Level 2 Diploma in Maritime Defence (Foundation Competence) (4615-02)

Version 1 (September 2017)

Qualification Handbook

Qualification at a glance

Subject area	Mechanical
City & Guilds number	4615
Age group approved	16-19, 19+
Entry requirements	Entry Requirements
Assessment types	Portfolio
Approvals	Approval application required
Support materials	Qualification handbook
Registration and certification	Consult the Walled Garden/Online Catalogue for last dates

Title and level	GLH	TQT	City & Guilds qualification number	Ofqual accreditation number
Level 2 Diploma in Maritime Defence (Foundation Competence)	280	350	4615-02	603/2424/7

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1 Introduction

This document tells you what you need to do to deliver the qualification:

Area	Description
Who is the qualification for?	It is aimed at anyone over the age of 16 who has an interest in working and progressing in the Maritime Engineering sector. It is designed to be the base to train and qualify the next generation of Maritime Defence Engineers to meet an identified gap in the market and minimise the potential loss of skills and knowledge over the next 5-10 years.
What does the qualification cover?	This qualification allows learners to learn, develop and practise the skills required for employment and/or career progression in the Maritime engineering and Engineering sector in general.
What opportunities for progression are there?	Upon completion of this qualification learners will have developed most of the basic skills required during their foundation phase of the Apprenticeship and will enable them to progress into further training. Learners can progress to the Level 3 Diploma in Maritime Defence (Development Competence).
Who did we develop the qualification with?	This qualification has been developed by the Engineering Technician Employer Group which included the following organisations: BAE Systems, Airbus Group, The Institution of Engineering and Technology, British Airways, Rolls- Royce plc, Royal Aeronautical Society, Royal Air Force Cosford, Royal Navy, Institution of Mechanical Engineers, Siemens plc, Jaguar Land Rover, BMW, Toyota Motor Manufacturing (UK) Ltd and Babcock International Ltd.
Is it part of an apprenticeship framework or initiative?	Yes. This qualification forms part of the mandatory foundation phase for the on-programme section of the new Engineering Technician Standard. The qualification can also be used for full time students who would like to gain the basic knowledge and skills that will enable them to progress into further training to become a Maritime Engineer.

Structure

Learners must achieve 3 mandatory units (201-203) plus 4 optional units from (204-223)

City & Guilds unit number	Unit title	GLH
Mandatory		
201	Complying with statutory regulations and organisational safety requirements	35
202	Working efficiently and effectively in an engineering environment	25
203	Using and communicating technical information	25
Optional		
204	Producing components using hand fitting techniques	60
205	Producing mechanical assemblies	60
206	Forming and assembling pipework systems	60
207	Maintaining mechanical devices and equipment	60
208	Assembling and testing fluid power systems	60
209	Maintaining fluid power equipment	60
210	Producing sheet metal components and assemblies	60
211	Producing platework components and assemblies	60
212	Cutting and shaping materials using thermal cutting equipment	60
213	Preparing and using manual metal arc welding equipment	60
214	Preparing and using manual TIG or plasma-arc welding equipment	60
215	Preparing and using semi-automatic MIG, MAG and flux cored arc welding equipment	60
216	Preparing and using manual flame brazing and braze welding equipment	60
217	Wiring and testing electrical equipment and circuits	60
218	Forming and assembling electrical cable enclosure and support systems	60
219	Assembling, wiring and testing electrical panels/components mounted in enclosures	60
220	Maintaining electrical equipment/systems	60
221	Using wood for pattern, modelmaking and other engineering applications	60
222	General machining applications (turning and milling)	60
223	General welding applications	60

Total Qualification Time

Total Qualification Time (TQT) is the number of notional hours which represents an estimate of the total amount of time that could reasonably be expected for a learner to achieve and demonstrate the achievement of the level of attainment necessary for the award of a qualification.
TQT is comprised of the following two elements:

1) The number of hours which an awarding organisation has assigned to a qualification for Guided Learning, and
2) an estimate of the number of hours a Learner will reasonably be likely to spend in preparation, study or any other form of participation in education or training, including assessment, which takes place as directed by - but, unlike Guided Learning, not under the Immediate Guidance or Supervision of - a lecturer, supervisor, tutor or other, appropriate provider of education or training.

Title and level	GLH	TQT
Level 2 Diploma in Maritime Defence (Foundation Competence)	280	350

2 Centre requirements

Approval

If your centre is currently approved to offer the following qualifications:

Level 2 NVQ Diploma in Performing Engineering Operations (7682-20)

Level 3 NVQ Extended Diploma in Engineering Maintenance (1788 pathways -30, -31, -32, -33, -34 and -80)

then you will have automatic approval for the new Level 2 Diploma in Maritime Defence (Foundation Competence).

To offer these qualifications, new centres will need to gain both centre and qualification approval. Please refer to the Centre Manual - Supporting Customer Excellence for further information.

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

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 monitoring quality. Centres are responsible for internal quality assurance and City & Guilds is responsible for external quality assurance.

Standards and rigorous quality assurance are maintained by the use of:

- internal quality assurance
- City & Guilds external quality assurance.

In order to carry out the quality assurance role, Internal Quality Assurers must have appropriate teaching and vocational knowledge and expertise. Assessor/Verifier (A/V) units are valued as qualifications for the centre, but they are not currently a requirement for this qualification.

Staff must:

- be familiar with the occupation and technical content covered within the qualification
- be familiar with the Engineering Technician (UK spec) requirements where delivering/assessing Level 3, they will be required to provide a signed declaration confirming they have read and understood the Engineering Technician UK Spec and the evidence requirements to meet the Engineering Technician (UK Spec) criteria.

Resource requirements

Centre staffing

Staff delivering these qualifications must be able to demonstrate that they meet the following occupational expertise requirements. They should:

- be occupationally competent or technically knowledgeable in the area[s] for which they are delivering training and/or have experience of providing training. This knowledge must be to the same level as the training being delivered
- have recent relevant experience in the specific area they will be assessing
- have credible experience of providing training.

Centre staff may undertake more than one role, eg tutor and assessor or internal verifier, but cannot internally verify their own assessments.

Additionally, those involved in internal quality assurance must:

- have experience in quality management/internal verification
- hold or be working towards an appropriate teaching/training/assessing qualification
- be familiar with the occupation and technical content covered within the qualification

Centre staff may undertake more than one role, eg tutor and assessor or internal verifier, but cannot internally verify their own assessments They must:

- be technically knowledgeable in the area(s) for which they are delivering training/assessing, with appropriate qualifications
- be familiar with the Engineering Technician (UK Spec) requirements where delivering/assessing Level 3, they will be required to provide a signed declaration confirming they have read and understood the Engineering Technician UK Spec and the evidence requirements to meet the Engineering Technician (UK Spec) criteria.

Learner entry requirements

City & Guilds does not set entry requirements for these qualifications. However, centres must ensure that candidates have the potential and opportunity to gain the qualifications successfully.

Individual employers will set the criteria, but most candidates will have four GCSEs at grade C (or equivalent) or above on entry (including English, Maths & Science). Employers who recruit learners without English, Maths and Science at Grade C or above, must ensure that the learner achieves this requirement, or an equivalent Level 2, prior to completion of the Apprenticeship.

This qualification is a mandatory component of the on-programme foundation phase of the Engineering Technician Apprenticeship Standard for the following occupational pathways:

Maritime Electrical Fitter
Maritime Mechanical Fitter
Maritime Fabricator
Maritime Pipeworker.

The Standard and Assessment plan has been designed by Employers. Centres should make themselves familiar with the Standard and Assessment Plan requirements, details of which can be found at:

https://www.gov.uk/government/collections/apprenticeship-standards

Age restrictions

City & Guilds cannot accept any registrations for learners under 16 as these qualifications are not approved for learners under 16.

3 Delivering the qualification

Initial assessment and induction

An initial assessment of each candidate should be made before the start of their programme to identify:

- if the candidate has any specific training needs
- support and guidance they may need when working towards their qualifications
- the appropriate type and level of qualification.

We recommend that centres provide an induction programme so the candidate fully understands the requirements of the qualification, their responsibilities as a candidate, and the responsibilities of the centre. This information can be recorded on a learning contract.

Support materials

The following resources are available for these qualifications:

Description	How to access
Approval forms	www.cityandguilds.com

Recording documents

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

City & Guilds endorses several ePortfolio systems, including our own, Learning Assistant, an easy-to-use and secure online tool to support and evidence learners' progress towards achieving qualifications. Further details are available at: www.cityandguilds.com/eportfolios.

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

Although new centres are expected to 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. Amendable (MS Word) versions of the forms are available on the City & Guilds website.

4 Assessment

Summary of assessment methods

Candidates must: have a completed portfolio of evidence covering mandatory and chosen optional units.

- Although all of the content and assessment requirements must be met in full, employers can tailor the training outcomes to ensure that the content of the programme is specific to their requirements in terms of products, processes, procedures, tools, equipment, materials, documentation and information systems.
- This will allow each organisation to develop their own specific and tailored apprentice training programme whilst meeting their own business requirements whilst at the same time ensuring that the overall generic content is to a high standard in terms of depth and breadth to enable progression and/or transferability to other employers.

Assessment strategy

Access to assessment
There are no entry requirements required for the Units of Competence unless this is a legal requirement of the process or the environment in which the Apprentice is working in. Assessment is open to any Apprentice who has the potential to reach the assessment requirements set out in the relevant units.
Aids or appliances, which are designed to alleviate disability, may be used during assessment, providing they do not compromise the standard required.

Carrying out assessments
The Units of Competence have been specifically developed to cover a wide range of activities. The evidence produced for the units will, therefore, depend on the skills and knowledge required by employer and specified in the Apprentice's Training Plan. The Skills section of the Units of Competence makes reference to a number of optional items listed (for example 'any three from five'). This is the minimum standard set by the employer group.

Where the unit requirements gives a choice of optional areas, Assessors should note that Apprentices do not need to provide evidence of the other areas to complete the unit, unless specified by the employer (in this example above, two items) particularly where these additional items may relate to other activities or methods that are not part of the Apprentice's normal workplace activities or required by the employer.

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 of the unit activity will be required. Items of performance evidence often contain features that apply to more than one unit, and can be used as evidence in any unit where they are suitable.
Performance evidence must be:

- products of the Apprentice's work, such as items that have been produced or worked on, plans, charts, reports, standard operating procedures, documents produced as part of a work activity,

records or photographs of the completed activity

together with:

- evidence of the way the Apprentice carried out the activities, such as witness testimonies, assessor observations or authenticated Apprentice reports of the activity undertaken.

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

Assessing knowledge and understanding requirements
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 Apprentice's knowledge and understanding 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. It is recommended that oral questioning and practical demonstrations are used perhaps whilst observing the apprentice undertake specific tasks, as these are considered the most appropriate for these units. Assessors should ask enough questions to make sure that the Apprentice has an appropriate level of knowledge and understanding, as required by the unit.

Evidence of knowledge and understanding will **not** be required for those items in the skills section of the Units of Competence that have not been selected by the employer.

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

Witness testimony
Where observation is used to obtain performance evidence, this must be carried out against the unit. 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 unit by someone else that is in close contact with the Apprentice. This could be a team leader, supervisor, mentor or line manager who may be regarded as a suitable witness to the Apprentice's competency. However, the witness must be technically competent in the process or skills that they are providing testimony for, to at least the same level of expertise as that required of the Apprentice. It will be the responsibility of the assessor to make sure that any witness testimonies accepted as evidence of the Apprentice's competency are reliable, auditable and technically valid.

Maximising opportunities to use assessment evidence
One of the critical factors required in order to make this Assessment Strategy as efficient and effective as possible and to ease the burden of assessment, is the Assessor's ability and expertise to work in partnership with the apprentice and their employer to provide advice and guidance on how to maximise opportunities to cross reference performance and knowledge evidence to all relevant Units of Competence. For example if a knowledge statement is repeated in a number of separate Units of Competence and the expected evidence/response to that statement is the same including the context, then the same piece of evidence should be cross referenced to the appropriate units.

Recognition of prior learning (RPL)

Recognition of prior learning means using a person's previous experience, or qualifications which have already been achieved, to contribute to a new qualification.

RPL is **not** allowed for this qualification.

http://www.cityandguilds.com/delivering-our-qualifications/centre-development/centre-document-library/policies-and-procedures/quality-assurance-documents

5 Units

Availability of units

The unit content can be found in this document or from Semta.

Structure of the units

These units each have the following:

- City & Guilds reference number
- Title
- Level
- Guided learning hours (GLH)
- Learning outcomes, which are comprised of a number of assessment criteria

Centres must deliver the full breadth of the range. Specialist equipment or commodities may not be available to all centres, so centres should ensure that their delivery covers their use. This may be covered by a practical demonstration (e.g. video). For the practical assessments for this qualification, centres should ensure that there are sufficient resources to complete the task but are not required to use all the equipment or commodities in the range.

Unit 201 Complying with statutory regulations and organisational safety requirements

Unit level:	Level 2
GLH:	35
Unit aim:	This Employer Unit of Competence (EUC) has been developed by employers in the Maritime Defence Sector and is part of an overall development programme designed to meet the requirements of the Sector, the published Apprenticeship Standard and Employer Occupational Brief. This EUC identifies the training and development required in order that the apprentice can demonstrate that they are competent in being able to deal with statutory regulations and organisational safety requirements, in accordance with approved procedures. They will be required 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. They will also need to be able to identify the relevant qualified first aiders or appointed person, and must know the location of the first aid facilities. They will have an understanding of the procedures to be adopted in the case of accidents involving injury, and in situations where there are dangerous occurrences or hazardous malfunctions of equipment, processes or machinery. They will also need to be fully conversant with the organisation's procedures for fire alerts and the evacuation of premises. They will 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, materials and substances that they use, working practices that do not follow laid-down procedures, and manual lifting and carrying techniques. Their responsibilities will require them to comply with organisational policy and procedures for the statutory regulations and organisational safety activities undertaken, and to report any problems with the safety activities that they cannot personally resolve, or are outside their permitted authority, to the relevant people. They will be expected to work with minimum supervision, taking personal responsibility for their own actions and for the way in which they carry out the required engineering activities. Their underpinning knowledge will provide a good understanding of their work, and will provide an informed approach to applying statutory regulations and organisational safety requirements and procedures. They will understand the safety requirements and their application, in adequate depth to provide a sound basis for carrying out the activities safely and correctly. They will be able to apply the appropriate behaviours required in the workplace to meet the job profile and overall company objectives, such

	as strong work ethic, positive attitude, team player, dependability, responsibility, honesty, integrity motivation and commitment.
Relationship to NOS:	EUCL2F-001
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The apprentice must be able to:

1.1 comply with their duties and obligations as defined in the Health and Safety at Work Act
1.2 demonstrate the required behaviours in line with the job role and company objectives
1.3 present themselves in the workplace suitably prepared for the activities to be undertaken
1.4 follow organisational accident and emergency procedures
1.5 recognise and control hazards in the workplace
1.6 use correct manual lifting and carrying techniques
1.7 apply safe working practices and procedures

Learning outcome

The learner will:

2 Demonstrate their duties and obligations to health and safety by carrying out **all** of the following:

2.1 applying, in principle, their duties and responsibilities as an individual under the Health and Safety at Work Act and other relevant current legislation.
2.2 identifying, within their working environment, appropriate sources of information and guidance on health and safety issues, to include eye protection and personal protective equipment (PPE), COSHH regulations and risk assessments.
2.3 identifying the warning signs and labels of the main groups of hazardous or dangerous substances.
2.4 complying with the appropriate statutory regulations at all times and specified regulations to their work.

Learning outcome

The learner will:

3 Comply with **all** emergency requirements, to include:

3.1 identifying the appropriate qualified first aiders or appointed person and the location of first aid facilities.
3.2 identifying the procedures to be followed in the event of injury to themselves or others.
3.3 following organisational procedures in the event of fire/fire drills and the evacuation of premises/work area.

3.4 identifying the procedures to be followed in the event of dangerous occurrences or hazardous malfunctions of equipment, processes or machinery.

