets/terminations
  - switches (such as limit, proximity)
  - gaskets/seals
  - bellows
  - diaphragms or discs
  - bourdon tubes
  - actuators or actuator components (such as pistons, springs, glands linkages)
  - valves or valve components (such as glands, spindles, seats)
  - pipework/pipework components
  - other specific components

11. carry out checks on the serviced/overhauled instruments, to include four of the following:
  - visual inspection of the instrument for completeness and freedom from damage or foreign objects
  - checking security of all mechanical connections
  - checking integrity of all electrical connectors
  - standard serviceability test
  - operational/function checks
12. report any instances where the repair/overhauling activities cannot be fully met, or where there are identified defects outside the planned repair/overhauling schedule
13. complete the relevant documentation, in accordance with organisational requirements
14. dispose of unwanted components, waste materials and substances, in accordance with safe working practices approved procedures
15. deal promptly and effectively with problems within their control and report those that cannot be solved

## Unit 177

# Repairing/Overhauling Instrumentation and Control Equipment

## Outcome 2

Know how to repair/overhaul instrumentation and control equipment

### Assessment Criteria

The learner will be able to:

1. describe the safe working practices and procedures and the specific safety precautions to be taken when repairing/overhauling instrumentation and control equipment (to include wearing protective clothing and equipment; decontamination procedures for the instruments being repaired/overhauled; lifting and handling techniques; safe working practices, procedures and guidelines which satisfy current regulations such as HASAWA, COSHH and other work related legislation and guidelines)
2. describe the hazards associated with repairing/overhauling instrumentation and control equipment, and with the tools and equipment used, and how to minimise them and reduce any risks
3. describe the protective equipment that they need to use for both personal protection and protection of the instrumentation and control equipment being repaired
4. explain how to extract and use information from equipment manuals, history/maintenance reports, charts, circuit and physical layouts, specifications, symbols used in instrumentation and control circuits, and other documents needed in the repair/overhaul process
5. describe the terminology used with instrumentation and control equipment, and the use of system diagrams and associated symbols
6. describe the basic principles of operation of the instrumentation and control equipment being repaired/overhauled, and the performance characteristics and function of the components within the equipment
7. describe the techniques used to remove components from the instrumentation and control equipment without damage to the components or surrounding structure (such as de-soldering components, applying electrostatic discharge (ESD) protection procedures)
8. describe the various types of electrical connector that are used, their methods of unlocking, orientation indicators and locating and locking-in of the connections
9. describe the various mechanical fasteners that are used, and their methods of removal and replacement (such as threaded fasteners, special securing devices)
10. describe the importance of using the specified components for the particular instrument, and why they must not substitute others
11. describe the need to label and store components correctly, and to check that replaced components have the correct part/identification markings
12. describe the procedure for obtaining replacement parts, materials and other consumables necessary for the repair/overhaul
13. describe the techniques used to position, align, adjust and secure the replaced components to the equipment without damage to the components or surrounding structure
14. describe the quality control procedures to be followed during the repair/overhauling operations
15. describe the procedures for ensuring that they have the correct tools, equipment, components and fasteners for the activities
16. explain how to conduct checks of the instruments to ensure the integrity, accuracy and quality of the repair/overhaul
17. describe the problems that can occur with the repair/overhauling operations, and how these can be overcome
18. explain how to recognise defects (such as poor seals, misalignment, incorrectly seated plugs and sockets, ineffective fasteners, foreign object damage or contamination)
19. describe the recording documentation to be completed for the activities undertaken
20. describe the procedure for the safe disposal of waste materials and scrap components
21. describe the extent of their own responsibility, and to whom they should report if they have problems that they cannot resolve

**Level:** 3  
**Credit value:** 50  
**UAN number:** J/600/5651

**Unit aim**

This unit covers the skills and knowledge needed to prove the competences required to carry out tests and calibration of instrumentation and control equipment and circuits, in accordance with approved procedures. The learner will be required to carry out the various tests and calibration on a range of instrumentation equipment, such as pressure, flow, level and temperature instruments; fiscal monitoring equipment; smoke, heat, gas, water, chemical and metal detection and alarm systems; industrial weighing systems; linear and rotational speed measurement and control; vibration monitoring equipment; photo-optic instruments; nucleonic and radiation measurement; analysers recorders and indicators; telemetry systems; emergency shutdown systems and other specific instrumentation, to establish that they are functioning at optimal level and to specification.

The learner will be required to carry out tests and calibration which will include voltage and current levels, resistance values, waveform, open/short circuit, signal injection, logic state, pressure/leak tests, signal measurement and transmission and other specific or special-to-type tests.

The learner's responsibilities will require them to comply with organisational policy and procedures for carrying out the testing and calibration activities, and to report any problems with these activities that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner will be expected to work with minimal supervision, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The learner's knowledge will provide a good understanding of the procedures for carrying out the required tests and calibration, and will provide an informed approach to applying the necessary testing and calibrating procedures. The learner will understand the equipment being worked on, the test and calibration equipment being used, and the various testing/calibrating procedures and their application, in adequate depth to provide a sound basis for carrying out the activities to the required specification and remains compliant with all standards and regulations. In addition, the learner will be expected to review the outcome of the tests/calibration, to compare the results with appropriate specifications, to determine the action required, and to record/report the results in the appropriate format.

The learner will understand the safety precautions required when carrying out the testing and calibrating activities, especially those for isolating the equipment. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

**Learning outcomes**

There are **two** learning outcomes to this unit. The learner will be able to:

1. Test and calibrate instrumentation and control equipment and circuits
2. Know how to test and calibrate instrumentation and control equipment and circuits

### **Guided learning hours**

It is recommended that **60** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 78: Testing and Calibrating Instrumentation and Control Equipment and Circuits (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**



## Unit 178

# Testing and Calibrating Instrumentation and Control Equipment and Circuits

### Outcome 1

Test and calibrate instrumentation and control equipment and circuits

#### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the testing and calibration activities:
  - obtain and use the correct issue of company and/or manufacturers' drawings and testing/calibration documentation
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations
  - where appropriate, ensure the insertion of any relevant system trip defeats (such as fire extinguishant, emergency shutdown)
  - ensure the safe isolation of instruments (such as process, electrical, hydraulic, pneumatic, mechanical)
  - ensure that test equipment used is appropriate for the tests being carried out, is within current calibration dates and is used within its specified range
  - provide and maintain safe access and working arrangements for the testing and calibration area
  - carry out the testing and calibration activities, using appropriate techniques and procedures
  - where applicable, take electrostatic (ESD) precautions when handling sensitive components and circuit boards
  - re-connect and return the equipment to service on completion of the testing and calibration activities
  - dispose of waste items in a safe and environmentally acceptable manner, and leave the work area in a safe condition
3. carry out tests and calibration on four of the following types of instrumentation and control equipment and circuit:
  - pressure (such as absolute, gauge, vacuum)
  - flow (such as orifice plate, venturi tube, electromagnetic, ultrasonic, differential pressure cell, positive displacement)
  - level (such as floats, displacer, differential pressure cells, load cells, ultrasonic, conductivity)
  - temperature (such as bi-metallic, thermocouples, resistance, infra-red, thermal imaging)
  - weight (such as mechanical systems, load cells/strain gauges, transducers)
  - fiscal metering (such as gas, electricity, water, fuel)
  - detection and alarm (such as smoke, heat, gas, chemical, water, metal)
  - speed measurement (such as mechanical, electrical, stroboscopic)
  - emergency shutdown
  - speed control (such as mechanical governors, electrical governors, DC speed controller, AC motor control systems, stepper motors, invertors)
  - vibration monitoring (such as vibration switches, proximity probes, seismic velocity transducer, linear variable differential transformers, portable data collectors)
  - nucleonic and radiation (such as Geiger-Muller tube, neutron counter, photomultiplier tube, proportional counter, ionising radiation monitors)
  - analysers (such as gas detection, spectroscopy, oxygen analyser, water analysis, moisture measurement, density)
  - recorders and indicators
  - telemetry systems (such as master station, outstation, stand alone systems)
  - valves and valve mechanisms (such as control valves, valve actuators and positioners)
  - other specific instrumentation

4. follow the appropriate procedures for use of tools and equipment to carry out the required tests
5. test and calibrate instrumentation and control equipment and circuits, in compliance with one or more of the following:
  - company standards and procedures
  - BS, ISO and/or BSEN standards
  - customer standards and requirements
  - instrument manufacturer's requirements
6. set up and carry out the tests using the correct procedures and within agreed timescales
7. carry out tests and calibration using a range of tools and test equipment, to include six of the following:
  - analogue or digital multimeter
  - signal sources
  - current injection devices
  - analogue and digital meters
  - logic probes
  - workshop potentiometers
  - insulation testers
  - standard test gauges
  - pressure sources
  - digital pressure indicators
  - calibrated flow meters
  - temperature baths
  - calibrated weights
  - comparators
  - dead weight tester
  - special purpose test equipment
8. carry out all of the following during the testing/calibrating activities:
  - obtaining calibration parameters from data records
  - installing alarm defeat keys or program overrides (where appropriate)
  - connecting up supplies, test and calibration equipment
  - carrying out the tests and calibration to manufacturers' procedures
  - setting, adjusting and calibrating the equipment and control circuit to the required specification parameters
  - recording the test and calibration results in the appropriate formats/documentation
  - dealing with instruments and control circuits that do not meet specification requirements
9. carry out six of the following tests and calibrations:
  - visual inspection of the instrument for completeness and freedom from damage or foreign objects
  - standard serviceability test/calibration
  - leak/pressure test
  - soak test
  - signal measurement and transmission
  - five point calibration
  - unit substitution
  - equipment self-diagnostics
  - signal injection tests
  - special-to-type tests
  - operational/function checks
10. record the results of the tests in the appropriate format
11. review the results and carry out further tests if necessary

## Unit 178

# Testing and Calibrating Instrumentation and Control Equipment and Circuits

### Outcome 2

Know how to test and calibrate instrumentation and control equipment and circuits

#### Assessment Criteria

The learner will be able to:

1. describe the health and safety requirements of the area in which the testing and calibrating activity is to take place, and the responsibility these requirements place on the learner
2. describe their responsibilities under regulations relevant to the instrumentation and control equipment and circuit testing activities being undertaken
3. describe 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
4. describe the specific safety precautions to be taken when carrying out instrument and circuit testing and calibration activities
5. describe the hazards associated with carrying out testing and calibrating activities on instrumentation and control systems (such as stored pressure/force, electrical supplies, process controller interface, using damaged or badly maintained tools and equipment, not following laid-down testing and calibration procedures), and how to minimise them and reduce any risks
6. describe the importance of wearing protective clothing, and other appropriate safety equipment, during the testing and calibrating activities
7. explain how the testing and calibrating activities may affect the work of others, and the procedure for informing them of the work to be carried out
8. describe the procedures and precautions to be adopted to eliminate/protect against electrostatic discharge (ESD)
9. explain how to obtain and interpret circuit drawings, calibration data, instrument specifications, manufacturers' manuals, history/maintenance reports, symbols used on instrumentation and control documents, and other documents needed in the testing and calibration process
10. describe the basic principles of operation of the instrumentation and control equipment being tested/calibrated, how the system functions, its operating sequence, the working purpose of individual units/components and how they interact
11. describe the reasons for making sure that 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
12. describe the identification of instrument sensors (including how to identify their markings, calibration information, component values, operating parameters and working range)
13. describe the methods of checking and calibrating instruments, and the type and range of equipment that can be used
14. explain how to set up and apply the appropriate test and calibration equipment (such as pressure testing in incremental stages)
15. explain how to check that the test and calibration equipment is free from damage or defects, is in a safe and usable condition, and is configured correctly for the intended purpose
16. explain how to analyse the test and calibration results, and how to use comparison and sequential techniques
17. describe the environmental control requirements and company operating procedures relating to the testing and calibrating activities
18. describe the documentation required, and the procedures to be followed, at the conclusion of the testing and calibrating
19. explain what to do if instruments or control circuits do not meet the required calibration parameters
20. describe the extent of their own authority and to whom they should report if they have problems that they cannot resolve

**Level:** 3  
**Credit value:** 48  
**UAN number:** J/600/5634

**Unit aim**

This unit covers the skills and knowledge needed to prove the competences required to assist in the installation of mechanical equipment, in accordance with approved procedures. The learner will be required to assist in the installation of a range of mechanical equipment such as machine tools, conveyors, elevators, processing plant, engines, lifting and handling equipment, and structures like hoppers and large storage vessels. This unit does not involve maintenance/repair type activities, such as removal and replacement of existing equipment.

The learner will be required to use the specified tools and equipment throughout the installation, and to apply a range of installation methods and techniques, such as marking out, drilling and hole preparation, positioning equipment, shimming and packing, levelling and aligning equipment, and making the required connections. The installation activities will include making checks and adjustments, in line with their permitted authority, and assisting others to ensure that the installed equipment functions to the required specification.

The learner's responsibilities will require them to comply with organisational policy and procedures for the installation activities undertaken, and to report any problems with the activities, tools or equipment used that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner must check that all tools, equipment and materials used in the installation activities are removed from the work area on completion of the work, and that the necessary job/task documentation is completed accurately and legibly. The learner will be expected to work to instructions, alone or in conjunction with others, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The installation activity may be carried out as a team effort, but the learner must demonstrate a significant personal contribution to the installation activities, in order to satisfy the requirements of the standard, and they must demonstrate competence in all the areas required by the standard.

The learner's knowledge will be sufficient to provide a sound basis for their work, and will enable them to adopt an informed approach to applying mechanical installation procedures. The learner will have an understanding of the equipment being installed, and its installation requirements, in adequate depth to provide a sound basis for carrying out the installation process safely and effectively.

The learner will understand the safety precautions required when carrying out the installation activities, especially those for ensuring the safe isolation of services. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

### **Learning outcomes**

There are **two** learning outcomes to this unit. The learner will be able to:

1. Assist in the installation of mechanical equipment
2. Know how to assist in the installation of mechanical equipment

### **Guided learning hours**

It is recommended that **161** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 80: Assisting in the Installation of Mechanical Equipment (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

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Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

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## Unit 180

# Assisting in the Installation of Mechanical Equipment

### Outcome 1

Assist in the installation of mechanical equipment

#### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the installation of the mechanical equipment:
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations
  - confirm that authorisation to carry out the installation activities has been given
  - check that safe access and working arrangements for the installation area have been provided
  - confirm that services have been safely isolated, ready for the installation (such as mechanical, electricity, gas, air or fluids)
  - check that all required installation consumables are available
  - leave the work area in a safe condition and free from foreign object debris
3. assist in the installation of one of the following types of mechanical equipment:
  - machine tools
  - industrial compressors
  - conveyors
  - turbines
  - elevators
  - processing plant
  - hoppers or large storage vessels
  - lifting and handling equipment
  - engines
  - other equipment (specify)
  - process control equipment (such as large valves and actuating mechanisms, pumps)
4. follow all relevant instructions/documentation for the installation being carried out
5. produce installations which comply with all of the following, as appropriate to the equipment being installed:
  - equipment manufacturer's operating range
  - BS, ISO and/or BSEN standards
  - customer (contractual) standards and requirements
  - company standards and procedures
6. use the correct tools and equipment for the installation operations, and check that they are in a safe and usable condition
7. use two of the following during the installation activities:
  - straight edges and feeler gauges
  - tapes and rules
  - engineers' levels
  - measuring instruments (such as electrical, mechanical, fluid power)
  - plumb lines and taut wires
  - self-diagnostic equipment
  - dial test indicators
  - laser alignment equipment

8. assist in the installation, positioning and securing of the equipment, using appropriate methods and techniques
9. carry out the installation by applying five of the following methods and techniques:
  - marking out of locating and securing positions
  - drilling and hole preparation
  - fitting inserts (such as rag bolts or expanding bolts)
  - positioning equipment
  - aligning equipment
  - levelling equipment
  - shimming and packing
  - fitting anti-vibration mountings
  - securing by using mechanical fixings
  - applying screw fastener locking devices
  - make installation connections (such as mechanical, electrical, fluid power, utilities)
10. assist in the movement and positioning of equipment, using two of the following
  - slings
  - cranes
  - fork lift
  - portable lifting devices
  - block and tackle
  - rollers/skates
  - hoists
  - jacks
  - manual handling and moving loads
11. carry out and/or assist in checking the installation, and make any adjustments in accordance with the specification
12. carry out five the following checks and adjustments on the installed equipment:
  - fill/replenish fluids, oil, or grease
  - make 'off-load' checks
  - check level and/or alignment
  - make visual checks for completeness and freedom from damage
  - ensure that locking devices are fitted to fasteners (as appropriate)
  - ensure that moving parts are clear of obstruction and/or guarded