Learning outcome

The learner will:

4 Identify the hazards and risks that are associated with **all** of the following:

4.1 their working environment (such as working at heights, confined spaces, environmental conditions).
4.2 the tools and equipment that they use (such as machine tools, power tools, cutting tools).
4.3 the materials and substances that they use (such as fluids, oils, fluxes).
4.4 using working practices that do not follow laid-down procedures.

Learning outcome

The learner will:

5 Demonstrate the following method of manual lifting and carrying techniques:

5.1 lifting alone.

Plus **one** from:
5.2 with assistance of others .
5.3 with mechanical assistance.

Learning outcome

The learner will:

6 Apply safe working practices in an industrial environment, to include **all** of the following:

6.1 maintaining a tidy workplace with exits and gangways free from obstructions
6.2 using tools and equipment safely and only for the purpose intended
6.3 observing organisational safety rules, signs and hazard warnings
6.4 taking measures to protect others from harm resulting from any work they are carrying out
6.5 observe personal protection and hygiene procedures at all times

Learning outcome

The learner will:

7 Knowledge and understanding - The apprentice must know and understand:

7.1 the roles and responsibilities of themselves and others under the Health and Safety at Work Act and other current legislation (e.g., The Management of Health and Safety at Work

Regulations; Workplace Health and Safety and Welfare Regulations; Personal Protection at Work Regulations; Manual Handling Operations Regulations; Provision and Use of Work Equipment Regulations; Display Screen at Work Regulations).

7.2 the specific regulations and safe working practices and procedures that apply to their work activities.

7.3 the importance of applying the appropriate behaviours in the workplace and the implications for both the apprentice and the business if these are not adhered to.

7.4 the warning signs for the seven main groups of hazardous substances defined by Classification, Labelling and packaging of Dangerous Substances and mixtures Regulations.

7.5 how to locate relevant health and safety information for their tasks, and the sources of expert assistance when help is needed.

7.6 what constitutes a hazard in the workplace (such as moving parts of machinery, electricity, slippery and uneven surfaces, dust and fumes, handling and transporting, contaminants and irritants, material ejection, fire, working at height, environment, pressure/stored energy systems, volatile or toxic materials, unshielded processes).

7.7 their responsibilities for dealing with hazards and reducing risks in the workplace (such as hazard spotting and safety inspections; the use of hazard check lists, carrying out risk assessments, COSHH assessments and safe systems of working)

7.8 the risks associated with their working environment (the tools, materials and equipment that they use, spillages of oil and chemicals, not reporting accidental breakages of tools or equipment and not following laid-down working practices and procedures).

7.9 the processes and procedures that are used to identify and rate the level of risk (such as safety inspections, the use of hazard check lists, carrying out risk and COSHH assessments)

7.10 control measures that can be used to eliminate/reduce the hazard (such as lock-off and permit to work procedures, provision of safe access and egress, use of guards and fume extraction equipment, use of personal protective equipment).

7.11 the first aid facilities that exist within their work area and within the organisation in general, and the procedures to be followed in the case of accidents involving injury.

7.12 what constitutes dangerous occurrences and hazardous malfunctions, and why these must be reported even when no one was injured.

7.13 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

7.14 the organisational policy with regard to firefighting procedures; the common causes of fire and what they can do to help prevent them.

7.15 the protective clothing and equipment that is available for their areas of activity.

7.16 the need to observe personal protection and hygiene procedures at all times (such as skin care (barrier creams, gloves), eye protection (safety glasses, goggles, full face helmets), hearing protection (ear plugs, ear defenders), respiratory protection (fume extraction, face masks, breathing apparatus), head protection (caps with hair restraints, protective helmets), foot protection (safety footwear), dangers of ingestion and the importance of washing hands).

7.17 how to act responsibly within the working environment (such as observing restricted area notices, complying with warning signs, walking not running, using equipment only for its intended purpose, not interfering with equipment or processes that are not within their job role, following approved safety procedures at all times).

7.18 how to lift and carry loads safely, and the manual and mechanical aids available.

7.19 how to prepare and maintain safe working areas; standards and procedures to ensure good housekeeping.

7.20 the importance of safe storage of tools, equipment, materials and products.

7.21 the extent of their own authority and whom they should report to in the event of problems that they cannot resolve.

Unit 201 Complying with statutory regulations and organisational safety requirements

Supporting Information

Unit guidance

Assessment requirements have been developed by employers for the occupational competency units and qualifications for Advanced Manufacturing and Engineering Sector. These assessment requirements are set down in the relevant Qualification Assessment Strategies available from Semta. Please contact Customer.Services@semta.org.uk quoting Advanced Manufacturing and Engineering Trailblazer Qualification Assessment Strategy and specifying the title of the relevant Trailblazer Standard.

Although all of the content and assessment requirements must be met in full, employers can tailor the training outcomes to ensure that the content of the programme is specific to their requirements in terms of products, processes, procedures, tools, equipment, materials, documentation and information systems.

This will allow each organisation to develop their own specific and tailored apprentice training programme that meets their own business requirements whilst at the same time ensuring that the overall generic content is to a high standard in terms of depth and breadth to enable progression and/or transferability to other employers

Unit 202 Working efficiently and effectively in an engineering environment

Unit level:	Level 2
GLH:	25
Unit aim:	This Employer Unit of Competence (EUC) has been developed by employers in the Maritime Defence Sector and is part of an overall development programme designed to meet the requirements of the Sector, the published Apprenticeship Standard and Employer Occupational Brief. This EUC identifies the training and development required in order that the apprentice can demonstrate that they are competent in being able to carry out all necessary preparations; within the scope of their responsibility prior to undertaking the engineering activity. This will include preparing the work area and ensuring that it is in a safe condition to carry out the intended activities, obtain the appropriate job documentation, work instructions, tools, equipment and materials required for the work activities undertaken, and to check they are in a safe and usable condition. Planning their work activities before they start them will also form part of this unit. On completion of the engineering activity, they will be required to return their immediate work area to an acceptable condition before undertaking further work. This may involve placing part-completed or completed work in the correct location, returning and/or storing any tools and equipment in the correct area, removing any waste and/or scrapped materials, and reporting any defects or damage to the tools and equipment used. In order to be efficient and effective in the workplace, they will also be required to demonstrate that they can create and maintain effective working relationships with colleagues and supervisors. They will be expected to review objectives and targets for their personal development and to contribute to, and communicate any opportunities for, improvements that could be made to working practices and procedures. Fundamental to this unit is the apprentices ability to be able to apply the appropriate behaviours required in the workplace to meet the job profile and overall company objectives, such as strong work ethic, positive attitude, team player, dependability, responsibility, honesty, integrity motivation and commitment Their responsibilities will require them to comply with health and safety requirements, environmental and organisational policy and procedures for the activities undertaken. They will need to take account of any potential difficulties or problems that may arise with

	the activities, and to seek appropriate help and advice in determining and implementing a suitable solution. They will work under a high level of supervision, whilst taking responsibility for their own actions and for the quality and accuracy of the work that they carry out. Their underpinning knowledge will provide a good understanding of their work, and will provide an informed approach to working efficiently and effectively in an engineering environment. They 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. They will know how to contribute to improvements, deal with problems, maintain effective working relationships, understand the behaviours that are required in the workplace and agree their development objectives and targets, in adequate depth to provide a sound basis for carrying out the activities safely and correctly. They will understand the safety precautions required when carrying out the specific engineering activities and will be required to demonstrate safe working practices throughout, and will understand the responsibility that they owe to themselves and others in the workplace. They will be able to apply the appropriate behaviours required in the workplace to meet the job profile and overall company objectives, such as strong work ethic, positive attitude, team player, dependability, responsibility, honesty, integrity motivation and commitment.
Relationship to NOS:	EUCL2F-002
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The apprentice must be able to:

1.1 work safely at all times, complying with health and safety and environmental legislation, regulations and other relevant guidelines.
1.2 demonstrate the required behaviours in line with the job role and company objectives.
1.3 plan the engineering activities before they start them.
1.4 prepare the work area for carrying out the engineering activity.
1.5 obtain all necessary tools and equipment and check that they are in a safe and usable condition.
1.6 deal promptly and effectively with problems within their control, and seek help and guidance from the relevant people if they have problems that they cannot resolve.
1.7 maintain effective working relationships with colleagues and supervisors.
1.8 review personal training and development, as appropriate to the job role.
1.9 clean, tidy up and restore the work area on completion of the engineering activity.

Learning outcome

The learner will:

2 Ensure that they apply **all** of the following checks and practices at all times during the engineering activities:

2.1 adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations.

2.2 wear the appropriate personal protective equipment for the work area and specific activity being carried out.

2.3 use all tools and equipment safely and correctly, and only for their intended purpose including adherence to the Control of Vibration at Work Regulations (Hand and Arm).

2.4 ensure that the work area is maintained and left in a safe and tidy condition.

Learning outcome

The learner will:

3 Create and maintain effective working relationships and behaviours, to include carrying out and demonstrating **all** of the following during the foundation phase of the apprenticeship:

3.1 maintains a consistently good record of punctuality and attendance in accordance with company policy.

3.2 always suitably dressed for the activities to be undertaken.

3.3 follows both verbal and written instructions provided, seeking additional information, clarification or assistance where necessary in a courteous and polite manner.

3.4 able take advice from others in a positive way.

3.5 makes a positive contribution to any discussions.

3.6 flexible in their approach to work, responding positively to any agreed amendments or changes.

3.7 communicates with others using clear, accurate and appropriate language.

3.8 demonstrates an open and honest approach, showing respect for the views, rights and property of others including the values of diversity and equality.

3.9 demonstrates a willingness to help others when working towards a common team objective.

Learning outcome

The learner will:

4 Prepare for the specific engineering activity, by producing work plans which includes **all** of the following:

4.1 documentation required (such as drawings, technical/reference documents – examples could include tapping drill sizes, imperial to metric conversion books, component specifications, quality documentation).

4.2 materials required (such as stock material, components, part-machined components, cables/wire, welding consumables).
4.3 equipment required (such as machine tools to be used, lifting and handling equipment, bending and forming equipment, anti-static equipment, test equipment).
4.4 workholding methods and equipment (such as machine or bench vice, clamps, special workholding arrangements), where appropriate.
4.5 tools required (such as hand tools, portable power tools, cutting tools, soldering irons).
4.6 measuring equipment required (such as mechanical, electrical, pressure, flow, level, speed, sound).
4.7 the operating sequence to be followed.
4.8 timescale required to complete the engineering operations.

Learning outcome

The learner will:

5 Prepare to carry out the engineering activity, ensuring **all** of the following, as applicable to the work to be undertaken:

5.1 the work area is free from hazards and is suitably prepared for the activities to be undertaken.
5.2 any required safety procedures are implemented.
5.3 any necessary personal protection equipment is obtained, and is in a usable condition.
5.4 all necessary drawings, specifications and associated documents are obtained
5.5 job instructions are obtained and understood.
5.6 the correct materials or components are obtained.
5.7 appropriate authorisation to carry out the work is obtained.

Learning outcome

The learner will:

6 Complete the work activities, to include **all** of the following:

6.1 returning tools and equipment to the designated location.
6.2 returning drawings and work instructions.
6.3 disposing of waste materials, in line with organisational and environmental requirements.
6.4 completing all necessary documentation accurately and legibly.
6.5 identifying, where appropriate, any damaged or unusable tools or equipment.

Learning outcome

The learner will:

7 Deal with problems affecting the engineering activity, to include **two** of the following:

7.1 materials
7.2 job specification

7.3 timescales
7.4 tools and equipment
7.5 quality
7.6 safety
7.7 drawings
7.8 people
7.9 work activities or procedures.

Learning outcome

The learner will:

8 Contribute to developing their own engineering competence, to include **all** of the following:

8.1 describing the levels of skill, knowledge and understanding needed for competence in the areas of work expected of them.
8.2 describing their development objectives/program, and how these were identified.
8.3 providing information on their expectations and progress towards their identified objectives.
8.4 using feedback and advice to improve their personal performance.

Learning outcome

The learner will:

9 Knowledge and understanding - The apprentice must know and understand:

9.1 the safe working practices and procedures to be followed whilst preparing and tidying up their work area.
9.2 the importance of applying the appropriate behaviours in the workplace and the implications for both the apprentice and the business if these are not adhered to.
9.3 how to present themselves in the workplace suitably dressed for the activities to be undertaken (such as being neat, clean and dressed in clothes appropriate to the area of activity).
9.4 the importance of reporting to work on time and returning from breaks on time and the potential consequences if this is not adhered to.
9.5 the types of attitudes and behaviours that are likely to create conflict or negative responses.
9.6 the benefits of team working and understanding of team objectives.
9.7 the roles of individual team members and the strengths they bring to the team.
9.8 the importance of clear communication both oral and written, using appropriate language and format.
9.9 the need to change communication styles to meet the needs of the target audience.
9.10 the need to adhere to timescales set for work, whilst maintaining appropriate quality standards and the implications if these are not adhered to.
9.11 the importance of seeking additional support and guidance when required.
9.12 why it is important to be open and honest and admit to any errors and/or mistakes.

9.14 the need to be flexible in their approach to work, responding positively to changes or amendments required by the business.

9.15 the importance of taking an active and positive part in the implementation of any amendments or changes to work requirements .

9.16 their individual responsibility to work in an ethical manner and the organisations policies relating to ethical working and behaviours.

9.17 the importance of respecting others, including an awareness of diversity and inclusion.

9.18 the personal protective equipment (PPE) to be worn for the engineering activities undertaken (such as correctly fitting overalls, safety shoes, eye protection, ear protection).

9.19 the correct use of any equipment used to protect the health and safety of themselves and their colleagues.

9.2 planning and preparing to carry out the engineering activity (such as obtaining the appropriate drawings/documentation to be used, determining the materials required, determining the tools and equipment required, determining a suitable sequence of operations, determining the quality checks to be made and equipment to be used).

9.21 the procedure for ensuring that all documentation relating to the work being carried out is available, prior to starting the activity.

9.22 the procedure for ensuring that all tools and equipment are available prior to undertaking the activity.

9.23 the checks to be carried out to ensure that tools and equipment are in full working order, prior to undertaking the activity.

9.24 the checks to be carried out to ensure that all materials required are correct and complete, prior to undertaking the activity.

9.25 the action that should be taken if documentation, tools and equipment or materials are incomplete or do not meet the requirements of the activity.

9.26 their role in helping to develop their own skills and knowledge (such as checking with their supervisor about the work they are expected to carry out and the standard they need to achieve; the safety points to be aware of and the skills and knowledge they will need to develop).

9.27 the benefits of continuous personal development, and the training opportunities that are available in the workplace.

9.28 the importance of reviewing their training and development with trainers and supervisors, of comparing the skills, setting objectives to overcome any shortfall or address any development needs.

9.29 their responsibilities for providing evidence of their performance and progress (such as submitting work for assessment or the completion of assignments or tests).

9.30 the importance of maintaining effective working relationships within the workplace (such as listening attentively to instructions from their supervisor, making sure they ask for help and advice in a polite and courteous manner, responding positively to requests for help from others).

9.31 the reason for informing others of their activities which may have impact on their work (such as the need to temporarily disconnect a shared resource like electricity or compressed air supply; making undue noise or creating sparks, fumes or arc flashes from welding)

9.31 dealing with disagreements with others in ways which will help to resolve difficulties and maintain long term relationships.

9.32 the organisational procedures to deal with and report any problems that can affect working relationships.

9.33 the difficulties that can occur in working relationships, and how to resolve them.

9.34 the regulations that affect how individuals should be treated at work (such as Equal Opportunities and Equal Pay, Race Relations and Sex .

Unit 202 Working efficiently and effectively in an engineering environment

Supporting Information

Unit guidance

Assessment requirements have been developed by employers for the occupational competency units and qualifications for Advanced Manufacturing and Engineering Sector. These assessment requirements are set down in the relevant Qualification Assessment Strategies available from Semta. Please contact Customer.Services@semta.org.uk quoting Advanced Manufacturing and Engineering Trailblazer Qualification Assessment Strategy and specifying the title of the relevant Trailblazer Standard.

Although all of the content and assessment requirements must be met in full employers can tailor the training outcomes to ensure that the content of the programme is specific to their requirements in terms of products, processes, procedures, tools, equipment, materials, documentation and information systems.

This will allow each organisation to develop their own specific and tailored apprentice training programme that meets their own business requirements whilst at the same time ensuring that the overall generic content is to a high standard in terms of depth and breadth to enable progression and/or transferability to other employers.

Unit 203 Using and communicating technical information

Unit level:	Level 2
GLH:	25
Unit aim:	This Employer Unit of Competence (EUC) has been developed by employers in the Maritime Defence Sector and is part of an overall development programme designed to meet the requirements of the Sector, the published Apprenticeship Standard and Employer Occupational Brief. This EUC identifies the training and development required in order that the apprentice can demonstrate that they are competent in being able to make full use of text, numeric and graphical information, by interpreting and using technical information extracted from a range of documentation such as engineering drawings, technical manuals, technical specifications, reference tables and charts, electronic displays, planning and quality control documentation, which will prepare them for entry into the engineering or manufacturing sectors, creating a progression between education and employment, or will act as a basis for the development of additional skills and occupational competences in the working environment. They will be required to extract the necessary data from the various specifications and related documentation, in order to establish and carry out the work requirements, and to make valid decisions about the quality and accuracy of the work carried out. They will also need to be able to communicate and record technical information, using a range of different methods such as producing detailed sketches, preparing work planning documentation, producing technical reports and recording data from testing activities. Their responsibilities will require them to comply with organisational policy and procedures for obtaining, using and communicating the technical information applicable to the activity. They will need to take account of any potential difficulties or problems that may arise with the activities, and to seek appropriate help and advice in determining and implementing a suitable solution. They will work under a high level of supervision, whilst taking responsibility for their own actions and for the quality and accuracy of the work that they carry out. Their underpinning knowledge will provide a good understanding of the types of documentation available for use, and will provide an informed approach to applying and communicating engineering instructions and procedures. They will be able to read and interpret the documentation available, and will know

	about the conventions, symbols and abbreviations to the required depth to provide a sound basis for carrying out the activities to the required specification. They will be able to apply the appropriate behaviours required in the workplace to meet the job profile and overall company objectives, such as strong work ethic, positive attitude, team player, dependability, responsibility, honesty, integrity motivation and commitment.
Relationship to NOS:	EUCL2F-003
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The apprentice must be able to:

1.1 use the approved source to obtain the required data, documentation or specifications.
1.2 demonstrate the required behaviours in line with the job role and company objectives.
1.3 extract and interpret information from engineering drawings and other related documentation.
1.4 report any inaccuracies or discrepancies in the drawings and specifications.
1.5 use the information obtained to establish work requirements.
1.6 record and communicate the technical information by appropriate means.
1.7 deal promptly and effectively with problems within their control, and seek help and guidance from the relevant people if they have problems that they cannot resolve.

Learning outcome

The learner will:

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

2.1 check the currency and validity of the data and documentation used.
2.2 exercise care and control over the documents at all times.
2.3 correctly extract all necessary data in order to carry out the required tasks.
2.4 seek out additional information where there are gaps or deficiencies in the information obtained.
2.5 deal with or report any problems found with the data.
2.6 make valid decisions based on the evaluation of the engineering information.
2.7 return all documentation to the approved location on completion of the work
2.8 complete all necessary production documentation.

Learning outcome

The learner will:

3 Use information extracted from engineering documentation, to include **two** or more of the following:

3.1 detailed component drawings
3.2 illustrations
3.3 welding drawings
3.4 general assembly drawings
3.5 visual display screens
3.6 modification drawings
3.7 operational diagrams
3.8 fluid power drawings
3.9 sub-assembly drawings
3.10 physical layouts
3.11 wiring/circuit diagrams
3.12 schematic diagrams
3.13 manufacturers' manuals/drawings
3.14 installation drawings
3.15 fabrication drawings
3.16 photographic representations
3.17 approved sketches
3.18 pattern drawings
3.19 contractual specifications.

Learning outcome

The learner will:

4 Use information extracted from related documentation, to include **two** from the following:

4.1 job instructions
4.2 material specifications
4.3 planning documentation
4.4 drawing instructions
4.5 finishing specifications
4.6 quality control documents
4.7 test schedules
4.8 reference tables/charts
4.9 operation sheets
4.10 manufacturers' instructions
4.11 national, international and organisational standards
4.12 process specifications

4.13 welding procedure specifications.

Learning outcome

The learner will:

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

5.1 materials or components required
5.2 surface texture requirements
5.3 surface finish required
5.4 dimensions
5.5 location/orientation of parts
5.6 weld type and size
5.7 tolerances
5.8 process or treatments required
5.9 operations required
5.10 build quality
5.11 assembly sequence
5.12 shape or profiles
5.13 installation requirements
5.14 inspection requirements
5.15 test points to be used
5.16 connections to be made
5.17 part numbers for replacement parts
5.18 system characteristics (such as pressure, flow, current, voltage, speed).

Learning outcome

The learner will:

6 Record and communicate technical information, using **three** of the following methods:

6.1 producing fully detailed sketches of work/circuits completed or required
6.2 preparing work planning documentation
6.3 recording data from testing activities
6.4 producing technical reports on activities they have completed
6.5 completing material and tool requisition documentation
6.6 producing a list of replacement parts required for a maintenance activity
6.7 completing training records or portfolio references.

Learning outcome

The learner will:

7 Knowledge and understanding - The apprentice must know and understand:

7.1 the importance of applying the appropriate behaviours in the workplace and the implications for both the apprentice and the business if these are not adhered to

7.2 the information sources used for the data and documentation that they use in their work activities (such as verbal, written, electronic)

7.3 why technical information is presented in different forms (such as drawings, data sheets, and national and international standards)

7.4 how and where to obtain the various documents that they will be using (such as safety handouts, drawings, planning documentation, work instructions, maintenance records, technical manuals and reference tables/charts), and how to check that they are current and valid

7.5 the types of engineering drawings used, and how they interrelate (such as isometric and orthographic drawings; assembly, sub-assembly and general arrangement drawings; circuit and wiring diagrams, block and schematic diagrams; fluid power and instrumentation and control diagrams)

7.6 the meaning of the different symbols and abbreviations found on the documents that they use (such as surface finish to be achieved, linear and geometric tolerances, electronic components, weld symbols and profiles, pressure and flow characteristics, torque values, imperial and metric systems of measurement, tolerancing and fixed reference points)

7.7 how to use other sources of information to support the data (such as electronic component pin configuration specifications, standard reference charts for limits and fits, tapping drill reference charts, bend allowances required for material thickness, electrical conditions required for specific welding electrodes, mixing ratios for bonding and finishing materials, metal finishing specifications and inspection requirements)

7.8 the procedures for reporting discrepancies in the data or documents, and for reporting lost or damaged drawings and documents

7.9 care and control procedures for the documents, how damage or graffiti on drawings can lead to scrapped work and the importance of returning them to the designated location on completion of the work activities

7.10 typical ways of communicating technical information (such as sketches, test and inspection reports, work planning documents), and the amount of detail that should be included

7.11 the need to ensure that sketches are of a suitable size, use appropriate drawing conventions, are in proportion and are legible to others

7.12 why it is important to use a fixed common reference point for dimensioning of drawings and sketches

7.13 when to act on their own initiative to find, clarify and evaluate information, and when to seek help and advice from others

7.14 why they should always seek clarification if they are in any doubt as to the validity or suitability of the information they have gathered

7.15 to whom they should report in the event of problems that they cannot resolve

Unit 203 Using and communicating technical information

Supporting Information

Unit guidance

Assessment requirements have been developed by employers for the occupational competency units and qualifications for Advanced Manufacturing and Engineering Sector. These assessment requirements are set down in the relevant Qualification Assessment Strategies available from Semta. Please contact Customer.Services@semta.org.uk quoting Advanced Manufacturing and Engineering Trailblazer Qualification Assessment Strategy and specifying the title of the relevant Trailblazer Standard.

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This will allow each organisation to develop their own specific and tailored apprentice training programme that meets their own business requirements whilst at the same time ensuring that the overall generic content is to a high standard in terms of depth and breadth to enable progression and/or transferability to other employers.

Unit 204 Producing components using hand fitting techniques

Unit level:	Level 2
GLH:	60
Unit aim:	This Employer Unit of Competence (EUC) has been developed by employers in the Maritime Defence Sector and is part of an overall development programme designed to meet the requirements of the Sector, the published Apprenticeship Standard and Employer Occupational Brief. This EUC identifies the training and development required in order that the apprentice can demonstrate that they are competent in being able to produce components using a broad range of basic hand fitting competences that will prepare them for entry into the engineering or manufacturing sectors, creating a progression between education and employment, or will provide a basis for the development of additional skills and occupational competences in the working environment. They will be expected to prepare for the hand fitting activities by obtaining all the necessary information, documentation, tools and equipment required, and to plan how they intend to carry out the required fitting activities and the sequence of operations they intend to use. They will be required to select the appropriate equipment to use, based on the operations to be carried out and the accuracy required. In producing the components, they will be expected to use appropriate tools and equipment to mark out the material for a range of features to be produced, and then to use hand tools, portable power tools, and shaping and fitting techniques appropriate to the type of material and operations being performed. These activities will include hand sawing, band sawing, filing, drilling, chiselling, threading, scraping, lapping and grinding. The components produced will have features that include flat, square, parallel and angular faces, radii and curved profiles, drilled holes, internal and external threads, and sliding or mating parts. During, and on completion of, the fitting operations, they will be expected to check the quality of the workpiece, using measuring equipment appropriate to the aspects being checked and the tolerances to be achieved. They will need to be able to recognise fitting defects, to take appropriate action to remedy any faults that occur and to ensure that the finished workpiece is within the drawing requirements. On completion of the fitting activities, they will be expected to return all tools and equipment to the correct locations, and to leave the work area in a safe and tidy condition.

	Their responsibilities will require them to comply with health and safety requirements and organisational policy and procedures for the fitting activities undertaken. They will need to take account of any potential difficulties or problems that may arise with the fitting activities, and to seek appropriate help and advice in determining and implementing a suitable solution. They will work under a high level of supervision, whilst taking responsibility for their own actions and for the quality and accuracy of the work that they carry out. Their underpinning knowledge will provide an understanding of their work, and will enable them to apply appropriate hand fitting techniques safely. They will understand the hand fitting process, and its application, and will know about the equipment, materials and consumables, to the required depth to provide a sound basis for carrying out the activities to the required specification. They will understand the safety precautions required when using hand fitting techniques, and when using hand and power tools. They will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace. They will be able to apply the appropriate behaviours required in the workplace to meet the job profile and overall company objectives, such as strong work ethic, positive attitude, team player, dependability, responsibility, honesty, integrity, motivation and commitment.
Relationship to NOS:	EUCL2F-004
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The apprentice must be able to:

1.1 work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines

1.2 demonstrate the required behaviours in line with the job role and company objectives

1.3 plan the fitting activities before they start them

1.4 obtain the appropriate tools and equipment for the hand fitting operations, and check that they are in a safe and usable condition

1.5 mark out the components for the required operations, using appropriate tools and techniques

1.6 cut and shape the materials to the required specification, using appropriate tools and techniques

1.7 measure and check that all dimensional and geometrical aspects of the component are to the specification

1.8 deal promptly and effectively with problems within their control, and seek help and guidance from the relevant people if they have problems that they cannot resolve

1.9 leave the work area in a safe and tidy condition on completion of the fitting activities

Learning outcome

The learner will:

2 Carry out **all** of the following during the hand fitting activities:

2.1 adhere to procedures or systems in place for risk assessment, COSHH, Personal Protective Equipment (PPE) and other relevant safety regulations

2.2 follow job instructions, assembly drawings/information and procedures

2.3 ensure that all tools, cables, extension leads or air supply hoses are in a safe, tested and serviceable condition

2.4 check that tools and measuring instruments to be used are within calibration (where applicable)

2.5 ensure that the components used are free from foreign objects, dirt or other contamination

2.6 return all tools and equipment to the correct location on completion of the fitting activities

Learning outcome

The learner will:

3 Mark out a range of material forms, to include **two** of the following:

3.1 square/rectangular (such as bar stock, sheet material, machined components)

3.2 circular/cylindrical (such as bar stock, tubes, turned components, flat discs)

3.3 sections (such as angles, channel, tee section, joists, extrusions)

3.4 irregular shapes (such as castings, forgings, odd shaped components).

Learning outcome

The learner will:

4 Use marking out methods and techniques, to include:

4.1 direct marking using instruments

Plus **one** more of the following:

4.2 use of templates

4.3 tracing/transfer methods

Learning outcome

The learner will:

5 Use a range of marking out equipment, to include **all** of the following

5.1 rules/tapes
5.2 scribers
5.3 scribing blocks
5.4 protractor
5.5 dividers or trammels
5.6 punches
5.7 squares
5.8 vernier instruments

Learning outcome

The learner will:

6 Mark out workpieces which include **all** of the following features:

6.1 datum/centre lines
6.2 circles
6.3 linear hole positions
6.4 square/rectangular profiles
6.5 radial profiles
6.6 radial hole positions

Plus **one** more from the following:
6.7 angles/angular profiles
6.8 allowances for bending
6.9 simple pattern development

Learning outcome

The learner will:

7 Use both of the following hand fitting activities:

7.1 filing
7.2 hand sawing

Plus **one** more from the following
7.3 scraping
7.4 chiselling

7.5 power sawing
7.6 lapping
7.7 grinding

Learning outcome

The learner will:

8 Produce components which combine different operations and have features that cover all of the following:

8.1 flat datum faces
8.2 drilled through holes
8.3 internal threads
8.4 faces which are square to each other
8.5 faces that are parallel to each other
8.6 reamed holes
8.7 external threads

Plus **three** more from the following;

8.8 curved profiles
8.9 chamfers and radii
8.10 faces angled to each other
8.11 counter bore, countersink, or spot face
8.12 holes drilled to a depth
8.13 sliding or mating parts

Learning outcome

The learner will:

9 Cut and shape **all** of the following materials:

9.1 ferrous
9.2 non ferrous
9.3 non metallic

Learning outcome

The learner will:

10 Use **all** of the following measuring equipment during the hand fitting and checking activities:

10.1 linear dimensions
10.2 hole position

10.3 flatness
10.4 hole size/fit
10.5 squareness
10.6 depths
10.7 angles
10.8 thread size and fit
10.9 profiles
10.10 surface finish

Learning outcome

The learner will:

11 Use **all** of the following measuring equipment during the hand fitting and checking activities

11.1 external micrometers
11.2 internal micrometers
11.3 vernier calliper
11.4 rules
11.5 feeler gauges
11.6 squares
11.7 callipers
11.8 thread gauges
11.9 depth micrometers

Plus **three** more of the following:
11.10 surface finish equipment (such as comparison plates, machines)
11.11 bore/hole gauges
11.12 slip gauges
11.13 protractors
11.14 radius/profile gauges
11.15 depth verniers
11.16 Dial Test Indicators (DTI)
11.17 Coordinate Measuring Machine (CMM)

Learning outcome

The learner will:

12 Produce components to **all** of the following standards, as applicable to the process

12.1 components to be free from false tool cuts, burrs and sharp edges
12.2 general dimensional tolerance +/- 0.25mm or +/- 0.010”
12.3 there must be one or more specific dimensional tolerances within +/- 0.1mm or +/- 0.004”
12.4 flatness and squareness 0.05mm per 25mm or 0.002 per inch

Plus **one** from the following:

12.5 angles within +/- 1 degree

12.6 screw threads to BS Medium fit

12.7 reamed and bored holes within H8

12.8 surface finish 63 µin or 1.6 µm

Learning outcome

The learner will:

13 Knowledge and understanding - The apprentice must know and understand:

13.1 the health and safety requirements and safe working practices and procedures required for the hand fitting activities undertaken

13.2 the importance of wearing appropriate protective clothing and equipment (PPE), and of keeping the work area safe and tidy