Plus: assist in carrying out two of the following:

  - setting working clearance
  - tensioning
  - pressurising the system
  - testing that the equipment operates to the installation specification
  - checking torque settings of fasteners
  - making sensory checks (sight, sound, smell, touch)
13. deal promptly and effectively with problems within their control and report those that cannot be solved
14. assist in dealing with two of the following conditions during the installation process:
  - installations with no faults
  - partial equipment malfunction
  - complete malfunction of equipment
15. assist in using fault location methods and techniques on installed equipment, to include using one of the following:
  - diagnostic aids (such as manufacturers' manuals, fault analysis charts, troubleshooting guides)
  - fault finding techniques (such as six point, half-split, unit substitution)
  - functional testing the installation/running equipment self-diagnostics

16. dispose of waste items in a safe and environmentally acceptable manner
17. assist in the completion of installation documentation to include one of the following:
  - installation records
  - company-specific documentation
  - job card



## Unit 180

# Assisting in the Installation of Mechanical Equipment

## Outcome 2

Know how to assist in the installation of mechanical equipment

### Assessment Criteria

The learner will be able to:

1. describe the health and safety requirements of the area in which the installation activity is to take place, and the responsibility these requirements place on the learner
2. describe the isolation and lock-off procedure or permit-to-work procedure that applies
3. describe the specific health and safety precautions to be applied during the installation procedure, and their effects on others
4. describe the hazards associated with installing mechanical equipment, and with the tools and equipment used, and how to minimise them and reduce any risks
5. describe the importance of wearing protective clothing and other appropriate safety equipment during the installation
6. explain how to obtain and interpret information from job instructions and other documentation used in the installation activities (such as installation drawings, specifications, manufacturers' manuals, BS7671/IEE regulations, symbols and terminology)
7. describe the basic principle of operation of the equipment being installed
8. describe the methods of marking out the site for positioning the equipment, and the tools and equipment used for this
9. describe the various mechanical fasteners that will be used, and their method of installation (such as threaded fasteners, special securing devices, masonry fixing devices)
10. describe the procedures for ensuring that they have the correct tools, equipment, and fasteners for the installation activities
11. describe the types of tools and instruments used to position, secure and align the equipment (such as spanners, wrenches, crowbars, torque wrenches, engineers levels, alignment telescopes and laser devices)
12. describe the techniques used to position, align, level and adjust the equipment
13. describe the methods of lifting, handling and supporting the equipment during the installation activities
14. describe the methods of connecting to mechanical power transmission devices (such as belt and chain drives, couplings, clutches and brakes)
15. describe the methods of connecting equipment to service supplies (such as electrical, fluid power, compressed air oil and fuel supplies)
16. explain why electrical bonding is critical, and why it must be both mechanically and electrically secure
17. describe the procedure for the safe disposal of waste materials
18. explain how to identify installation defects (such as leaks, poor seals, misalignment, ineffective fasteners, foreign object damage, or contamination)
19. describe the importance of ensuring that the completed installation is free from dirt, swarf and foreign object damage, and of ensuring that any exposed components or pipe ends are correctly covered/protected
20. describe the problems that can occur with the installation operations, and how these can be overcome
21. describe the fault-finding techniques to be used if the equipment fails to operate correctly
22. describe the recording documentation to be completed for the activities undertaken
23. describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve.

**Level:** 3  
**Credit value:** 48  
**UAN number:** H/600/5642

**Unit aim**

This unit covers the skills and knowledge needed to prove the competences required to assist in the installation of electrical/electronic equipment, in accordance with approved procedures. The learner will be required to assist in the installation of various electrical power supplies, such as single phase, three-phase, direct current and low voltage. The installation will also include fitting and connecting a range of electrical components, such as switchgear and distribution panels, motors and starters, control systems, safety devices, luminaires, and wiring enclosures. This unit does not involve maintenance/repair type activities, such as removal and replacement of existing equipment, or the installation of simple, self-contained items of equipment requiring minimal installation.

The learner will be required to use the appropriate tools and equipment throughout the installation, and to apply a range of installation methods and techniques to install various electrical components, wires, cables, enclosures and connectors that make up the electrical system/circuit. In addition, the learner will be expected to make electrical connections to sensors/activators and other devices, as appropriate to the equipment being installed, which could include mechanical, fluid power, water or fuel supplies. The installation activities will include making checks and adjustments, in line with their permitted authority, and assisting others to ensure that the installed equipment functions to the required specification.

The learner's responsibilities will require them to comply with organisational policy and procedures for the installation activities undertaken, and to report any problems with the activities, tools or equipment used that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner must check that all tools, equipment and materials used in the installation activities are removed from the work area on completion of the work, and that the necessary job/task documentation is completed accurately and legibly. The learner will be expected to work to instructions, alone or in conjunction with others, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The installation activity may be carried out as a team effort, but the learner must demonstrate a significant personal contribution to the installation activities, in order to satisfy the requirements of the standard, and they must demonstrate competence in all the areas required by the standard.

The learner's knowledge will be sufficient to provide a sound basis for their work, and will enable them to adopt an informed approach to applying electrical/electronic installation procedures. The learner will have an understanding of the equipment being installed and its installation requirements, in adequate depth to provide a sound basis for carrying out the installation process safely and effectively.

The learner will understand the safety precautions required when carrying out the installation activities, especially those for ensuring the safe isolation of services. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

### **Learning outcomes**

There are **two** learning outcomes to this unit. The learner will be able to:

1. Assist in the installation of electrical/electronic equipment
2. Know how to assist in the installation of electrical/electronic equipment

### **Guided learning hours**

It is recommended that **161** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 81: Assisting in the Installation of Electrical/Electronic Equipment (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

## Unit 181

# Assisting in the Installation of Electrical/Electronic Equipment

### Outcome 1

Assist in the installation of electrical/electronic equipment

#### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the installation of the electrical/electronic equipment:
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations
  - confirm that authorisation to carry out the installation activities has been given
  - check that safe access and working arrangements for the installation area have been provided
  - confirm that services have been safely isolated, ready for the installation (such as mechanical, electricity, gas, air or fluids)
  - check that all required installation consumables are available
  - leave the work area in a safe condition and free from foreign object debris
3. assist in the installation of six of the following electrical modules/components:
  - switchgear
  - alarm devices
  - programmable controllers
  - power factor correction devices
  - motors and starters
  - luminaires
  - panels or sub-assemblies
  - control devices
  - communication equipment
  - cable connectors
  - encoders or resolvers
  - conduit
  - bus bars
  - safety devices
  - emergency/standby batteries
  - overload protection devices
  - sensors and actuators
  - electronic modules/units
  - trunking
  - traywork
  - other electrical equipment (specify)
4. assist in the connection of equipment to two of the following types of electrical supply:
  - single phase
  - direct current
  - three phase
  - low voltage (up to 115V)
5. follow all relevant instructions/documentation for the installation being carried out

6. produce installations which comply with all of the following, as appropriate to the equipment being installed:
  - equipment manufacturer's operation range
  - BS7671/IEE wiring regulations
  - BS, ISO and/or BSEN standards
  - customer (contractual) standards and requirements
  - company standards and procedures
7. use the correct tools and equipment for the installation operations, and check that they are in a safe and usable condition
8. use two of the following instruments during the installation activities:
  - multimeter
  - insulation resistance tester
  - earth-loop impedance tester
  - other specific test equipment
9. assist in the installation, positioning and securing of the equipment, using appropriate methods and techniques
10. carry out four of the following installation methods and techniques:
  - marking out the location of components/modules
  - positioning and securing equipment and components
  - securing by using mechanical fixings
  - drilling and hole preparation
  - levelling and/or alignment
  - securing by using masonry fixings
  - making installation connections (such as mechanical, electrical, fluid power, utilities)
11. carry out four of the following cable termination activities:
  - stripping cable insulation/protection
  - routing and securing wires and cables
  - terminating cables and wires
  - making mechanical/screwed/clamped connections
  - soldering and de-soldering
  - attaching suitable cable identification
  - heat shrinking (devices and boots)
  - crimping (such as tags and pins)
  - sealing and protecting cable connections
  - adding cable end fittings
12. carry out and/or assist in checking the installation, and make any adjustments in accordance with the specification
13. carry out three the following checks on the installed equipment:
  - making visual checks for completeness and freedom from damage
  - polarity
  - insulation resistance values
  - earth-loop impedance
  - continuity
14. deal promptly and effectively with problems within their control and report any that cannot be solved
15. assist in dealing with two of the following conditions during the installation process:
  - installations with no faults
  - partial equipment malfunction
  - complete malfunction of equipment