13.3 the hazards associated with the hand fitting activities (such as use of power tools, trailing leads or hoses, damaged or badly maintained tools and equipment, using files with damaged or poor fitting handles), and how they can be minimised

13.4 the importance of applying the appropriate behaviours in the workplace and the implications for both the apprentice and the business if these are not adhered to

13.5 the procedure for obtaining the required drawings, job instructions and other related specifications

13.6 how to use and extract information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS or ISO standards), in relation to work undertaken

13.7 how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing

13.8 the basic characteristics and properties of the materials that are used

13.9 how to prepare the materials in readiness for the marking out activities, in order to enhance clarity, accuracy and safety (such as visually checking for defects, cleaning the materials, removing burrs and sharp edges, applying a marking out medium)

13.10 how to select and establish a suitable datum; the importance of ensuring that marking out is undertaken from the selected datum, and the possible effects of working from a different datum

13.11 methods of holding and supporting the workpiece during the marking out activities, and equipment that can be used (such as surface plates, angle plates, vee blocks and clamps, parallel bars, screw jacks)

13.12 use of marking out conventions when marking out the workpiece (including datum lines, cutting guidelines, square and rectangular profiles, circular and radial profiles, angles, holes which are linearly positioned, boxed and on pitch circles)

13.13 ways of laying out the marking out shapes or patterns to maximise use of materials

13.14 the need for clear and dimensional accuracy in marking out to specification and drawing requirements

13.15 setting and adjusting tools (such as squares, protractors and verniers)

13.16 the uses of measuring equipment (such as micrometers, verniers, run-out devices and other measuring devices)

13.17 the importance of using tools only for the purpose intended; the care that is required when using the equipment and tools; the proper way of storing tools and equipment between operations

13.18 the cutting and shaping methods to be used, and the sequence in which the operations are to be carried out

13.19 the various types of file that are available, and the cut of files for different applications and materials

13.20 the importance of ensuring that file handles are secure and free from embedded foreign bodies or splits

13.21 how to prepare the components for the filing operations (cleaning, de-burring, marking out)

13.22 the use of vice jaw plates to protect the workpiece from damage

13.23 how to file flat, square and curved surfaces, and how to achieve a smooth surface finish (such as by draw filing, the use of abrasive cloth, lapping using abrasive pastes)

13.24 how to select saw blades for different materials, and how to set the saw blades for different operations (such as cutting externally and internally)

13.25 how to cut external threads using hand dies, and the method of fixing and adjusting the dies to give the correct thread fit

13.26 how to determine the drill size for tapped holes, and the importance of using the taps in the correct sequence

13.27 how to prepare drilling machines for operations (such as adjustment of table height and position; mounting and securing drills, reamers, countersink and counter bore tools in chucks or morse taper sockets; setting and adjusting spindle speeds; setting and adjusting guards/safety devices)

13.28 how to mount the workpiece (such as in a machine vice, clamped to table, clamped to angle brackets); techniques of positioning drills to marking out, use of centre drills and taking trial cuts and checking accuracy, and how to correct holes which are off centre

13.29 how to produce a sliding or mating fit using filing, scraping and lapping techniques

13.30 the problems that can occur with the hand fitting activities, and how these can be overcome (such as defects caused by incorrectly ground drills, inappropriate speeds, damage by workholding devices, broken taps or drills)

13.31 when to act on their own initiative and when to seek help and advice from others

13.32 the importance of leaving the work area in a safe and clean condition on completion of the fitting activities (such as removing and storing power leads, isolating machines, removing and returning drills, cleaning the equipment and removing and disposing of waste)

Unit 204 Producing components using hand fitting techniques

Supporting Information

Specific Standard Requirements

In order to prove their ability to combine different fitting operations, at least **one** of the components produced must be of a significant nature, and must have a minimum of **five** of the features listed in LO 8 in the skills requirements section.

Unit guidance

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Unit 205 Producing mechanical assemblies

Unit level:	Level 2
GLH:	60
Unit aim:	This Employer Unit of Competence (EUC) has been developed by employers in the Maritime Defence Sector and is part of an overall development programme designed to meet the requirements of the Sector, the published Apprenticeship Standard and Employer Occupational Brief. This EUC identifies the training and development required in order that the apprentice can demonstrate that they are competent in being able to produce mechanical assemblies by obtaining all the necessary information, documentation, tools and equipment required, and to plan how they intend to carry out the required assembly activities and the sequence of operations they intend to use. They will be required to select the appropriate equipment to use, based on the operations to be carried out and the type of components to be assembled. They will be expected to follow specified assembly techniques, in order to produce the required mechanical assembly. The assembly activities will also include making all necessary checks and adjustments, to ensure that components are correctly orientated, positioned and aligned, that moving parts have the correct working clearances, that all fasteners are tightened to the correct torque, and that the assembled parts are checked for completeness and they function as per the specification. Their responsibilities will require them to comply with health and safety requirements and organisational policy and procedures for the assembly activities undertaken. They will need to take account of any potential difficulties or problems that may arise with the assembly activities, and to seek appropriate help and advice in determining and implementing a suitable solution. They will work under a high level of supervision, whilst taking responsibility for their own actions and for the quality and accuracy of the work that they carry out. Their underpinning knowledge will provide an understanding of their work, and will enable them to apply appropriate assembly techniques safely. They will understand the assembly process, and its application, and will know about the mechanical equipment being assembled, the components, tools and consumables used, to the required depth to provide a sound basis for carrying out the activities to the required specification. They will understand the safety precautions required when carrying out the assembly activities, and when using assembly tools and equipment. They will be required to demonstrate safe

	working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace. They will be able to apply the appropriate behaviours required in the workplace to meet the job profile and overall company objectives, such as strong work ethic, positive attitude, team player, dependability, responsibility, honesty, integrity, motivation and commitment.
Relationship to NOS:	EUCL2F-005
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The apprentice must be able to:

1.1 work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines
1.2 demonstrate the required behaviours in line with the job role and company objectives
1.3 plan the assembly activities before they start them
1.4 obtain and prepare the appropriate components, tools and equipment
1.5 use the appropriate methods and techniques to assemble the components in their correct positions
1.6 secure the components using the specified connectors and securing devices
1.7 check the completed assembly to ensure that all operations have been completed and that the finished assembly meets the required specification
1.8 deal promptly and effectively with problems within their control and seek help and guidance from the relevant people if they have problems that they cannot resolve
1.9 leave the work area in a safe and tidy condition on completion of the assembly activities

Learning outcome

The learner will:

2 Carry out all of the following during the assembly activities:

2.1 adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations
2.2 follow job instructions, assembly drawings and procedures
2.3 ensure that all tools, cables, extension leads or air supply hoses are in a safe and serviceable condition
2.4 check that tools and measuring instruments to be used are within calibration (where applicable)
2.5 use lifting and slinging equipment in accordance with health and safety guidelines and procedures (where appropriate)
2.6 ensure that the components used are free from foreign objects, dirt or other contamination

2.7 return all tools and equipment to the correct locations on completion of the assembly activities

Learning outcome

The learner will:

3 Produce assemblies using **six** of the following methods and techniques:

3.1 applying sealants/adhesives
3.2 fitting (such as filing, scraping, lapping or polishing)
3.3 securing by using mechanical fasteners/threaded devices
3.4 setting and adjusting
3.5 aligning components
3.6 drilling
3.7 torque setting

Plus **two** from the following:

3.8 assembling of components by expansion/contraction
3.9 electrical bonding of components
3.10 assembling of products by pressure
3.11 applying fastener/bolt locking methods (such as wire locking, split pins and tab washers)
3.12 shimming and packing
3.13 riveting
3.14 pinning
3.15 reaming
3.16 blue-bedding of components

Learning outcome

The learner will:

4 Assemble products to meet the required specification, using **eight** of the following types of component:

4.1 pre-machined components
4.2 shafts
4.3 bearings
4.4 couplings
4.5 gaskets
4.6 seals
4.7 pipework/hoses
4.8 valves (such as non-return, relief, ball and isolation)

Plus **two** from the following:

4.9 assembly structure (framework, support, casings, panels)
4.10 levers/linkages
4.11 springs
4.12 fabricated components
4.13 chains
4.14 keys
4.15 belts
4.16 pulleys
4.17 sprockets
4.18 gears
4.19 bushes
4.20 cams and followers
4.21 other components to be specified by the employer

Learning outcome

The learner will:

5 Secure the components using **both** of the following categories of fastening devices:

5.1 threaded fasteners (such as nuts, bolts, machine screws, cap screws)
5.2 locking and retaining devices (such as tab washers, locking nuts, wire locks, special purpose types)

Plus **one** more from the following:

5.3 pins (such as parallel/dowels, hollow/roll, tapered, split)
5.4 spring clips (such as external circlips, internal circlips, special clips)
5.5 rivets (such as countersunk, roundhead, blind, special purpose types)

Learning outcome

The learner will:

6 Assemble products using **two** of the following assembly aids and equipment:

6.1 workholding devices
6.2 shims and packing
6.3 lifting and moving equipment
6.4 rollers or wedges
6.5 specialised assembly tools/equipment
6.6 supporting equipment
6.7 jigs and fixtures

Learning outcome

The learner will:

7 Carry out the required quality checks, to include **eight** from the following, using appropriate equipment:

7.1 positional accuracy
7.2 alignment
7.3 freedom of movement
7.4 function
7.5 component security
7.6 bearing/shaft end float
7.7 completeness
7.8 operating/working clearances
7.9 dimensions
7.10 freedom from damage or foreign objects
7.11 orientation
7.12 torque settings
7.13 safety equipment/systems are operational

Learning outcome

The learner will:

8 Produce mechanical assemblies which comply with **all** of the following:

8.1 all components are correctly assembled and aligned in accordance with the specification
8.2 moving parts are correctly adjusted and have appropriate clearances
8.3 where appropriate, assemblies meet required geometric tolerances (such as square, straight, angles free from twists)
8.4 all fastenings have appropriate washers and are tightened to the required torque
8.5 the correct locking methods are applied where applicable

Learning outcome

The learner will:

9 Knowledge and understanding - The apprentice must know and understand:

9.1 the health and safety requirements, and safe working practices and procedures required for the assembly activities undertaken
9.2 the importance of wearing appropriate protective clothing and equipment (PPE), and of keeping the work area safe and tidy

9.3 the hazards associated with the assembly activities (such as use of power tools, trailing leads or air hoses, damaged or badly maintained tools and equipment, lifting and handling heavy items), and how they can be minimised

9.4 the importance of applying the appropriate behaviours in the workplace and the implications for both the apprentice and the business if these are not adhered to

9.5 the procedure for obtaining the required drawings, job instructions and other related specifications

9.6 how to use and extract information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS or ISO standards) in relation to work undertaken

9.7 how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerencing

9.8 how to prepare the components in readiness for the assembly activities (such as visually checking for defects, cleaning the components, removing burrs and sharp edges)

9.9 the general principles of mechanical assembly, and the purpose and function of the components and materials used (including component identification systems such as codes and component orientation indicators)

9.10 the assembly/joining methods, techniques and procedures to be used, and the importance of adhering to these procedures

9.11 how the components are to be aligned, adjusted and positioned prior to securing, and the tools and equipment to be used for this

9.12 the various mechanical fastening devices that are used (such as nuts, bolts, machine screws, cap screws, clips, pins, locking and retaining devices)

9.13 the importance of using the specified components and joining devices for the assembly, and why they must not use unauthorised substitutes

9.14 where appropriate, the application of sealants, adhesives and jointing compound within the assembly activities, and the precautions that must be taken when working with them

9.15 how to conduct any necessary checks to ensure the accuracy, position, security, function and completeness of the assembly (such as checking for correct operation where the assembly has moving parts, checking the torque figures to which critical fastenings have been tightened, checking the end float on shafts, checking operating clearance on actuating mechanisms)

9.16 how to detect assembly defects, and what to do to rectify them (such as ineffective joining techniques, foreign objects, component damage)

9.17 the methods and equipment used to transport, lift and handle components and assemblies

9.18 how to check that the tools and equipment to be used are calibrated (where applicable) and are in a safe and serviceable condition

9.19 the importance of ensuring that all tools are used correctly and within their permitted operating range

9.20 the importance of ensuring that all tools, equipment and components are accounted for and returned to their correct location on completion of the assembly activities

9.21 problems that could occur with the assembly operations, and the importance of informing appropriate people of non-conformances

9.22 when to act on their own initiative and when to seek help and advice from others

9.23 leaving the work area in a safe and clean condition on completion of the assembly activities (such as removing and storing power leads, returning hand tools and equipment to the designated location, cleaning the work area and removing and disposing of waste)

Unit 205 Producing mechanical assemblies

Supporting Information

Specific Standard Requirements

In order to prove their ability to combine different assembly operations, at least **one** of the assemblies produced must be of a significant nature, and must contain a minimum of **six** of the components listed in LO 4 in the skills requirements section.

Unit guidance

Assessment requirements have been developed by employers for the occupational competency units and qualifications for Advanced Manufacturing and Engineering Sector. These assessment requirements are set down in the relevant Qualification Assessment Strategies available from Semta. Please contact Customer.Services@semta.org.uk quoting Advanced Manufacturing and Engineering Trailblazer Qualification Assessment Strategy and specifying the title of the relevant Trailblazer Standard.

Although all of the content and assessment requirements must be met in full employers can tailor the training outcomes to ensure that the content of the programme is specific to their requirements in terms of products, processes, procedures, tools, equipment, materials, documentation and information systems.

This will allow each organisation to develop their own specific and tailored apprentice training programme that meets their own business requirements whilst at the same time ensuring that the overall generic content is to a high standard in terms of depth and breadth to enable progression and/or transferability to other employers

Unit 206 Forming and assembling pipework systems

Unit level:	Level 2
GLH:	60
Unit aim:	This Employer Unit of Competence (EUC) has been developed by employers in the Maritime Defence Sector and is part of an overall development programme designed to meet the requirements of the Sector, the published Apprenticeship Standard and Employer Occupational Brief. This EUC identifies the training and development required in order that the apprentice can demonstrate that they are competent in being able to prepare for the forming and assembling pipe fitting activities by obtaining all the necessary information, documentation, tools and equipment required, and to plan how they intend to carry out the required pipe fitting activities and the sequence of operations they intend to use. They will be expected to select the appropriate equipment to use, based on the operations to be carried out and the accuracy required. In producing the pipework systems, They will be expected to select and use a range of hand tools, pipe bending and forming equipment and pipe assembly techniques, appropriate to the type of material and operations being performed. Activities will include cutting the pipes to the required lengths using hand saws, power saws or pipe cutters; bending pipes using hand bending machines, springs, fillers or heating techniques; and the use of templates or set wires to check bend profiles which will include angular bends, offsets, bridge sets and expansion loops. They will then be expected to assemble the pipes, using a range of different connectors such as straight connectors, elbows, tee pieces, reducers, tank connectors and valves. During, and on completion of, the pipe fitting operations, they will be expected to check the quality of the work, using measuring equipment appropriate to the aspects being checked and the tolerances to be achieved. They will need to be able to recognise pipe bending and fitting defects, to take appropriate action to remedy any faults that occur and to ensure that the finished system is within the drawing requirements. On completion of the pipe fitting activities, they will be expected to return all tools and equipment to the correct locations, and to leave the work area in a safe and tidy condition. Their responsibilities will require them to comply with health and safety requirements and organisational policy and procedures for the pipe bending, forming and fitting activities undertaken. They will need to take account of any potential difficulties or problems that may arise with the activities, and to seek appropriate help

	and advice in determining and implementing a suitable solution. They will work under a high level of supervision, whilst taking responsibility for their own actions and for the quality and accuracy of the work that they carry out. Their underpinning knowledge will provide an understanding of their work, and will enable them to apply appropriate pipe bending, forming and fitting techniques safely. They will understand the pipe bending, forming and fitting equipment and techniques, and their application, and will know about the equipment, materials and consumables, to the required depth to provide a sound basis for carrying out the activities to the required specification. They will understand the safety precautions required when carrying out the pipe bending, forming and fitting activities, and when using the associated tools and equipment. They will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace. They will be able to apply the appropriate behaviours required in the workplace to meet the job profile and overall company objectives, such as strong work ethic, positive attitude, team player, dependability, responsibility, honesty, integrity, motivation and commitment.
Relationship to NOS:	EUCL2F-006
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The apprentice must be able to:

1.1 work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines

1.2 demonstrate the required behaviours in line with the job role and company objectives

1.3 plan the pipe fitting activities before they start them

1.4 cut the pipes to the appropriate lengths making allowances for bending and attachment of fittings

1.5 bend and form the pipes using the appropriate tools and equipment for the types and sizes of pipe

1.6 assemble and secure the pipework, using the correct fittings and joining techniques

1.7 check the completed assembly to ensure that all operations have been completed and that the finished pipe assembly meets the required specification

1.8 test the completed pipe assembly, using the appropriate techniques, tools and equipment

1.9 deal promptly and effectively with problems within their control, and seek help and guidance from the relevant people if they have problems that they cannot resolve

1.10 leave the work area in a safe and tidy condition on completion of the assembly activities

Learning outcome

The learner will:

2 Carry out **all** of the following during the pipe bending, forming and fitting activities:

2.1 adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations
2.2 follow job instructions, assembly drawings and procedures
2.3 check that the bending and forming equipment is in a safe and usable condition
2.4 return all tools and equipment to the correct location on completion of the pipe fitting activities
2.5 apply safe working practices at all times

Learning outcome

The learner will:

3 Produce pipework assemblies using **all** of the following types of pipe:

3.1 Ferrous
3.2 non-ferrous
3.3 non-metallic

Learning outcome

The learner will:

4 Mark out pipework, using **all** the following methods

4.1 direct marking using tapes and markers
4.2 producing set wires
4.3 set-outs of pipework using templates
4.4 set-outs of pipework onto floor

Learning outcome

The learner will:

5 Use **one** of the following cutting methods:

5.1 hand-held oxy-fuel cutting equipment
5.2 hand-held plasma gas cutting equipment
5.3 simple, portable, track-driven cutting equipment (electrical or mechanical)
5.4 fixed bench gas cutting equipment

Learning outcome

The learner will:

6 Cut and prepare the pipes for forming and assembly, to include carrying out **all** of the following:

6.1 cutting pipes to length with appropriate allowance for fittings
6.2 removing all external and internal burrs
6.3 cleaning pipe ends
6.4 cutting threads on pipe ends to the appropriate length

Learning outcome

The learner will:

7 Cut and prepare pipework using **both** of the following:

7.1 saws (hand or power)
7.2 pipe/tube cutter

Plus **two** more of the following:
7.3 de-burring reamers
7.4 abrasive cloth
7.5 wire pipe cleaners
7.6 abrasive disc
7.7 machine tool
7.8 thermal cutting equipment

Learning outcome

The learner will:

8 Bend and form pipe using the following method:

8.1 hand operated pipe bender

Plus **one** more from the following:
8.2 bending springs
8.3 pipe expander
8.4 swaging kit
8.5 hydraulic pipe bending equipment
8.6 thermal methods (hot or cold)
8.7 fillers

Learning outcome

The learner will:

9 Produce pipework bends/forms that include **both** of the following:

9.1 angular bends
9.2 offsets

Plus **one** more from the following:
9.3 bridge sets
9.4 radii
9.5 internal swaged ends
9.6 expansion loops
9.7 external swaged ends

Learning outcome

The learner will:

10 Assemble pipes using **three** of the following methods:

10.1 compression fittings
10.2 soldered fittings
10.3 cemented fittings
10.4 snap-on/push fittings
10.5 brazed fittings
10.6 welded joints
10.7 screwed connections
10.8 swaged fitting
10.9 cryo fitting
10.10 clamped fitting.

Learning outcome

The learner will:

11 Produce pipework assemblies which combine a range of different fittings, covering **all** of the following:

11.1 straight couplings
11.2 elbows
11.3 tee pieces
11.4 flanges

plus **three** more from the following:

11.5 reduction pieces
11.6 drain/bleeding devices
11.7 unions
11.8 valves
11.9 blanking caps
11.10 screwed fittings (such as tank, tap, pump and gauges)

Learning outcome

The learner will:

12 Assemble pipework using **all** of the following methods and techniques:

12.1 connecting pipe-to-equipment
12.2 securing and fitting pipework supports
12.3 using gaskets, seals/sealing tapes or jointing compounds
12.4 connecting pipe-to-pipe
12.5 alignment/levelling equipment

Learning outcome

The learner will:

13 Carry out tests on the assembled pipework, to include **one** of the following:

13.1 hydraulic pressure testing
13.2 gas/air leakage test
13.3 water leakage testing.

Learning outcome

The learner will:

14 Produce pipework assemblies which comply with **all** of the following:

14.1 pipes are bent to the appropriate shape/form/length and position
14.2 all pipe bends are free from buckling or deformation
14.3 appropriate fittings are used, and are secure and leak free
14.4 soldered and cemented fittings are free from excessive residues (where applicable)
14.5 the completed assembly meets the specific system requirements including cleanliness and contamination

Learning outcome

The learner will:

15 Knowledge and understanding - The apprentice must know and understand:

15.1 the health and safety requirements, and safe working practices and procedures required for the pipe fitting activities undertaken

15.2 the importance of wearing appropriate protective clothing and equipment (PPE), and keeping the work area safe and tidy

15.3 the hazards associated with the pipe fitting activities (such as handling long pipe lengths, using damaged or badly maintained tools and equipment, using pipe bending equipment, using heating and soldering equipment, using adhesives), and how they can be minimised

15.4 the importance of applying the appropriate behaviours in the workplace and the implications for both the apprentice and the business if these are not adhered to

15.5 the procedure for obtaining the required drawings, job instructions and other related specifications

15.6 how to use and extract information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS or ISO standards) in relation to work undertaken

15.7 How to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing

15.8 principles and methods of marking out pipework, and the type of equipment used (such as direct marking, use of templates, use of set wires)

15.9 how to prepare the pipes in readiness for the marking out activities (visually checking for defects, cleaning the materials, removing burrs and sharp edges)

15.10 how to determine the overall length of the pipework required, taking into account allowances for pipe fittings and (where appropriate) screwed connections

15.11 the tools and equipment used in the cutting and preparing the pipes (such as saws, pipe and tube cutters and thermal cutting equipment)

15.12 the characteristics of the various materials that are to be used with regard to the bending operations, and why some materials may require the addition of heat/hot air to aid the bending process

15.13 the methods used to hand bend and form the pipe (including the use of bending springs, hand bending machines, fillers, heating methods)

15.14 how to produce the various bends required (such as angled bends, dog-leg sets, bridge sets and expansion loops)

15.15 the reasons for incorporating expansion loops in a system, and where they should be positioned

15.16 the preparation of pipework and fittings for the assembly operation (such as checking for damage, removing foreign objects, dirt and swarf from bore of pipe, removing burrs)

15.17 the range of pipe fittings that can be used, and how to identify them (such as straight connectors, elbows, tee pieces, reduction pieces, flanged fittings, valves, blanking pieces/cap ends)

15.18 the different types of fittings available, such as screwed fittings, soldered fittings, compression fittings, push fit fittings and glued/cemented fittings

15.19 how to produce screw threads on the pipe ends, and the tools and equipment that can be used (such as stocks and dies, pipe threading machines)

15.20 methods used to seal screwed joints (such as tapes and sealing compounds)

15.21 the use of flanges to connect pipes; use of gaskets; and torque loading of flange bolts and tighten in the correct order/sequence

15.22 how to select the correct gasket material for the pipework system

15.23 the methods used to prepare pipe ends and fittings for soldering, brazing or welding, and why it is necessary to ensure that these preparations are carried out

15.24 the types of soldered connectors available (such as solder ring types and capillary fittings)

15.25 the methods used to solder the joints, and how to recognise when the fitting is correctly soldered

15.26 the precautions to be taken when using gas torches/nozzles to form the joint, and the effect of overheating the joint

15.27 the precautions to be taken when using any freezing media when assembling pipework systems

15.28 the methods used to prepare pipe ends and fittings when using adhesives, and why it is necessary to ensure that these preparations are carried out

15.29 the methods used to cement the joints, and how to recognise when the fitting is correctly secured

15.30 the various adhesives and sealing compounds that are used on pipework systems

15.31 the precautions to be taken when using the adhesives, cements and sealing compounds (such as adequate ventilation, fume extraction, away from naked flames, avoiding skin contact)

15.32 the use of compression fittings; how the pipes are sealed; and the effects of over tightening the fittings

15.33 the use of push-fit connectors, and their advantages and disadvantages

15.34 how to identify the correct orientation of fittings with regard to flow, and the consequences of incorrect orientation

15.35 the supporting methods that are used when assembling pipework, and the type of fittings that are used

15.36 methods of testing pipework systems for leaks (using air, water or hydraulic testing methods)

15.37 the extent of their own responsibility and whom they should report to if they have problems that they cannot resolve

15.38 the importance of leaving the work area in a safe and clean condition on completion of the pipework assembly activities (such as removing and storing power leads, returning hand tools and equipment to is designated location, cleaning the work area and removing and disposing of waste)

Unit 206 Forming and assembling pipework systems

Supporting Information

Specific Standard Requirements

In order to prove their ability to combine different pipe assembly operations, at least **one** of the pipe assemblies produced must be of a significant nature, and must have a minimum of **six** of the fittings listed in LO 10 in the skills requirement section.

Unit guidance

Assessment requirements have been developed by employers for the occupational competency units and qualifications for Advanced Manufacturing and Engineering Sector. These assessment requirements are set down in the relevant Qualification Assessment Strategies available from Semta. Please contact Customer.Services@semta.org.uk quoting Advanced Manufacturing and Engineering Trailblazer Qualification Assessment Strategy and specifying the title of the relevant Trailblazer Standard.

Although all of the content and assessment requirements must be met in full employers can tailor the training outcomes to ensure that the content of the programme is specific to their requirements in terms of products, processes, procedures, tools, equipment, materials, documentation and information systems.

This will allow each organisation to develop their own specific and tailored apprentice training programme that meets their own business requirements whilst at the same time ensuring that the overall generic content is to a high standard in terms of depth and breadth to enable progression and/or transferability to other employers

Unit 207 Maintaining mechanical devices and equipment

Unit level:	Level 2
GLH:	60
Unit aim:	This Employer Unit of Competence (EUC) has been developed by employers in the Maritime Defence Sector and is part of an overall development programme designed to meet the requirements of the Sector, the published Apprenticeship Standard and Employer Occupational Brief. This EUC identifies the training and development required in order that the apprentice can demonstrate that they are competent in being able to maintain mechanical devices and equipment activities by obtaining all necessary information, documentation, tools and equipment required, and to plan how they intend to carry out the required maintenance activities and the sequence of operations they intend to use. They will be required to select the appropriate equipment to use, based on the maintenance operations to be carried out and the type of mechanical equipment being maintained. This will include equipment such as gearboxes, pumps, machine tools, conveyor systems, workholding arrangements, engines, processing plant and equipment, and other organisation-specific equipment. They will be expected to use a variety of maintenance diagnostic techniques and procedures, such as gathering information from fault reports, using recognised fault finding techniques and diagnostic aids, measuring, inspecting and operating the equipment. They will then be expected to dismantle, remove and replace or repair any faulty units or components, on a variety of mechanical assemblies and sub-assemblies. This will include components such as shafts, bearings, couplings, gears, pulleys, clutches, brakes, levers and linkages, cams and followers, and other specific mechanical components. They will be expected to cover a range of maintenance activities, such as draining and removing fluids, releasing stored energy, labelling/proof marking to aid reassembly, dismantling components to the required level, dismantling components requiring pressure or expansion/contraction techniques, checking components for serviceability, replacing faulty components and `lifed' items, setting, aligning and adjusting components, tightening fasteners to the required torque and making `off-load' checks of the maintained equipment.

	Their responsibilities will require them to comply with health and safety requirements and organisational policy and procedures for the mechanical maintenance activities undertaken. They will need to take account of any potential difficulties or problems that may arise with the maintenance activities, and to seek appropriate help and advice in determining and implementing a suitable solution. They will work under a high level of supervision, whilst taking responsibility for their own actions and for the quality and accuracy of the work that they carry out. Their underpinning knowledge will provide an understanding of their work, and will enable them to apply appropriate mechanical maintenance techniques and procedures safely. They will understand the maintenance process, and its application, and will know about the mechanical equipment being maintained, the equipment components, tools and consumables used, to the required depth to provide a sound basis for carrying out the activities to the required specification. They will understand the safety precautions required when carrying out the maintenance activities, and when using maintenance tools and equipment. They will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace. They will be able to apply the appropriate behaviours required in the workplace to meet the job profile and overall company objectives, such as strong work ethic, positive attitude, team player, dependability, responsibility, honesty, integrity, motivation and commitment.
Relationship to NOS:	EUCL2F-007
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The apprentice must be able to:

1.1 work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines

1.2 demonstrate the required behaviours in line with the job role and company objectives

1.3 plan the maintenance activities before they start them

1.4 obtain all the information they need for the safe removal, replacement and maintenance of the equipment components

1.5 obtain and prepare the appropriate tools and equipment

1.6 apply appropriate maintenance diagnostic techniques and procedures

1.7 use appropriate methods and techniques to remove, replace and maintain the required components

1.8 carry out tests and or checks on the maintained equipment, in accordance with the test schedule/defined test procedures

1.9 deal promptly and effectively with problems within their control and seek help and guidance from the relevant people if they have problems that they cannot resolve

1.10 leave the work area in a safe and tidy condition on completion of the maintenance activities

Learning outcome

The learner will:

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

2.1 adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations

2.2 ensure the safe isolation and zero energy checks of equipment (such as mechanical, electrical, gas, air or fluids), where appropriate

2.3 follow job instructions, maintenance drawings and procedures

2.4 check that the tools and test instruments are within calibration (where applicable), and are in a safe and usable condition

2.5 ensure that the system is kept free from foreign objects, dirt or other contamination

2.6 return all tools and equipment to the correct location on completion of the maintenance activities

Learning outcome

The learner will:

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

3.1 gearboxes

3.2 machine tools

3.3 engines

3.4 pumps

3.5 compressors

3.6 processing plant

3.7 transfer equipment

3.8 workholding devices

3.9 process control valves

Learning outcome

The learner will:

4 Use **four** of the following maintenance diagnostic techniques, tools and aids:

4.1 fault finding techniques (such as half-split, input/output, unit substitution)

4.2 diagnostic aids (such as manuals, flowcharts, troubleshooting guides, maintenance records)
4.3 information gathered from fault reports
4.4 visual checks (such as signs of leakage, damage, missing parts, wear/deterioration)
4.5 alignment checks
4.6 movement checks (such as excessive movement or clearance, loose fittings and connections)
4.7 force/pressure checks (such as spring pressure, belt or chain tension)
4.8 overheating checks (such as bearings, friction surfaces)
4.9 sensory input (such as sight, sound, smell, touch)
4.10 information from monitoring equipment or gauges
4.11 operating (such as manual operation, timing and sequencing)
4.12 test instrumentation measurement (such as pressure, flow, timing, sequence, movement)
4.13 measuring instruments (such as dial test indicators, torque measuring devices, feeler gauges).

Learning outcome

The learner will:

5 Carry out **all** of the following maintenance activities, as applicable to the equipment being maintained:

5.1 dismantling equipment to unit/sub-assembly level
5.2 setting, aligning and adjusting replaced components
5.3 dismantling units to component level
5.4 proof marking/labelling of components
5.5 tightening fastenings to the required torque
5.6 checking components for serviceability
5.7 making `off-load' checks before starting up
5.8 replacing all `lifed' items (such as seals, bearings, gaskets)
5.9 replenishing oils and greases
5.10 replacing damaged/defective components

Learning outcome

The learner will:

6 Remove, replace and maintain a range of mechanical components, to include **eight** of the following:

6.1 shafts
6.2 bearing and seals
6.3 slides
6.4 couplings
6.5 fitting keys

6.6 rollers
6.7 gears
6.8 springs
6.9 housings
6.10 clutches
6.11 diaphragms
6.12 actuating mechanisms
6.13 valves and seats
6.14 cams and followers
6.15 structural components
6.16 pistons
6.17 chains and sprockets
6.18 locking and retaining devices (such as circlips, pins)
6.19 brakes
6.20 pulleys and belts
6.21 splines
6.22 levers and links
6.23 other specific components

Learning outcome

The learner will:

7 Carry out checks on the maintained equipment, to include **three** of the following:

7.1 correct operation of moving parts
7.2 correct working clearance of parts
7.3 backlash in gears
7.4 belt/chain tension
7.5 bearing loading
7.6 torque loading of fasteners
7.7 operational performance
7.8 functionally test.