16. assist in using fault location methods and techniques on the installed equipment, to include one of the following:
  - diagnostic aids (such as company records/history, manufacturers' manuals, fault analysis charts, troubleshooting guides)
  - fault finding techniques (such as six point, half-split, unit substitution)
  - functional testing the installation/running equipment self-diagnostics
17. dispose of waste items in a safe and environmentally acceptable manner
18. assist in the completion of installation documentation to include one of the following:
  - installation records
  - company-specific documentation
  - job card

## Unit 181

# Assisting in the Installation of Electrical/Electronic Equipment

## Outcome 2

Know how to assist in the installation of electrical/electronic equipment

### Assessment Criteria

The learner will be able to:

1. describe the health and safety requirements of the area in which the installation activity is to take place, and the responsibility these requirements place on the learner
2. describe the isolation and lock-off procedure or permit-to-work procedure that applies
3. describe the specific health and safety precautions to be applied during the installation procedure, and their effects on others
4. describe the hazards associated with installing electrical/electronic equipment, and with the tools and equipment used, and how to minimise them and reduce any risks
5. describe the importance of wearing protective clothing and other appropriate safety equipment during the installation
6. explain how to obtain and interpret information from job instructions and other documentation used in the installation activities (such as installation drawings, specifications, manufacturers' manuals, BS7671/IEE regulations, symbols and terminology)
7. describe the basic principle of operation of the equipment/circuits being installed
8. describe the different types of cabling used in the maintenance activities, and their methods of termination
9. describe the care, handling and application of electrical measuring instruments (such as multimeter, resistance tester, earth-loop impedance tester)
10. describe the methods of lifting, handling and supporting the equipment during the installation activities
11. explain how to check that components meet the required specification/operating conditions (such as values, tolerance, current carrying capacity, voltage rating, power rating, working temperature range)
12. describe the techniques used to terminate electrical equipment (such as plugs, soldering, screwed, clamped and crimped connections)
13. describe the methods of attaching markers/labels to components or cables, to assist with identification
14. describe the tools and equipment used in the installation activities (such as cable stripping tools, crimping tools, soldering irons and torches, gland connecting tools)
15. explain how to make adjustments to components/assemblies to ensure that they function correctly
16. explain how to check that tools and equipment are free from damage or defects, and are in a safe and usable condition
17. describe the importance of making 'off-load' checks before proving the equipment with the electrical supply on
18. explain why electrical bonding is critical, and why it must be both mechanically and electrically secure
19. describe the calibration/care and control procedures for tools and equipment
20. describe the problems that can occur with the installation operations, and how these can be overcome
21. describe the fault-finding techniques to be used if the equipment fails to operate correctly
22. describe the recording documentation to be completed for the activities undertaken
23. describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve

**Level:** 3  
**Credit value:** 48  
**UAN number:** L/600/5649

**Unit aim**

This unit covers the skills and knowledge needed to prove the competences required to assist in the installation of fluid power equipment, on mobile or static plant, in accordance with approved procedures. The learner will be required to assist in the installation of a range of fluid power equipment, such as hydraulic, pneumatic or vacuum. This will involve the installation of components and units such as pumps, valves, actuators, sensors, intensifiers, regulators, compressors, pipes and hoses, and other specific fluid power equipment. This unit does not involve maintenance/repair type activities, such as removal and replacement of existing equipment.

The learner will be required to use the appropriate tools and equipment throughout the installation activities, and to apply a range of installation methods and techniques to position, align and connect various fluid power components, and to make all necessary connections to the required service. The installation activities will include making checks and adjustments, in line with their permitted authority, and assisting others to ensure that the installed equipment functions to the required specification.

The learner's responsibilities will require them to comply with organisational policy and procedures for the installation activities undertaken, and to report any problems with the activities, tools or equipment used that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner must check that all tools, equipment and materials used in the installation activities are removed from the work area on completion of the work, and that the relevant job/task documentation is completed accurately and legibly. The learner will be expected to work to instructions, alone or in conjunction with others, taking personal responsibility for their own actions and for the quality and accuracy of the work that they carry out.

The installation activity may be carried out as a team effort, but the learner must demonstrate a significant personal contribution to the installation activities, in order to satisfy the requirements of the standard, and they must demonstrate competence in all the areas required by the standard.

The learner's knowledge will be sufficient to provide a sound basis for their work, and will enable them to adopt an informed approach to applying fluid power installation procedures. The learner will have an understanding of the equipment being installed, and its installation requirements, in adequate depth to provide a sound basis for carrying out the installation process safely and effectively.

The learner will understand the safety precautions required when carrying out the installation activities, especially those for ensuring the safe isolation of services. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.



### **Learning outcomes**

There are **two** learning outcomes to this unit. The learner will be able to:

1. Assist in the installation of fluid power equipment
2. Know how to assist in the installation of fluid power equipment

### **Guided learning hours**

It is recommended that **161** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 82: Assisting in the Installation of Fluid Power Equipment (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

## Unit 182

# Assisting in the Installation of Fluid Power Equipment

## Outcome 1

Assist in the installation of fluid power equipment

### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the installation of the fluid power equipment:
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations
  - confirm that authorisation to carry out the installation activities has been given
  - check that safe access and working arrangements for the installation area have been provided
  - confirm that services have been safely isolated, ready for the installation (such as mechanical, electricity, gas, air or fluids)
  - check that all required installation consumables are available
  - leave the work area in a safe condition and free from foreign object debris
3. assist in the installation of one of the following types of fluid power system:
  - pneumatic
  - hydraulic
  - vacuum
4. follow all relevant instructions/documentation for the installation being carried out
5. produce installations which comply with all of the following, as appropriate to the equipment being installed:
  - equipment manufacturer's operation range
  - BS, ISO and/or BSEN standards
  - customer (contractual) standards and requirements
  - company standards and procedures
6. use the correct tools and equipment for the installation operations, and check that they are in a safe and usable condition
7. use three of the following types of equipment during the installation activities:
  - pressure testing devices
  - flow testing devices
  - mechanical measuring devices
  - bleeding devices
  - alignment devices
  - electrical measuring devices
  - timing devices
  - fluid sampling device
  - flushing blocks/rigs
8. assist in the installation, positioning and securing of the equipment, using appropriate methods and techniques

9. assist in the installation of six of the following fluid power components:
  - rigid pipework
  - filters
  - reservoirs/storage receivers
  - compressors
  - accumulators
  - lubricators
  - gaskets and seals
  - regulators
  - pumps
  - receivers
  - switches
  - hoses/tubing
  - cylinders
  - valves
  - actuators
  - sensors
  - pressure intensifiers
  - other (specify)
  
10. carry out the installation by applying five of the following methods and techniques:
  - marking out of locating and securing positions
  - drilling and hole preparation
  - positioning equipment/components
  - aligning pipework and connections
  - dressing and securing piping and hoses
  - connecting wires and cables
  - securing by using mechanical fixings
  - securing by using masonry fixings
  - applying screw fastener locking devices
  - applying hose/cable clips and fasteners
  - making installation connections (such as mechanical, electrical, fluid power, utilities)
  
11. carry out and/or assist in checking the installation, and make any adjustments in accordance with the specification
12. carry out all of the following checks and adjustments, as appropriate to the equipment being installed:
  - leak checks
  - making 'off-load' checks
  - checking level and alignment
  - making visual checks for completeness and freedom from damage
  - making sensory checks (sight, sound, smell, touch)
  - ensuring that any moving parts are clear of obstruction and/or are guarded
  - Plus: assist in carrying out two of the following:
    - filling the system using the correct cleanliness control procedures
    - setting system pressure/flow
    - pressurising the system
    - line pressure checks
    - flow checks
    - check the sequencing of the system
    - ensuring that locking devices are fitted to fasteners (where appropriate)
    - testing to ensure that the equipment operates to the installation specifications
  