Learning outcome

The learner will:

8 Maintain mechanical equipment in compliance with **two** of the following:

8.1 organisational guidelines and codes of practice
8.2 equipment manufacturers' technical publications
8.3 BS and/or ISO standards

Learning outcome

The learner will:

9 Knowledge and understanding - The apprentice must know and understand:

9.1 the health and safety requirements, and safe working practices and procedures required for the mechanical maintenance activities undertaken

9.2 the importance of wearing appropriate protective clothing and equipment (PPE), and of keeping the work area safe and tidy

9.3 hazards associated with carrying out mechanical maintenance activities (such as handling oils, greases, stored energy/force, misuse of tools, using damaged or badly maintained tools and equipment, not following laid-down maintenance procedures), and how to minimise them

9.4 the system isolation procedures or permit-to-work procedure that applies

9.5 the importance of applying the appropriate behaviours in the workplace and the implications for both the apprentice and the business if these are not adhered to

9.6 how to obtain and interpret drawings, specifications, manufacturers' manuals and other documents needed in the maintenance process

9.7 the procedure for obtaining drawings, job instructions, related specifications, replacement parts, materials and other consumables necessary for the maintenance activities

9.8 the basic principles of how the equipment functions, its operating sequence, the working purpose of individual units/components and how they interact

9.9 the various maintenance diagnostic techniques and aids that can be used (such as fault reports, visual checks, measuring, movement and alignment checks, testing)

9.10 the various fault location techniques that can be used, and how they are applied (such as half-split, input-to-output, function testing, unit substitution, and equipment self-diagnostics)

9.11 how to evaluate sensory information (sight, sound, smell, touch)

9.12 the sequence to be adopted for the dismantling/re-assembly of various types of assemblies

9.13 the methods and techniques used to dismantle/assemble mechanical equipment (such as release of pressures/force, proof marking, extraction, pressing, alignment)

9.14 methods of checking that components are within specification and or serviceable, and how to identify defects and wear characteristics

9.15 the identification, application, fitting and removal of different types of bearings (such as roller, ring, thrust)

9.16 methods and techniques of fitting keys and splines

9.17 identification, application, fitting and removal of different types of gears

9.18 how to correctly tension belts and chains

9.19 the identification and application of different types of locking device

9.20 methods of checking that removed components are fit for purpose, and the need to replace `lifed' items (such as seals and gaskets) and the implications if 'lifed' items are not replaced

9.21 The uses of measuring equipment (such as micrometers, verniers, run-out devices and other measuring devices)

9.22 how to check that tools and equipment are free from damage or defect, are in a safe and usable condition, are within calibration, and are configured correctly for the intended purpose

9.23 how to make adjustments to components/assemblies to ensure that they function correctly (such as setting working clearance, setting travel, setting backlash in gears, preloading bearings)

9.24 the importance of making `off-load' checks before running the equipment under power

9.25 the importance of completing maintenance documentation and/or reports following the maintenance activity

9.26 how to use lifting and handling equipment in the maintenance activity

9.27 the problems associated with the mechanical maintenance activity, and how they can be overcome

9.28 when to act on their own initiative and when to seek help and advice from others

9.29 the importance of leaving the work area and equipment in a safe and clean condition on completion of the maintenance activities (such as returning hand tools and test equipment to the designated locations, cleaning the work area, and removing and disposing of waste)

Unit 207 Maintaining mechanical devices and equipment

Supporting Information

Specific Standard Requirements

In order to prove their ability to combine different maintenance operations, at least **one** of the maintenance activities must be of a significant nature, and must cover at least **seven** of the activities listed in LO 5 plus the removal and replacement of a minimum of **five** of the components listed in LO 6 in the skills requirement section.

Unit guidance

Assessment requirements have been developed by employers for the occupational competency units and qualifications for Advanced Manufacturing and Engineering Sector. These assessment requirements are set down in the relevant Qualification Assessment Strategies available from Semta. Please contact Customer.Services@semta.org.uk quoting Advanced Manufacturing and Engineering Trailblazer Qualification Assessment Strategy and specifying the title of the relevant Trailblazer Standard

Although all of the content and assessment requirements must be met in full employers can tailor the training outcomes to ensure that the content of the programme is specific to their requirements in terms of products, processes, procedures, tools, equipment, materials, documentation and information systems.

This will allow each organisation to develop their own specific and tailored apprentice training programme that meets their own business requirements whilst at the same time ensuring that the overall generic content is to a high standard in terms of depth and breadth to enable progression and/or transferability to other employers

Unit 208 Assembling and testing fluid power systems

Unit level:	Level 2
GLH:	60
Unit aim:	This Employer Unit of Competence (EUC) has been developed by employers in the Maritime Defence Sector and is part of an overall development programme designed to meet the requirements of the Sector, the published Apprenticeship Standard and Employer Occupational Brief. This EUC identifies the training and development required in order that the apprentice can demonstrate that they are competent in being able to prepare for the assembly activities by obtaining all necessary information, documentation, tools and equipment required, and to plan how they intend to carry out the required assembly activities and the sequence of operations they intend to use. They will be required to select the appropriate equipment to use, based on the assembly operations to be carried out and the type of fluid power equipment being assembled, which will include hydraulic and pneumatic systems. In carrying out the fluid power assembly operations, they will be required to follow specific assembly techniques in order to assemble the various components, which will include rigid and flexible pipework, hoses, valves, actuators and cylinders, regulators, switches and sensors. The assembly activities will also include making all necessary checks and adjustments to ensure that fluid power components are correctly positioned and aligned are dimensionally accurate and secure; pipework is dimensionally accurate and free from ripples, creases and damage; and joints are checked for security, with threaded devices tightened correctly. They will also be expected to carry out appropriate test procedures (such as leak or pressure) to confirm that the fluid power assembly meets the operational performance required. Their responsibilities will require them to comply with health and safety requirements and organisational policy and procedures for the fluid power assembly activities undertaken. They will need to take account of any potential difficulties or problems that may arise with the assembly activities, and to seek appropriate help and advice in determining and implementing a suitable solution. They will work under a high level of supervision, whilst taking responsibility for their own actions and for the quality and accuracy of the work that they carry out. Their underpinning knowledge will provide an understanding of their work, and will enable them to apply appropriate fluid power assembly techniques and procedures safely. They will understand

	the assembly process, and its application, and will know about the fluid power equipment being assembled, the system components, tools and consumables used, to the required depth to provide a sound basis for carrying out the activities to the required specification. They will understand the safety precautions required when carrying out the assembly activities, and when using assembly tools and equipment. They will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace. They will be able to apply the appropriate behaviours required in the workplace to meet the job profile and overall company objectives, such as strong work ethic, positive attitude, team player, dependability, responsibility, honesty, integrity, motivation and commitment.
Relationship to NOS:	EUCL2F-008
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The apprentice must be able to:

1.1 work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines
1.2 demonstrate the required behaviours in line with the job role and company objectives
1.3 plan the assembly activities before they start them
1.4 obtain all the information they need for the safe assembly of the fluid power system
1.5 obtain and prepare the appropriate components, assembly tools and test equipment
1.6 use the appropriate methods and techniques to assemble the components in their correct positions
1.7 secure the components, using the specified connectors and securing devices
1.8 check the completed assembly to ensure that all operations have been completed and that the finished system meets the required specification
1.9 carry out tests on the assembled system, in accordance with the test schedule/defined test procedures
1.10 deal promptly and effectively with problems within their control, and seek help and guidance from the relevant people if they have problems that they cannot resolve
1.11 leave the work area in a safe and tidy condition on completion of the assembly activities

Learning outcome

The learner will:

2 Carry out **all** of the following during the assembly of the fluid power system:

2.1 adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations

2.2 ensure the safe isolation and zero energy checks of equipment (such as mechanical, electrical, gas, air or fluids)

2.3 follow job instructions, assembly drawings and procedures

2.4 check that assembly tools and test instruments to be used are within calibration (where applicable) and are in a safe and usable condition

2.5 ensure that the fluid power system is kept free from foreign objects, dirt or other contamination

2.6 return all tools and equipment to the correct location on completion of the assembly activities

Learning outcome

The learner will:

3 Assemble **both** of the following types of fluid power system

3.1 pneumatic

3.2 hydraulic

Learning outcome

The learner will:

4 Produce fluid power assemblies that contain a range of components, including **all** of the following:

4.1 rigid pipework

4.2 hoses

4.3 valves

4.4 cylinders/actuators

Plus **six** more from the following:

4.5 pumps

4.6 lubricators

4.7 switches

4.8 bearings

4.9 compressors

4.10 pressure intensifiers

4.11 sensors

4.12 cables and wires

4.13 accumulators

4.14 regulators

4.15 receivers
4.16 gaskets and seals
4.17 reservoirs/storage devices
4.18 gauges/indicators
4.19 filters
4.20 motors
4.21 coolers
4.22 timers
4.23 other specific components

Learning outcome

The learner will:

5 Apply fluid power assembly methods and techniques to include **all** of the following

5.1 checking components for serviceability
5.2 applying screw fastener locking devices
5.3 positioning equipment/components
5.4 tightening fastenings to the required torque
5.5 aligning pipework and connections
5.6 applying hose/cable clips and fasteners
5.7 dressing and securing pipes and hoses
5.8 making de-energised checks before filling and/or pressurising the system
5.9 setting, aligning and adjusting system components
5.10 securing by using mechanical fixings

Learning outcome

The learner will:

6 Carry out quality checks, to include **all** of the following, using appropriate equipment

6.1 the system is complete, as per specification
6.2 connections to components are tightened to the required torque
6.3 dimensions are within specification requirements
6.4 components are correctly positioned
6.5 pipework is free from ripple and creases
6.6 components are correctly aligned
6.7 electrical connections are correctly made (where applicable)
6.8 direction and flow indicators on components are correct
6.9 components are securely held in place

Learning outcome

The learner will:

7 Carry out **all** the following tests and adjustments on the assembled system:

7.1 leak test
7.2 operational performance
7.3 contamination test

Plus **two** more from the following:
7.4 pressure line pressure tests
7.5 speed
7.6 return line pressure test
7.7 sequence
7.8 flow

Learning outcome

The learner will:

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

8.1 the test equipment is correctly calibrated
8.2 the test equipment used is appropriate for the tests being carried out
8.3 test procedures used are as recommended in the appropriate specifications
8.4 test readings are taken at the appropriate points, and where appropriate components are adjusted to give the required readings
8.5 test equipment is operated within its specification range

Learning outcome

The learner will:

9 Produce fluid power assemblies which meet **all** of the following:

9.1 all components are correctly assembled and aligned, in accordance with the specification
9.2 moving parts are correctly adjusted and have appropriate clearances
9.3 the system functions in line with the specification requirements
9.4 the system is leak free

Learning outcome

The learner will:

10 Knowledge and understanding - The apprentice must know and understand:

10.1 the health and safety requirements, and safe working practices and procedures required for the fluid power assembly activities undertaken

10.2 the importance of wearing appropriate protective clothing and equipment (PPE), and keeping the work area safe and tidy

10.3 hazards associated with carrying out assembly activities on fluid power equipment (such as handling fluids, stored energy/force, misuse of tools), and how these can be minimised

10.4 the importance of applying the appropriate behaviours in the workplace and the implications for both the apprentice and the business if these are not adhered to

10.5 how to obtain and interpret drawings, charts, circuit and physical layouts, specifications, manufacturers' manuals, symbols used in fluid power, and other documents needed in the assembly activities

10.6 how to use and extract information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS or ISO standards in relation to work undertaken

10.7 the procedure for obtaining drawings, job instructions, related specifications, components, materials and other consumables necessary for the assembly activities

10.8 the basic principles of how the fluid power equipment functions, its operating sequence, the purpose of individual units/components and how they interact

10.9 the different types of pipework, fittings and manifolds, and their application

10.10 the identification and application of different types of valve (such as poppet, spool, piston, disc)

10.11 the identification and application of different types of sensors and actuators (such as rotary, linear, mechanical, electrical)

10.12 the identification and application of different types of cylinder (such as single acting, double acting)

10.13 the identification and application of different types of pump (such as positive and non-positive displacement)

10.14 the identification and application of different types compressors (such as screw, piston, rotary vane)

10.15 the application and fitting of static and dynamic seals

10.16 the techniques used to assemble/install fluid power equipment (such as marking out the positions of components; making pipe bends using fittings and by hand bending methods; connecting components using rigid and flexible pipework; using gaskets/seals and jointing/sealing compounds)

10.17 the need to ensure that pipework is supported at appropriate intervals, and the need to eliminate stress on the pipework connections

10.18 the need to ensure cleanliness of the fluid power system, and the ways of purging pipework before connection to components and pressure sources

10.19 recognition of contaminants and the problems they can create, and the effects and likely symptoms of contamination in the system

10.20 methods of testing the fluid power system; the types of test equipment to be used, and their selection for particular tests

10.21 how to make safety checks of the system before carrying out tests, to ensure that all pipes and components are secure and that moving parts guarded/protected

10.22 how to connect suitably calibrated test equipment into the circuit, and how to connect the circuit to a suitable pressure source containing appropriate ancillary equipment

10.23 how to carry out the tests (such as applying test pressures in incremental stages; checking for leaks; taking appropriate test readings; adjusting appropriate components to give required operating conditions)

10.24 how to determine pressure settings, and their effect on the system

10.25 how to display/record test results, and the documentation used

10.26 how to interpret the test readings obtained, and the significance of the readings gained

10.27 the importance of ensuring that test equipment is used only for its intended purpose and within its specified range and limits

10.28 how to check that tools and test equipment are free from damage or defect, are in a safe and usable condition, are within calibration, and are configured correctly for the intended purpose

10.29 the problems associated with the fluid power assembly and testing activity, and how they can be overcome

10.30 when to act on their own initiative and when to seek help and advice from others

10.31 the importance of leaving the work area in a safe and clean condition on completion of the assembly activities (such as returning hand tools and test equipment to is designated location, cleaning the work area, and removing and disposing of waste)

Unit 208 Assembling and testing fluid power systems

Supporting Information

Specific Standard Requirements

In order to prove their ability to combine different fluid power assembly operations, at least **one** of the fluid power assemblies produced must be of a significant nature, and must contain a minimum of **ten** of the components listed in LO 4 in the skills requirement section.

Unit Range Description

Assessment requirements have been developed by employers for the occupational competency units and qualifications for Advanced Manufacturing and Engineering Sector. These assessment requirements are set down in the relevant Qualification Assessment Strategies available from Semta. Please contact Customer.Services@semta.org.uk quoting Advanced Manufacturing and Engineering Trailblazer Qualification Assessment Strategy and specifying the title of the relevant Trailblazer Standard

Although all of the content and assessment requirements must be met in full employers can tailor the training outcomes to ensure that the content of the programme is specific to their requirements in terms of products, processes, procedures, tools, equipment, materials, documentation and information systems.

This will allow each organisation to develop their own specific and tailored apprentice training programme that meets their own business requirements whilst at the same time ensuring that the overall generic content is to a high standard in terms of depth and breadth to enable progression and/or transferability to other employers

Unit 209 Maintaining fluid power equipment

Unit level:	Level 2
GLH:	60
Unit aim:	This Employer Unit of Competence (EUC) has been developed by employers in the Maritime Defence Sector and is part of an overall development programme designed to meet the requirements of the Sector, the published Apprenticeship Standard and Employer Occupational Brief. This EUC identifies the training and development required in order that the apprentice can demonstrate that they are competent in being able to prepare them for entry into the engineering or manufacturing sectors, creating a progression between education and employment, or that will provide a basis for the development of additional skills and occupational competences in the working environment. They will be expected to prepare for the maintenance activities by obtaining all necessary information, documentation, tools and equipment required, and to plan how they intend to carry out the required maintenance activities and the sequence of operations they intend to use. They will be required to select the appropriate equipment to use, based on the maintenance operations to be carried out and the type of fluid power equipment being maintained, which will include hydraulic or pneumatic equipment and circuits. They will be expected to use a variety of maintenance diagnostic techniques and procedures, such as gathering information from fault reports, using recognised fault finding techniques and diagnostic aids, measuring, inspecting and operating the equipment. They will then be expected to dismantle, remove and replace, or repair any faulty units or components, including pumps, valves, actuators, sensors, intensifiers, regulators, compressors, pipes and hoses, and other specific fluid power equipment. They will be expected to cover a range of maintenance activities, such as draining and removing fluids, removing stored pressure, labelling/proof marking to aid reassembly, dismantling components to the required level, checking components for serviceability, replacing faulty components and `lifed' items, setting and adjusting components, tightening fasteners to the required torque and making `off-load' checks, before starting up and testing the maintained equipment, using appropriate techniques and procedures. Their responsibilities will require them to comply with health and safety requirements and organisational policy and procedures for the fluid power maintenance activities undertaken. They will need to take account of any potential difficulties or problems that may arise with the maintenance activities, and to seek appropriate help and advice in determining and implementing a suitable

	solution. They will work under a high level of supervision, whilst taking responsibility for their own actions and for the quality and accuracy of the work that they carry out. Their underpinning knowledge will provide an understanding of their work, and will enable them to apply appropriate fluid power maintenance techniques and procedures safely. They will understand the maintenance process, and its application, and will know about the fluid power equipment being maintained, the system components, tools and consumables used, to the required depth to provide a sound basis for carrying out the activities to the required specification. They will understand the safety precautions required when carrying out the maintenance activities, and when using maintenance tools and equipment. They will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace. They will be able to apply the appropriate behaviours required in the workplace to meet the job profile and overall company objectives, such as strong work ethic, positive attitude, team player, dependability, responsibility, honesty, integrity motivation and commitment.
Relationship to NOS:	EUCL2F-009
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The apprentice must be able to:

1.1 work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines

1.2 demonstrate the required behaviours in line with the job role and company objectives

1.3 plan the maintenance activities before they start them

1.4 obtain all the information they need for the safe isolation, removal and replacement of the system components

1.5 obtain and prepare the appropriate tools and test equipment

1.6 apply appropriate maintenance diagnostic techniques and procedures

1.7 use the appropriate methods and techniques to remove and replace the required components

1.8 carry out tests on the maintained system in accordance with the test schedule/defined test procedures

1.9 deal promptly and effectively with problems within their control and seek help and guidance from the relevant people when they have problems they cannot resolve

1.10 leave the work area in a safe and tidy condition on completion of the maintenance activities

Learning outcome

The learner will:

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

2.1 adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations
2.2 ensure the safe isolation of equipment and service supplies (such as mechanical, electrical, gas, air or fluids)
2.3 follow job instructions, maintenance drawings and procedures
2.4 check that tools and test instruments to be used are within calibration and are in a safe and usable condition
2.5 ensure that the system is kept free from foreign objects, dirt or other contamination
2.6 return all tools and equipment to the correct location on completion of the maintenance activities

Learning outcome

The learner will:

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

3.1 pneumatic
3.2 hydraulic.

Learning outcome

The learner will:

4 Use **four** of the following maintenance diagnostic techniques, tools and aids:

4.1 fault finding techniques (such as six point, half-split, input/output, unit substitution, emergent sequence)
4.2 diagnostic aids (such as manuals, flow charts, troubleshooting guides, maintenance records)
1.3 information gathered from fault reports
4.4 inspecting (such as checking for damage, wear/deterioration, leaks, loose fittings and connections)
4.5 sensory input (such as sight, sound, smell, touch)
4.6 monitoring equipment or gauges
4.7 operating the equipment (such as manual operation, timing and sequencing)
4.8 test instrumentation measurement (such as pressure, flow, timing, sequence, movement)

Learning outcome

The learner will:

5 Use **two** of the following types of fluid power test instruments:

5.1 measuring devices
5.2 flow indicators
5.3 self-diagnostic equipment
5.4 pressure or temperature indicators
5.5 test rigs

Learning outcome

The learner will:

6 Carry out **all** of the following maintenance activities, as applicable to the equipment being maintained:

6.1 chocking/supporting cylinders/rams/components
6.2 draining and removing fluids (as applicable)
6.3 releasing stored energy
6.4 disconnecting/removing hoses and pipes
6.5 removing and replacing units/components (such as pumps, cylinders, valves, actuators)
6.6 proof marking/labelling of removed components
6.7 checking components for serviceability
6.8 replacing damaged/defective components
6.9 replacing all `lifed' items (such as seals, filters, gaskets)
6.10 tightening fastenings to the required torque
6.11 setting, aligning and adjusting replaced components
6.12 prime, bleed and recharge the system (as applicable)
6.13 making de-energised checks before re-pressurising the system

Learning outcome

The learner will:

7 Remove and replace a range of fluid power components, to include **all** of the following:

7.1 rigid pipework
7.2 hoses
7.3 valves
7.4 cylinders/actuators

Plus **five** more of the following:

7.5 reservoirs/storage devices
7.6 pumps
7.7 switches
7.8 accumulators
7.9 motors
7.10 sensors
7.11 pressure intensifiers
7.12 gaskets and seals
7.13 lubricators
7.14 compressors
7.15 pistons
7.16 filters
7.17 receivers
7.18 spools
7.19 cables and wires
7.20 regulators
7.21 bearings
7.22 gauges/indicators
7.23 timers
7.24 coolers
7.25 other components (to be specified by the employer).

Learning outcome

The learner will:

8 Carry out **all** the following tests on the maintained equipment:

8.1 leak test
8.2 operational performance
8.3 contamination test

Plus **two** from the following:

8.4 pressure line pressure tests
8.5 speed
8.6 return line pressure test
8.7 sequence
8.8 flow

Learning outcome

The learner will:

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

9.1 the test equipment is correctly calibrated
9.2 the test equipment used is appropriate for the tests being carried out
9.3 test procedures used are as recommended in the appropriate specifications
9.4 test readings are taken at the appropriate points, and where appropriate components are adjusted to give the required readings
9.5 test equipment is operated within its specification range

Learning outcome

The learner will:

10 Maintain fluid power equipment in compliance with **two** or more of the following:

10.1 organisational guidelines and codes of practice
10.2 specific system requirements
10.3 equipment manufacturers' technical publications
10.4 BS and/or ISO standards.

Learning outcome

The learner will:

11 Knowledge and understanding - The apprentice must know and understand:

11.1 the health and safety requirements, and safe working practices and procedures required for the fluid power maintenance activities undertaken
11.2 the importance of wearing appropriate protective clothing and equipment (PPE) and keeping the work area safe and tidy
11.3 hazards associated with carrying out maintenance activities on fluid power equipment (such as handling fluids, stored energy/force, misuse of tools), and how these can be minimised
11.4 the system isolation procedures or permit-to-work procedure that applies
11.5 the importance of applying the appropriate behaviours in the workplace and the implications for both the apprentice and the business if these are not adhered to
11.6 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
11.7 the procedure for obtaining drawings, job instructions, related specifications, replacement parts, materials and other consumables necessary for the maintenance activities
11.8 how to use and extract information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS or ISO standards in relation to work undertaken
11.9 the basic principles of how the fluid power equipment functions, its operating sequence, the purpose of individual units/components and how they interact
11.10 the different types of pipework, fittings and manifolds, and their application

11.11 the identification and application of different types of valve (such as poppet, spool, piston, disc)

11.12 the identification and application of different types of sensors and actuators (such as rotary, linear, mechanical, electrical)

11.13 the identification and application of different types of cylinder (such as single acting, double acting)

11.14 the identification and application of different types of pump (such as positive and non-positive displacement)

11.15 the identification and application of different types compressors (such as screw, piston, rotary vane)

11.16 the application and fitting of static and dynamic seals

11.17 the techniques used to dismantle/assemble fluid power equipment (such as release of energy/force, proof marking, extraction)

11.18 methods of checking that components are fit for purpose

11.19 how to make adjustments to components/assemblies to ensure that they function correctly

11.20 how to determine pressure settings, and their effect on the system

11.21 selection of fluids for the system

11.22 recognition of contaminants and the problems they can create, and the effects and likely symptoms of contamination in the system

11.23 the various maintenance diagnostic techniques and aids that can be used (such as fault reports, visual checks, measuring, movement and alignment checks, testing)

11.24 the various fault location techniques that can be used, and how they are applied (such as half-split, input-to-output, function testing, unit substitution, and equipment self-diagnostics)

11.25 how to evaluate sensory information (sight, sound, smell, touch)

11.26 how to use a range of fault diagnostic equipment to investigate the problem

11.27 the care, handling and application of mechanical measuring/test equipment (such as measuring instruments, pressure and flow indicators and self-diagnostic equipment)

11.28 types of test equipment to be used, and their selection for particular tests

11.29 how the test equipment is connected into the circuit, and the methods of doing this

11.30 the techniques, methods and procedures to be used during the tests

11.31 how to display/record test results, and the documentation used

11.32 how to interpret the test readings obtained, and the significance of the readings gained

11.33 the importance of ensuring that test equipment is used only for its intended purpose and within its specified range and limits

11.34 how to check that tools and test equipment are free from damage or defect, are in a safe and usable condition, are within calibration, and are configured correctly for the intended purpose

11.35 the problems associated with maintaining fluid power equipment, and how they can be overcome

11.36 when to act on their own initiative and when to seek help and advice from others

11.37 the importance of leaving the work area in a safe and clean condition on completion of the maintenance activities (such as returning hand tools and test equipment to is designated location, cleaning the work area, and removing and disposing of waste)

Unit 209 Maintaining fluid power equipment

Supporting Information

Specific Standard Requirements

In order to prove their ability to combine different maintenance operations, at least **one** of the fluid power maintenance activities must be of a significant nature, and must involve the removal and replacement of a minimum of **five** of the components listed in LO 7 in the skills requirement section.

Unit guidance

Assessment requirements have been developed by employers for the occupational competency units and qualifications for Advanced Manufacturing and Engineering Sector. These assessment requirements are set down in the relevant Qualification Assessment Strategies available from Semta. Please contact Customer.Services@semta.org.uk quoting Advanced Manufacturing and Engineering Trailblazer Qualification Assessment Strategy and specifying the title of the relevant Trailblazer Standard.

Although all of the content and assessment requirements must be met in full employers can tailor the training outcomes to ensure that the content of the programme is specific to their requirements in terms of products, processes, procedures, tools, equipment, materials, documentation and information systems.

This will allow each organisation to develop their own specific and tailored apprentice training programme that meets their own business requirements whilst at the same time ensuring that the overall generic content is to a high standard in terms of depth and breadth to enable progression and/or transferability to other employers.

Unit 210 Producing sheet metal components and assemblies

Unit level:	Level 2
GLH:	60
Unit aim:	This Employer Unit of Competence (EUC) has been developed by employers in the Maritime Defence Sector and is part of an overall development programme designed to meet the requirements of the Sector, the published Apprenticeship Standard and Employer Occupational Brief. This EUC identifies the training and development required in order that the apprentice can demonstrate that they are competent in being able to prepare for the sheet metalworking activities by obtaining all necessary information, documentation, tools and equipment required, and to plan how they intend to carry out the required cutting, forming and assembly activities, and the sequence of operations they intend to use. They will be required to select the appropriate equipment to use, based on the type and thickness of material, the operations to be carried out and the accuracy to be achieved. In carrying out the cutting and shaping activities, they will need to use a range of hand tools, portable power tools and simple machines to produce a variety of shapes, profiles and forms. They will also be expected to produce simple sheet metal assemblies, using self-secured joints, thermal methods or mechanical fastening devices. Their responsibilities will require them to comply with health and safety requirements and organisational policy and procedures for the sheet metalworking activities undertaken. They will need to take account of any potential difficulties or problems that may arise with the activities, and to seek appropriate help and advice in determining and implementing a suitable solution. They will work under a high level of supervision, whilst taking responsibility for their own actions and for the quality and accuracy of the work that they carry out. Their underpinning knowledge will provide an understanding of their work, and will enable them to apply appropriate sheet metalworking techniques and procedures safely. They will understand the cutting, forming and assembly process, and its application, and will know about the tools and equipment used, to the required depth to provide a sound basis for carrying out the activities to the required specification. They will understand the safety precautions required when carrying out sheet metalworking activities, and when using the various tools and equipment, especially with the use of guillotines and bending/forming equipment. They will be required to

	demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace. They will be able to apply the appropriate behaviours required in the workplace to meet the job profile and overall company objectives, such as strong work ethic, positive attitude, team player, dependability, responsibility, honesty, integrity, motivation and commitment.
Relationship to NOS:	EUCL2F-010
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The apprentice must be able to:

1.1 work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines
1.2 demonstrate the required behaviours in line with the job role and company objectives
1.3 plan the sheet metalworking activities before they start them
1.4 obtain the appropriate tools and equipment for the sheet metalworking operations, and check that they are in a safe and usable condition
1.5 mark out the components for the required operations, using appropriate tools and techniques
1.6 cut and shape the materials to the required specification, using appropriate tools and techniques
1.7 use the appropriate methods and techniques to assemble and secure the components in their correct positions
1.8 measure and check that all dimensional and geometrical aspects of the component are to the specification
1.9 deal promptly and effectively with problems within their control, and seek help and guidance from the relevant people if they have problems that they cannot resolve
1.10 leave the work area in a safe and tidy condition on completion of the fitting activities

Learning outcome

The learner will:

2 Carry out **all** of the following during the sheet metalworking activities:

2.1 adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations
2.2 ensure that all power tool cables, extension leads or air supply hoses are in a tested and serviceable condition

2.3 return all tools and equipment to the correct location on completion of the sheet metalworking activities

2.4 check that all measuring equipment is within calibration (where applicable)

Learning outcome

The learner will:

3 Use marking out methods and techniques, including:

3.1 direct marking using instruments

Plus **one** more from the following:

3.2 use of templates

3.3 tracing/transfer methods

Learning outcome

The learner will:

4 Use a range of marking out equipment, to include **all** of the following:

4.1 scriber

4.2 rule or tape

4.3 square

4.4 dividers or trammels

4.5 punch

4.6 straight edge

4.7 protractor

4.8 chalk, blueing or paint

Learning outcome

The learner will:

5 Mark out material, to include **all** of the following features:

5.1 datum and centre lines

5.2 curved profiles

5.3 square/rectangular profiles

5.4 cutting and bending detail (including allowances)

5.5 angles

5.6 hole centring and outlining (such as circular or linear)

5.7 circles

Learning outcome

The learner will:

6 Cut and finish material to the marked out shape, using **all** of the following machine tools:

6.1 tin snips
6.2 bench shears
6.3 hacksaw
6.4 files
6.5 hand power tools (such as drill, nibbling, saw)

Plus **one** more from the following:
6.6 pneumatic tools
6.7 trepanning
6.8 thermal device
6.9 other specific tool

Learning outcome

The learner will:

7 Cut and finish material to the marked out shape, using **all** the following machine tools:

7.1 guillotine
7.2 pillar drill
7.3 band saw

Plus **one** more of the following:
7.4 punch/cropping machine
7.5 trepanning machine
7.6 bench saw
7.7 nibbling machine
7.8 other specific machine tool.

Learning outcome

The learner will:

8 Perform cutting operations to produce components with all **three** of the following shapes:

8.1 square or rectangular profiles
8.2 angled profiles
8.3 external curved profiles

Plus **two** more from the following:

8.4 notches
8.5 internal curved contours
8.6 round holes
8.7 square or rectangular profiles.