13. deal promptly and effectively with problems within their control and report those that cannot be solved
14. assist in dealing with two of the following conditions during the installation process:
  - installations with no faults
  - partial system malfunction
  - complete malfunction of the system

15. assist in using fault location methods and techniques on the installed equipment, to include one of the following:
  - diagnostic aids (such as company records/history, manufacturers' manuals, fault analysis charts, troubleshooting guides, circuit diagrams, function diagrams)
  - fault finding techniques (such as six point, half-split, unit substitution, fault cause remedy, sequence chart)
  - function testing the installation/running equipment self-diagnostics
16. dispose of waste items in a safe and environmentally acceptable manner
17. assist in the completion of installation documentation to include one of the following:
  - installation records (such as test and system performance data)
  - company-specific documentation
  - job card

## Unit 182

# Assisting in the Installation of Fluid Power Equipment

## Outcome 2

Know how to assist in the installation of fluid power equipment

### Assessment Criteria

The learner will be able to:

1. describe the health and safety requirements of the area in which the installation activity is to take place, and the responsibility these requirements place on the learner
2. describe the isolation and lock-off procedure or permit-to-work procedure that applies
3. describe the specific health and safety precautions to be applied during the installation procedure, and their effects on others
4. describe the hazards associated with installing fluid power equipment, and with the tools and equipment used, and how to minimise them and reduce any risks
5. describe the importance of wearing protective clothing and other appropriate safety equipment during the installation
6. explain how to obtain and interpret information from job instructions and other documents needed in the installation process (such as drawings, specifications, manufacturers' manuals, symbols and terminology)
7. describe the methods of marking out the site for positioning the equipment, and the tools and equipment used for this
8. describe the methods of drilling holes for rag bolts and expanding bolts (including the use of grouting and adhesives)
9. describe the various mechanical fasteners that will be used, and their method of installation (including threaded fasteners, dowels, special securing devices, masonry fixing devices)
10. describe the basic principles of how the equipment functions, and its operating sequence
11. explain how to identify the various components that are to be installed (such as valves, cylinders, actuators, sensors, pumps)
12. explain how to determine the direction of flow through components, and their position within the system
13. describe the application and fitting of seals
14. describe the recognition of contaminants and the problems they can create, and the effects and likely symptoms of contamination in the system
15. describe the techniques used to ensure the safe and correct start-up of the system
16. describe the techniques used to ensure that correct checks are made on the system
17. describe the techniques used to fault-find the system
18. describe the procedures to follow to correctly fill the hydraulic reservoirs
19. describe the need to establish the cleanliness level of oil in the hydraulic reservoirs
20. describe the techniques used during the setting and testing of the fluid power equipment (such as controlled release of pressures/force, checking for correct actuator and valve movement, checking correct sequencing)
21. describe the procedures for ensuring that they have the correct tools, equipment and consumables for the installation activities
22. describe the types of tools and instruments used to position, secure and connect the equipment (such as spanners, pipe benders, torque wrenches, alignment devices, pressure testing devices)
23. describe the methods of lifting, handling and supporting the equipment during the installation activities
24. describe the methods of connecting equipment to service supplies (such as electrical, fluid power, compressed air, oil and any fuel supplies)

25. describe the procedure for the safe disposal of waste materials
26. describe the importance of ensuring that the completed installation is free from dirt, swarf and foreign object damage, and of ensuring that any exposed components or pipe ends are correctly covered/protected
27. describe the completion of documentation for the activities undertaken
28. describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve

## Unit 183

# Assisting in the Installation of Equipment to Produce an Engineered System

**Level:** 2  
**Credit value:** 48  
**UAN number:** T/600/5659

### Unit aim

This unit covers the skills and knowledge needed to prove the competences required to assist in the installation of equipment to produce an engineered system, in accordance with approved procedures. The learner will be required to assist in the installation of a range of equipment, all of which encompass an integrated system involving two or more of the following interactive technologies: mechanical, electrical, fluid power or process controller. Typical systems will include automated equipment such as robots, pick-and-place devices, stacking devices, automated systems, transfer equipment, processing plant, and material handling devices such as jigs and fixtures with fluid power and electrical mechanisms attached. This unit does not involve maintenance/repair type activities, such as removal and replacement of existing equipment, or the installation of items of equipment that are simple, self-contained items requiring minimal installation. It does, however, include the connection of sub-assemblies where these have been broken down for transportation purposes.

The learner will be required to use the appropriate tools and equipment throughout the installation activities, and to apply a range of installation methods and techniques to position, level and align the equipment, and to make connections to sensors and actuators which could be electrical, fluid power, water or fuel supply, as appropriate to the equipment installed. Where appropriate, the learner may also assist in work with PC/PLCs, making connections, installing hardware and loading and editing software. The installation activities will include making checks and adjustments, in line with their permitted authority, and assisting others to ensure that the installed equipment functions to the required specification.

The learner's responsibilities will require them to comply with organisational policy and procedures for the installation activities undertaken, and to report any problems with the activities, tools or equipment used that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner must check that all tools, equipment and materials used in the installation activities are removed from the work area on completion of the work, and that the relevant job/task documentation is completed accurately and legibly. The learner will be expected to work to instructions, alone or in conjunction with others, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The installation activity may be carried out as a team effort, but the learner must demonstrate a significant personal contribution to the installation activities, in order to satisfy the requirements of the standard, and they must demonstrate competence in all the areas required by the standard.

The learner's knowledge will be sufficient to provide a sound basis for their work, and will enable them to adopt an informed approach to applying procedures for the installation of an engineered system. The learner will have an understanding of the equipment being installed, and its installation requirements, in adequate depth to provide a sound basis for carrying out the installation process safely and effectively.

The learner will understand the safety precautions required when carrying out the installation activities, especially those for ensuring the safe isolation of services. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

### **Learning outcomes**

There are **two** learning outcomes to this unit. The learner will be able to:

1. Assist in the installation of equipment to produce an engineered system
2. Know how to assist in the installation of equipment to produce an engineered system

### **Guided learning hours**

It is recommended that **161** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 83: Assisting in the Installation of Equipment to Produce an Engineered System (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

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## Unit 183

# Assisting in the Installation of Equipment to Produce an Engineered System

## Outcome 1

Assist in the installation of equipment to produce an engineered system

### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the installation of the engineered system:
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations
  - confirm that authorisation to carry out the installation activities has been given
  - check that safe access and working arrangements for the installation area have been provided
  - confirm that services have been safely isolated, ready for the installation (such as mechanical, electricity, gas, air or fluids)
  - check that all required installation consumables are available
  - leave the work area in a safe condition and free from foreign object debris
3. assist in the installation of an engineered system, which includes installing equipment for two of the following interactive technologies:

(a) installing mechanical equipment/components:

assist in carrying out all of the following:

- installing mechanical equipment (such as machine tools, processing plant, turbines engines transfer equipment)
- levelling equipment
- aligning and securing sub-assemblies and units
- connecting units (such as shafts, couplings, belt and chain drives)

Plus one of the following:

- setting and adjusting drive mechanisms (such as shafts and couplings, belt and chain drives)
- setting and adjusting operating mechanisms (such as levers, linkages, cams and followers)
- setting and adjusting control mechanisms (such as clutches and brakes)

(b) installing electrical and electronic equipment/components:

- assist in carrying out all of the following:
  - installing electrical equipment (such as switch gear and distribution panels, motors and starters, luminaires)
  - attaching suitable cable identification (such as colour coding or numbering systems)
  - installing wiring enclosures/cable protection systems (such as conduit, trunking and tray work)
  - installing, routing and securing wires and cables (such as PVC, mineral and armoured cables)

plus one of the following:

- terminating cables to electrical components
- terminating cables to main distribution centre

(c) Installing fluid power components:

assist in carrying out all of the following:

- installing fluid power equipment (such as compressors, pumps, accumulators, storage reservoirs and receivers)
- installing fluid power components (such as cylinders, valves, sensors, actuators, filters and regulators)
- installing rigid and flexible pipework and hoses
- connecting components to pipework, using appropriate fittings
- dressing and securing piping and hoses

(d) Installing process controller components:

assist in carrying out all of the following:

- installing process controllers or sequential controllers (such as PLCs, data communication links)
- installing and connecting wires and cables to components
- installing input/output interfacing
- installing program logic peripherals (such as modems, PC peripheral devices)
- checking and confirming that signal measurement and transmission are satisfactory

(e) Installing instrumentation and control components:

Assist in carrying out all of the following:

- installing instrumentation and control equipment (such as pressure, flow, level, temperature, speed, weight, vibration)
- installing and connecting peripherals (such as sensors, actuators, relays, switches)
- installing and connecting process pipework
- Plus one of the following:
  - connecting electrical/pneumatic supply to instruments/sensors
  - connecting signal transmission supply to instruments/sensors
  - checking and confirming that signal measurement and transmission are satisfactory

4. follow all relevant instructions/documentation for the installation being carried out
5. produce installations which comply with all of the following, as appropriate to the equipment being installed:
  - equipment manufacturer's operation range
  - BS, ISO and/or BSEN standards
  - BS7671/IEE wiring regulations
  - customer (contractual) standards and requirements
  - company standards and procedures
6. use the correct tools and equipment for the installation operations, and check that they are in a safe and usable condition
7. use two of the following groups of instruments during the installation activities:
  - alignment devices (such as plumb lines, spirit levels, inclinometers, laser equipment)
  - linear measuring devices (such as tapes, dial test indicators, micrometers, verniers, feeler gauges)
  - electrical measuring equipment (such as multimeter, continuity tester, insulation resistance, earth loop impedance tester)
  - fluid/power testing equipment (such as pressure or flow testing devices, speed or temperature measurement)
8. assist in the installation, positioning and securing of the equipment, using appropriate methods and techniques

9. apply installation methods and techniques, to include four of the following:
  - marking out positions of all equipment
  - drilling and preparing holes
  - aligning and levelling equipment
  - shimming and packing
  - securing by using mechanical fixings (nuts and bolts)
  - securing by using adhesives
  - applying screw fastener locking devices
  - fitting anti-vibration mountings
  - moving and positioning equipment, using appropriate lifting and handling equipment
  - securing by using masonry fixings (such as rag bolts or expanding bolts)
10. carry out and/or assist in checking the installation, and make any adjustments in accordance with the specification
11. carry out all of the following checks and adjustments as appropriate to the equipment being installed:
  - making visual checks of the installation, for completeness and freedom from damage
  - topping up fluid/oil reservoirs
  - ensuring that all bolts are correctly torqued, and that locking devices are fitted to fasteners
  - ensuring that all pipe connections are correctly made, secure and leak free
  - ensuring that all moving parts are clear of obstructions and are guarded
  - making sensory checks of the system (sight, sound, smell, touch)

plus: assist in carrying out two of the following:

  - testing that the system operates to the installation specification
  - confirm that the correct software has been installed
  - ensuring that all electrical connections are correctly made, earth bonding is secure and connections covered
12. deal promptly and effectively with problems within their control and report those that cannot be solved
13. assist in dealing with two of the following conditions during the installation process:
  - installations with no faults
  - partial equipment malfunction
  - complete malfunction of equipment
14. assist in using fault location methods and techniques on the installation, to include one of the following:
  - diagnostic aids (such as company records/history, manufacturers' manuals, fault analysis charts, troubleshooting guides)
  - fault finding techniques (such as six point, half-split, unit substitution)
  - functional testing the installation/running equipment self-diagnostics
15. dispose of waste items in a safe and environmentally acceptable manner
16. assist in the completion of installation documentation
17. complete the relevant paperwork, to include one of the following, and pass it to the appropriate people:
  - installation records
  - company-specific documentation
  - job card

## Unit 183

# Assisting in the Installation of Equipment to Produce an Engineered System

## Outcome 2

Know how to assist in the installation of equipment to produce an engineered system

### Assessment Criteria

The learner will be able to:

1. describe the health and safety requirements of the area in which the installation activity is to take place, and the responsibility these requirements place on the learner
2. describe the isolation and lock-off procedure or permit-to-work procedure that applies
3. describe the specific health and safety precautions to be applied during the installation procedure, and their effects on others
4. describe the hazards associated with installing equipment to form an engineered system, and with the tools and equipment used, and how to minimise them and reduce any risks
5. describe the importance of wearing protective clothing and other appropriate safety equipment during the installation
6. explain how to obtain and interpret information from job instructions and other documentation used in the installation activities (such as installation drawings, specifications, manufacturers' manuals, BS7671/IEE regulations, symbols and terminology)
7. describe the basic principles of how the system functions, and its operating sequence
8. describe the methods of marking out the site for positioning the equipment, and the tools and equipment used for this
9. describe the methods of drilling holes in masonry for rag bolts and expanding bolts (including use of grouting and adhesives)
10. describe the various mechanical fasteners that will be used, and their method of installation
11. describe the methods of lifting, handling and supporting the equipment during the installation activities
12. describe the methods of levelling and aligning the equipment, and the types of tools, instruments and techniques used
13. describe the methods of connecting to mechanical power transmission devices (such as shafts, couplings belt and chain drives)
14. describe the different types of cabling used in the installation activities, and their methods of termination
15. describe the different types of wiring enclosures that are used (to include conduit, trunking and traywork systems)
16. describe the installation and termination of a range of electrical components (such as plugs, switches, sockets, lighting and fittings)
17. explain why electrical bonding is critical, and why it must be both mechanically and electrically secure
18. describe the care, handling and application of ohmmeters, multimeters and other electrical measuring instruments
19. describe the methods of assembling and installing pipework, hoses and fittings
20. explain how to recognise a range of fluid power components
21. describe the recognition of contaminants and the problems they can create, and the effects and likely symptoms of contamination in the system
22. describe the recognition of process instrumentation and associated peripherals (such as pressure, flow, temperature)

23. describe the recognition of plc systems and associated peripheral devices (such as input/output (I/O) devices)
24. explain how to conduct any necessary checks to ensure the equipment integrity, functionality, accuracy and quality of the installation (including the fitting of guards to all moving parts, and covers on electrical connections)
25. explain how to recognise installation defects (such as leaks, poor seals, misalignment, ineffective fasteners, foreign object damage)
26. describe the problems that can occur with the installation operations, and how these can be overcome
27. describe the fault-finding techniques to be used if the equipment fails to operate correctly
28. describe the recording documentation to be completed for the activities undertaken
29. describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve

**Level:** 3  
**Credit value:** 48  
**UAN number:** R/600/5667

**Unit aim**

This unit covers the skills and knowledge needed to prove the competences required to assist in the installation of engineering services equipment, in accordance with approved procedures. The learner will be required to assist in the installation of a range of services equipment such as fresh and waste water distribution equipment; workplace and environmental control equipment; emergency power generation equipment; heating, ventilating, air conditioning and refrigeration equipment; gas and compressed air equipment; process and instrumentation control equipment. This unit does not involve maintenance/repair type activities, such as removal and replacement of existing equipment.

The learner will be required to use the appropriate tools and equipment throughout the installation activities, and to apply a range of installation methods and techniques to position, level and align the equipment, and to make connections to the various mechanical, electrical, fluid power, water or fuel supplies, as appropriate to the equipment installed. The installation activities will include making checks and adjustments, in line with their permitted authority, and assisting others to ensure that the installed equipment functions to the required specification.

The learner's responsibilities will require them to comply with organisational policy and procedures for the installation activities undertaken, and to report any problems with the activities, tools or equipment used that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner must check that all tools, equipment and materials used in the installation activities are removed from the work area on completion of the work, and that the relevant job/task documentation is completed accurately and legibly. The learner will be expected to work with a minimum of supervision, alone or in conjunction with others, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The installation activity may be carried out as a team effort, but the learner must demonstrate a significant personal contribution to the installation activities, in order to satisfy the requirements of the standard, and they must demonstrate competence in all the areas required by the standard.

The learner's knowledge will be sufficient to provide a sound basis for their work, and will enable them to adopt an informed approach to applying procedures for the installation of engineering services equipment. The learner will have an understanding of the equipment being installed, and its installation requirements, in adequate depth to provide a sound basis for carrying out the installation process safely and effectively.

The learner will understand the safety precautions required when carrying out the installation activities, especially those for ensuring the safe isolation of services. The learner will be required to demonstrate safe working practices throughout, and will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

### **Learning outcomes**

There are **two** learning outcomes to this unit. The learner will be able to:

1. Assist in the installation of engineering services equipment
2. Know how to assist in the installation of engineering services equipment

### **Guided learning hours**

It is recommended that **161** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 84: Assisting in the Installation of Engineering Services Equipment (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

## Unit 184

# Assisting in the Installation of Engineering Services Equipment

## Outcome 1

Assist in the installation of engineering services equipment

### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the installation of the engineering services equipment:
  - obtain and correctly interpret documentation for the equipment being installed (such as job instructions, installation drawings and quality documentation)
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations
  - confirm that authorisation to carry out the installation activities has been given
  - check that safe access and working arrangements for the installation area have been provided
  - confirm that services have been safely isolated, ready for the installation (such as mechanical, electricity, gas, air or fluids)
  - check that all required installation consumables are available
  - follow specified and appropriate installation techniques and procedures at all times
  - leave the work area in a safe and tidy condition on completion of the installation activities
3. assist in the installation of one of the following engineering services systems/equipment:
  - fresh water
  - waste water
  - workplace environmental control
  - emergency power generation
  - heating and ventilating
  - air conditioning
  - gas distribution
  - compressed air
  - process control
  - refrigeration
  - environmental control
4. follow all relevant instructions/documentation for the installation being carried out
5. Produce installations which comply with all of the following standards, as appropriate to the equipment being installed:
  - equipment manufacturer's operation range
  - BS, ISO and/or BSEN standards
  - BS 7671/IEE wiring regulations
  - customer (contractual) standards and requirements
  - company standards and procedures
6. use the correct tools and equipment for the installation operations, and check that they are in a safe and usable condition



7. use two of the following during the installation activities:
  - alignment devices (such as plumb lines, spirit levels, inclinometers, laser equipment)
  - linear measuring devices (such as tapes, dial test indicators, micrometers, verniers, feeler gauges)
  - electrical measuring equipment (such as multimeter, continuity tester, insulation resistance, earth loop impedance tester)
  - fluid testing equipment (such as pressure or flow testing devices, speed or temperature measurement)
8. assist in the installation, positioning and securing of the equipment, using appropriate methods and techniques
9. apply installation methods and techniques, to include six of the following:
  - marking out positions of all equipment
  - drilling and preparing holes
  - positioning equipment
  - aligning and levelling equipment
  - installing and connecting peripherals
  - shimming and packing
  - making mechanical connections
  - making electrical connections
  - making pipe connections
  - securing by using mechanical fixings (nuts and bolts)
  - securing by using adhesives
  - applying screw fastener locking devices
  - fitting anti-vibration mountings
  - moving and positioning equipment, using appropriate lifting and handling equipment
  - securing by using masonry fixings (such as rag bolts or expanding bolts)
  - attaching suitable cable identification (such as colour coding or numbering systems)
10. carry out and/or assist in checking the installation, and make any adjustments in accordance with the specification
11. carry out all of the following checks and adjustments, as appropriate to the equipment being installed:
  - making visual checks of the installation, for completeness and freedom from damage
  - topping up fluid/oil reservoirs (where applicable)
  - ensuring that all bolts are correctly torqued, and that locking devices are fitted to fasteners
  - ensuring that all connections are correctly made and are mechanically secure
  - ensuring that all covers/guards on equipment are in place
  - making sensory checks of the system (such as sight, sound, smell, touch)
  - testing that the system operates to the installation specification
12. deal promptly and effectively with problems within their control and report those that cannot be solved
13. assist in dealing with two of the following conditions during the installation process:
  - installations with no faults
  - partial equipment malfunction
  - complete malfunction of equipment
14. assist in using fault location methods and techniques on the installation, to include one of the following:
  - diagnostic aids (such as company records/history, manufacturers' manuals, fault analysis charts, troubleshooting guides)
  - fault finding techniques (such as six point, half-split, unit substitution)
  - functional testing the installation/running equipment self-diagnostics
15. dispose of waste items in a safe and environmentally acceptable manner
16. assist in the completion of installation documentation
17. complete the relevant paperwork, to include one of the following, and pass it to the appropriate people:
  - installation records
  - company-specific documentation
  - job card

## Unit 184

# Assisting in the Installation of Engineering Services Equipment

### Outcome 2

Know how to assist in the installation of engineering services equipment

#### Assessment Criteria

The learner will be able to:

1. describe the health and safety requirements of the area in which the installation activity is to take place, and the responsibility these requirements place on the learner
2. describe the isolation and lock-off procedure or permit-to-work procedure that applies
3. describe the specific health and safety precautions to be applied during the installation procedure, and their effects on others
4. describe the hazards associated with installing engineering services equipment, and with the tools and equipment used, and how to minimise them and reduce any risk
5. describe the importance of wearing protective clothing and other appropriate safety equipment during the installation
6. explain how to obtain and interpret information from job instructions and other documentation used in the installation activities (such as installation drawings, specifications, manufacturers' manuals, BS7671/IEE regulations, symbols and terminology)
7. describe the basic principles of operation of the equipment being installed, and its operating sequence
8. describe the methods of marking out the site for positioning the equipment, and the tools and equipment used for this
9. describe the methods of drilling holes in masonry for rag bolts and expanding bolts (including use of grouting and adhesives)
10. describe the various mechanical fasteners that will be used, and their method of installation
11. describe the methods of lifting, handling and supporting the equipment during the installation activities
12. describe the methods of levelling and aligning the equipment, and the types of tools, instruments and techniques used
13. describe the methods of connecting the equipment to the services such as mechanical connections, pipe connections, electrical connections
14. describe the installation and termination of a range of electrical components (such as plugs, switches, sockets)
15. describe the care, handling and application of test instruments used in the installation activities (such as measuring instruments, levelling devices, electrical test equipment, fluid test equipment)
16. explain how to conduct any necessary checks to ensure the equipment integrity, functionality, accuracy and quality of the installation (including the fitting of covers/guards to all moving parts, and covers on electrical connections)
17. explain how to recognise installation defects (such as misalignment, ineffective fasteners, foreign object damage)
18. describe the problems that can occur with the installation operations, and how these can be overcome
19. describe the fault-finding techniques to be used if the equipment fails to operate correctly
20. describe the recording documentation to be completed for the activities undertaken
21. describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve

**Level:** 3  
**Credit value:** 48  
**UAN number:** F/600/6068

**Unit aim**

This unit covers the skills and knowledge needed to prove the competences required to assist in the installation of instrumentation and control equipment, in accordance with approved procedures. The learner will be required to assist in the installation of a range of instrumentation and control equipment such as pressure, flow, level, and temperature monitoring and control equipment, fiscal monitoring equipment, fire and gas detection and alarm equipment, industrial weighing equipment, speed measurement and control equipment, vibration monitoring equipment, nucleonics and radiation measurement, analysers, recorders and indicators, telemetry equipment and emergency shutdown equipment. This unit does not involve maintenance/repair type activities, such as removal and replacement of existing equipment.

The learner will be required to use the appropriate tools and equipment throughout the installation activities, and to apply a range of installation methods and techniques to position, level and align the equipment, and to make connections to the required services. The installation activities will include making checks and adjustments, in line with their permitted authority, and assisting others to ensure that the installed equipment functions to the required specification.

The learner's responsibilities will require them to comply with organisational policy and procedures for the installation activities undertaken, and to report any problems with the activities, tools or equipment used that they cannot personally resolve, or that are outside their permitted authority, to the relevant people. The learner must check that all tools, equipment and materials used in the installation activities are removed from the work area on completion of the work, and that the relevant job/task documentation is completed accurately and legibly.

The learner will be expected to work to instructions, alone or in conjunction with others, taking personal responsibility for their own actions, and for the quality and accuracy of the work that they carry out.

The installation activity may be carried out as a team effort, but the learner must demonstrate a significant personal contribution to the installation activities, in order to satisfy the requirements of the standard, and they must demonstrate competence in all the areas required by the standard.

The learner's knowledge will be sufficient to provide a sound basis for their work, and will enable them to adopt an informed approach to applying installation procedures to instrumentation and control equipment. The learner will have an understanding of the equipment being installed, and its installation requirements, in adequate depth to provide a sound basis for carrying out the installation process safely and effectively.

The learner will understand the safety precautions required when carrying out the installation activities, especially those for ensuring the safe isolation of services. The learner will be required to demonstrate safe working practices throughout, and they will understand their responsibility for taking the necessary safeguards to protect themselves and others in the workplace.

### **Learning outcomes**

There are **two** learning outcomes to this unit. The learner will be able to:

1. Assist in the installation of instrumentation and control equipment
2. Know how to assist in the installation of instrumentation and control equipment

### **Guided learning hours**

It is recommended that **161** hours should be allocated for this unit, although patterns of delivery are likely to vary.

### **Details of the relationship between the unit and relevant national standards**

This unit has been derived from National Occupational Standard Engineering Maintenance Unit No 85: Assisting in the Installation of Instrumentation and Control Equipment (Suite 3)

### **Support of the unit by a sector or other appropriate body**

This unit is endorsed by Semta.

### **Assessment**

This unit must be assessed in a work environment and must be assessed in accordance with the 'Common Requirements for National Vocational Qualifications (NVQ) in the QCF' which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

Additional assessment requirements have been published by Semta. These additional assessment requirements are set down in Semta's Engineering Maintenance Level 3 unit assessment strategy which can be downloaded from Semta's website:

**[http://www.semta.org.uk/training\\_providers\\_\\_awarding/national\\_occupational\\_standard/qca\\_assessment\\_requirements.aspx](http://www.semta.org.uk/training_providers__awarding/national_occupational_standard/qca_assessment_requirements.aspx)**

## Unit 185

# Assisting in the Installation of Instrumentation and Control Equipment

## Outcome 1

Assist in the installation of instrumentation and control equipment

### Assessment Criteria

The learner will be able to:

1. work safely at all times, complying with health and safety and other relevant regulations and guidelines
2. carry out all of the following during the installation of the instrumentation and control equipment:
  - adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations
  - confirm that authorisation to carry out the installation activities has been given
  - check that safe access and working arrangements for the installation area have been provided
  - confirm that services have been safely isolated, ready for the installation (such as mechanical, electricity, gas, air or fluids)
  - check that all required installation consumables are available
  - leave the work area in a safe condition and free from foreign object debris
3. assist in the installation of one of the following types of instrumentation and control equipment:
  - pressure monitoring/control
  - flow monitoring/control
  - level monitoring/control
  - temperature monitoring/control
  - weight monitoring/control
  - fiscal metering
  - fire detection and alarm
  - gas detection and alarm
  - emergency shutdown
  - speed measurement
  - speed control
  - vibration monitoring/control
  - nucleonic and radiation
  - analysers
  - recorders and indicators
  - telemetry equipment
  - control equipment (such as indexing, positioning, sequencing)
4. follow all relevant instructions/documentation for the installation being carried out
5. produce installations which comply with all of the following, as appropriate to the equipment being installed:
  - equipment manufacturer's operation range
  - BS7671/IEE wiring regulations
  - BS, ISO and/or BSEN standards
  - customer (contractual) standards and requirements
  - company standards and procedures
6. use the correct tools and equipment for the installation operations, and check that they are in a safe and usable condition
7. assist in using two 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

8. assist in the installation, positioning and securing of the equipment, using appropriate methods and techniques

9. carry out all of the following installation methods and techniques:

- positioning and securing equipment/components
- making mechanical connections
- proof marking/labelling of wires or components
- installing and connecting process pipework
- tightening fastenings to the required torque
- making installation connections (such as mechanical, electrical, fluid power, utilities)
- taking electrostatic discharge (ESD) precautions when handling components/circuit boards (as appropriate)

Plus: assist in carrying out two of the following:

- installing electrical/electronic components
- setting, calibrating and adjusting instruments
- installing and connecting peripherals (such as sensors, actuators, relays, switches, back-up batteries)
- connecting the electrical/pneumatic supply to instruments/sensors
- connecting the signal transmission supply to instruments/sensors

10. carry out and/or assist in checking the installation, and make any adjustments in accordance with the specification

11. carry out all of the following checks and adjustments, as appropriate to the equipment being installed:

- making visual checks for completeness and freedom from damage
- making sensory checks (sight, sound, smell, touch)
- checking the system for leaks
- checking security of connections/terminations

Plus: assist in carrying out two more from the following:

- checking signal transmission (electrical, electronic, pneumatic, mechanical)
- confirming that signal measurement and transmission are satisfactory
- final start-up of the system and removal of any trip defeats
- testing that the equipment operates to the installation specification

12. deal promptly and effectively with problems within their control and report those that cannot be solved

13. assist in dealing with two of the following conditions during the installation process:
  - installations with no faults
  - partial equipment malfunction
  - complete malfunction of equipment
  
14. assist in using fault location methods and techniques on the installed equipment, to include one of the following:
  - diagnostic aids (such as company records/history, manufacturers' manuals, fault analysis charts, troubleshooting guides)
  - fault finding techniques (such as six point, half-split, unit substitution)
  - function testing the installation/running equipment self-diagnostics
  
15. dispose of waste items in a safe and environmentally acceptable manner
16. assist in the completion of installation documentation
17. complete the relevant paperwork, to include one of the following, and pass it to the appropriate people:
  - installation records
  - company-specific documentation
  - job card

## Unit 185

# Assisting in the Installation of Instrumentation and Control Equipment

## Outcome 2

Know how to assist in the installation of instrumentation and control equipment

### Assessment Criteria

The learner will be able to:

1. describe the health and safety requirements of the area in which the installation activity is to take place, and the responsibility these requirements place on the learner
2. describe the isolation and lock-off procedure or permit-to-work procedure that applies
3. describe the specific health and safety precautions to be applied during the installation procedure, and their effects on others
4. describe the hazards associated with installing equipment, and with the tools and equipment used, and how to minimise them and reduce any risks
5. describe the importance of wearing protective clothing and other appropriate safety equipment during installation process
6. explain how to obtain and interpret information from job instructions and other documents needed in the installation process (such as drawings, specifications, manufacturers' manuals, BS7671/IEE regulations, symbols and terminology)
7. describe the basic principles of how the equipment functions, and its operating sequence
8. describe the reasons for making sure that control systems are isolated or put into manual control, and that appropriate trip locks or keys are inserted, before removing any sensors or instruments from the system
9. describe the identification of instrument sensors (including how to identify their markings, calibration information, component values, operating parameters and working range)
10. describe the correct way of fitting instruments to avoid faulty readings (caused by head correction, poor flow past the sensor, blockages, incorrect wiring, poor insulation, or incorrect materials)
11. explain how to carry out visual checks of the instruments (checking for leaks, security of joints and physical damage)
12. describe the methods of attaching identification marks/labels to components or cables
13. describe the methods of connecting equipment to service supplies (such as electrical, fluid power, compressed air oil and fuel supplies)
14. explain why electrical bonding is critical, and why it must be both mechanically and electrically secure
15. describe the procedure for the safe disposal of waste materials
16. explain how to recognise installation defects (such as leaks, poor seals, misalignment, ineffective fasteners, foreign object damage, or contamination)
17. describe the importance of ensuring that the completed installation is free from dirt, swarf and foreign object damage, and of ensuring that any exposed components or pipe ends are correctly covered/protected
18. describe the problems that can occur with the installation operations, and how these can be overcome
19. describe the fault finding techniques to be used if the equipment fails to operate correctly
20. describe the recording documentation to be completed for the activities undertaken
21. describe the extent of their own responsibility and to whom they should report if they have problems that they cannot resolve.



## Useful contacts

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<b>Single subject qualifications</b> Exam entries, Results, Certification, Missing or late exam materials, Incorrect exam papers, Forms request (BB, results entry), Exam date and time change	T: +44 (0)844 543 0000 F: +44 (0)20 7294 2413 F: +44 (0)20 7294 2404 (BB forms) E: <b>singlesubjects@cityandguilds.com</b>
<b>International awards</b> Results, Entries, Enrolments, Invoices, Missing or late exam materials, Nominal roll reports	T: +44 (0)844 543 0000 F: +44 (0)20 7294 2413 E: <b>intops@cityandguilds.com</b>
<b>Walled Garden</b> Re-issue of password or username, Technical problems, Entries, Results, e-assessment, Navigation, User/menu option, Problems	T: +44 (0)844 543 0000 F: +44 (0)20 7294 2413 E: <b>walledgarden@cityandguilds.com</b>
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