Learning outcome

The learner will:

9 Use **both** of the following types of forming equipment/techniques:

9.1 bending machine (hand or powered)
9.2 rolling machine (hand or powered)

Plus **one** more from the following:

9.3 hammers/panel beating equipment
9.4 wheeling machine
9.5 stakes and formers
9.6 swaging machine
9.7 presses
9.8 shrinking techniques
9.9 jenny/wiring machine
9.10 stretching techniques

Learning outcome

The learner will:

10 Carry out forming operations which produce components having **all** of the following shapes:

10.1 bends/upstands
10.2 tray/box sections
10.3 folds/safe edges
10.4 cylindrical sections

Plus **one** more from the following:

10.5 wired edges
10.6 cowlings and rounded covers
10.7 swages
10.8 square to round trunking
10.9 curved panels
10.10 lobster-back trunking
10.11 ribbed components
10.12 concertina ducting or trunking

Learning outcome

The learner will:

11 Assemble sheet metal components, using **two** of the following methods:

11.1 temporary tack welding
11.2 adhesive bonding
11.3 flanged and mechanically fastened (such as bolts, screws)
11.4 resistance spot welding
11.5 self-securing joints (such as knocked up, paned down, swaged, joggled)
11.6 riveting (such as hollow or solid).

Learning outcome

The learner will:

12 Use sheet metal (up to and including 3 mm) in **all** of the following materials:

12.1 ferrous
12.2 non-ferrous
12.3 non-metallic

Learning outcome

The learner will:

13 Produce sheet metal components which meet **all** of the following:

13.1 all dimensions are within +/- 2.0mm or +/- 0.079”
13.2 finished components meet the required shape/geometry (square, straight, angles free from twists)
13.3 completed components are free from excessive tooling marks, deformation, cracking, sharp edges, slivers or burrs
13.4 all components are correctly assembled and have secure and firm joints

Learning outcome

The learner will:

14 Knowledge and understanding - The apprentice must know and understand:

14.1 the health and safety requirements, and safe working practices and procedures required for the sheet metalworking activities undertaken

14.2 the personal protective clothing and equipment (PPE)to be worn when carrying out the sheet metal activities (such as leather gloves, eye protection, ear protection), and the importance of keeping the work area safe and tidy

14.3 the importance of applying the appropriate behaviours in the workplace and the implications for both the apprentice and the business if these are not adhered to

14.4 the correct methods of moving or lifting sheet materials

14.5 safe working practices and procedures to be observed when using manual and power operated tools

14.6 the hazards associated with carrying out sheet metalworking activities (such as handling sheet materials, using dangerous or badly maintained tools and equipment, operating guillotines and bending machines, and when using hand and bench shears), and how they can be minimised

14.7 the procedure for obtaining the required drawings, job instructions and other related specifications

14.8 how to use and extract information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS or ISO standards) in relation to work undertaken

14.9 how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing

14.10 how to prepare the materials in readiness for the marking out activities, in order to enhance clarity, accuracy and safety (such as visually checking for defects, cleaning the materials, removing burrs and sharp edges, applying a marking out medium)

14.11 how to select and establish a suitable datum; the importance of ensuring that marking out is undertaken from the selected datum, and the possible effects of working from a different datum

14.12 use of marking out conventions when marking out the workpiece (including datum lines, cutting guidelines, square and rectangular profiles, circular and radial profiles, angles, holes linearly positioned, boxed and on pitch circles)

14.13 ways of laying out the marking-out shapes or patterns to maximise use of materials

14.14 the tools and techniques available for cutting and shaping sheet metal (such as tin snips, bench shears, guillotines, portable power tools, bench drills, saws)

14.15 the use and care of tools and equipment (including checks that must be made to ensure that the tools are fit for purpose - such as sharp, undamaged, plugs and cables secure and free from damage, PAT tested, machine guards or safety devices operating correctly)

14.16 hand tools used in sheet metal forming activities (such as range of hammers, stakes, formers, sand bags), and typical operations that they are used for

14.17 the various machine tool forming equipment that can be used to produce a range of shapes (such as bends, box sections, cylinders and curved sections, wired edges and swages)

14.18 methods of stretching and shrinking materials, and the tools, equipment and techniques used for this

14.19 how to set up the various machines to produce the required forms (setting up of rolls; setting fingers on bending machines; setting forming tools for swaging)

14.20 ways of limiting distortion, marking, creases, flats (in curved sections)

14.21 the characteristics of the various materials used (with regard to the bending and forming process)

14.22 how the materials are to be prepared for the forming operations, and why some materials may require a heating process prior to forming

14.23 the importance of using tools or equipment only for the purpose intended; the care that is required when using the tools or equipment; the proper way of preserving tools or equipment between operations

14.24 the various methods of securing the assembled components, and the range of mechanical fastening devices that are used (such as nuts and bolts, rivets, screws, special fasteners), resistance and tack welding methods and techniques, adhesive bonding of components and self-secured joints (such as knocked up, paned down, swaged and joggled)

14.25 the preparations to be carried out on the components prior to assembling them

14.26 how to set up and align the various components, and the tools and equipment that are used for this

14.27 methods of temporarily holding the joints together to aid the assembly activities (such as clamps, rivet clamps)

14.28 inspection techniques that can be applied to check that shape (including straightness) and dimensional accuracy are to specification and within acceptable limits

14.29 the problems that can occur with the sheet metalworking activities (such as defects caused by incorrectly set or blunt shearing blades), and how these can be overcome

14.30 when to act on their own initiative and when to seek help and advice from others

14.31 the importance of leaving the work area and equipment in a safe and clean condition on completion of the sheet metal activities (such as storing power leads, isolating machines, cleaning the equipment and removing and disposing of waste)

Unit 210 Producing sheet metal components and assemblies

Supporting Information

Specific Standard Requirements

In order to prove their ability to combine different sheet metal cutting and forming operations, at least **one** of the jobs produced must be of a significant nature, and must contain a minimum of **three** of the features listed in LO 8 **plus three** of the features listed in LO 10 in the skills requirement section.

Unit guidance

Assessment requirements have been developed by employers for the occupational competency units and qualifications for Advanced Manufacturing and Engineering Sector. These assessment requirements are set down in the relevant Qualification Assessment Strategies available from Semta. Please contact Customer.Services@semta.org.uk quoting Advanced Manufacturing and Engineering Trailblazer Qualification Assessment Strategy and specifying the title of the relevant Trailblazer Standard

Although all of the content and assessment requirements must be met in full employers can tailor the training outcomes to ensure that the content of the programme is specific to their requirements in terms of products, processes, procedures, tools, equipment, materials, documentation and information systems.

This will allow each organisation to develop their own specific and tailored apprentice training programme that meets their own business requirements whilst at the same time ensuring that the overall generic content is to a high standard in terms of depth and breadth to enable progression and/or transferability to other employers

Unit 211 Producing platework components and assemblies

Unit level:	Level 2
GLH:	60
Unit aim:	This Employer Unit of Competence (EUC) has been developed by employers in the Maritime Defence Sector and is part of an overall development programme designed to meet the requirements of the Sector, the published Apprenticeship Standard and Employer Occupational Brief. This EUC identifies the training and development required in order that the apprentice can demonstrate that they are competent in being able to prepare for the plateworking (above 3mm) activities by obtaining all necessary information, documentation, tools and equipment required, and to plan how they intend to carry out the required cutting, forming and assembly activities, and the sequence of operations they intend to use. They will be required to select the appropriate equipment to use, based on the type and thickness of material, the operations to be carried out and the accuracy to be achieved. In carrying out the cutting and shaping activities, they will need to use a range of hand tools, portable power tools and machines to produce a variety of shapes, profiles and forms. They will also be expected to produce simple platework assemblies, using mechanical fastening devices and tack welding. Their responsibilities will require them to comply with health and safety requirements and organisational policy and procedures for the plate working activities undertaken. They will need to take account of any potential difficulties or problems that may arise with the activities, and to seek appropriate help and advice in determining and implementing a suitable solution. They will work under a high level of supervision, whilst taking responsibility for their own actions and for the quality and accuracy of the work that they carry out. Their underpinning knowledge will provide an understanding of their work, and will enable them to apply appropriate plateworking techniques and procedures safely. They will understand the cutting, forming and assembly process, and its application, and will know about the tools and equipment used, to the required depth to provide a sound basis for carrying out the activities to the required specification. They will understand the safety precautions required when carrying out plateworking the activities, and when using the various tools and equipment, especially those involved in using

	guillotines and bending/forming equipment. They will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace. They will be able to apply the appropriate behaviours required in the workplace to meet the job profile and overall company objectives, such as strong work ethic, positive attitude, team player, dependability, responsibility, honesty, integrity, motivation and commitment.
Relationship to NOS:	EUCL2F-011
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The apprentice must be able to:

1.1 work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines

1.2 demonstrate the required behaviours in line with the job role and company objectives

1.3 plan the plateworking activities before they start them

1.4 obtain the appropriate tools and equipment for the plateworking operations, and check that they are in a safe and usable condition

1.5 mark out the components for the required operations, using appropriate tools and techniques

1.6 cut and shape the materials to the required specification, using appropriate tools and techniques

1.7 use the appropriate methods and techniques to assemble and secure the components in their correct positions

1.8 measure and check that all dimensional and geometrical aspects of the components are to the specification

1.9 deal promptly and effectively with problems within their control, and seek help and guidance from the relevant people if they have problems that they cannot resolve

1.10 leave the work area in a safe and tidy condition on completion of the platework activities

Learning outcome

The learner will:

2 Carry out **all** of the following during the plateworking activities:

2.1 adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations

2.2 ensure that all power tool cables, extension leads or air supply hoses are in a tested and serviceable condition

2.3 return all tools and equipment to the correct location on completion of the plateworking activities

2.4 check that all measuring equipment is within calibration (where applicable)

Learning outcome

The learner will:

3 Use marking out methods and techniques, including:

3.1 direct marking using instruments

Plus **one** more from the following:

3.2 use of templates

3.3 tracing/transfer methods

3.4 other specific method

Learning outcome

The learner will:

4 Use a range of marking out equipment, to include **all** of the following:

4.1 scriber

4.2 rule or tape

4.3 square

4.4 dividers or trammels

4.5 punch

4.6 straight edge

4.7 protractor

4.8 chalk, blueing or paint

Learning outcome

The learner will:

5 Mark out material, to include **all** of the following features:

5.1 datum and centre lines

5.2 curved profiles

5.3 square/rectangular profiles

5.4 cutting and bending detail (including allowances)

5.5 angles

5.6 hole centring and outlining (such as circular or linear)

5.7 circles

Learning outcome

The learner will:

6 Cut and finish material to the marked out shape, using **both** of the following:

6.1 guillotine
6.2 drill (such as bench, pillar, radial)

Plus **two** more from the following:
6.3 abrasive disc (such as portable, fixed)
6.4 cropping machine
6.5 machine saw
6.6 thermal device

Learning outcome

The learner will:

7 Perform cutting operations to produce components that combine operations and cover **all** of the following features:

7.1 components with parallel sides
7.2 components with sides square to each other
7.3 holes linearly pitched

Plus **two** more from the following:
7.4 components with angled sides
7.5 components with curved contours
7.6 holes radially pitched
7.7 bevelled edges or weld preps

Learning outcome

The learner will:

8 Use **two** of the following types of forming equipment/techniques

8.1 bending machine (hand or powered)
8.2 presses
8.3 rolling machine (hand or powered)
8.4 heating techniques

Learning outcome

The learner will:

9 Perform forming operations to produce components that combine operations and cover **all** of the following features:

9.1 bends at 90°
9.2 bends of various angles
9.3 cylinders

Plus **two** more from the following:

9.4 set plate ends
9.5 segments of a cylindrical tank
9.6 box square and rectangular sections
9.7 curved section or sector of an otherwise flat plate
9.8 curved plates
9.9 counter-curved sections
9.10 pipe sections
9.11 flattening or straightening plate
9.12 cones

Learning outcome

The learner will:

10 Produce components which combine different operations and have features that cover **all** of the following:

10.1 drilled through holes
10.2 internal threads

Learning outcome

The learner will:

11 Assemble platework components using **two** of the following methods:

11.1 temporary tack welding
11.2 adhesive bonding
11.3 riveting (hot or cold)
11.4 mechanically fastened (such as bolts, screws)

Learning outcome

The learner will:

12 Use the following materials:

12.1 flat plate
12.2 rolled sections (such as angle, channel, RSJ, rail section)

Plus **one** more from the following:

12.3 pipe/tube
12.4 solid bar (such as square, round, hexagonal)
12.5 non-ferrous materials

Learning outcome

The learner will:

13 Produce platework components which meet all of the following:

13.1 all dimensions are within +/- 3.0mm or +/- 0.125”
13.2 finished components meet the required shape/geometry (such as square, straight, angles free from twists)
13.3 completed components are free from excessive tooling marks, deformation, cracking, sharp edges, slivers or burrs
13.4 all components are correctly assembled, and have secure and firm joints

Learning outcome

The learner will:

14 Knowledge and understanding - The apprentice must know and understand:

14.1 all dimensions are within +/- 3.0mm or +/- 0.125”
14.2 finished components meet the required shape/geometry (such as square, straight, angles free from twists)
14.3 completed components are free from excessive tooling marks, deformation, cracking, sharp edges, slivers or burrs
14.4 all components are correctly assembled, and have secure and firm joints
14.5 the importance of applying the appropriate behaviours in the workplace and the implications for both the apprentice and the business if these are not adhered to
14.6 the procedure for obtaining the required drawings, job instructions and other related specifications
14.7 how to use and extract information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS or ISO standards) in relation to work undertaken

14.8 how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing

14.9 how to prepare the materials in readiness for the marking out activities, in order to enhance clarity, accuracy and safety (such as visually checking for defects, cleaning the materials, removing burrs and sharp edges, applying a marking out medium)

14.10 how to select and establish a suitable datum; the importance of ensuring that marking out is undertaken from the selected datum, and the possible effects of working from a different datum

14.11 use of marking out conventions when marking out the workpiece (including datum lines, cutting guidelines, square and rectangular profiles, circular and radial profiles, angles, holes linearly positioned, boxed and on pitch circles)

14.12 ways of laying out the marking-out shapes or patterns to maximise use of materials

14.13 the tools and techniques available for cutting and shaping heavy plate and section materials (such as guillotines, cropping machines, abrasive discs (such as hand held portable machines and bench type radiac cutting machines), drilling machines and machine saws)

14.14 the selection and fitting of abrasive cutting discs, cutting disc identification markings, how to identify the correct type of disc for the type of material being cut; statutory regulations regarding the fitting and use of abrasive discs

14.15 the use and care of tools and equipment (including checks that must be made to ensure that the tools are fit for purpose - such as cutting blades are sharp and undamaged, setting and adjusting guillotine blades for the material thickness, ensuring machine guards, interlocks or other safety devices are operating correctly)

14.16 the various shearing machine cutting methods and techniques (such as cutting to marking out; using machine back-stops; setting plate at an angle to the machine slides)

14.17 the various machine tool forming equipment that can be used to produce a range of shapes (such as bends, box sections, cylinders and curved sections)

14.18 how to set up the various machines to produce the required forms (setting up of rolls; releasing formed work from rolls; setting up bending machines and setting forming tools)

14.19 ways of limiting distortion, marking, creases, flats (in curved sections)

14.20 the characteristics of the various materials used (with regard to the bending and forming process); how the materials are to be prepared for the forming operations, and why some materials may require a heating process prior to forming

14.21 the various methods of securing the assembled components; the range of mechanical fastening devices that are used (such as nuts and bolts, rivets, screws, special fasteners); tack welding methods and techniques

14.22 the preparations to be carried out on the components prior to assembling them

14.23 how to set up and align the various components, and the tools and equipment that are used for this

14.24 methods of temporarily holding the joints together to aid the assembly activities

14.25 inspection techniques that can be applied to check that shape (including straightness) and dimensional accuracy are to specification and within acceptable limits

14.26 the problems that can occur with the heavy plateworking activities, and how these can be overcome (such as defects caused by incorrectly set or blunt shearing blades)

14.27 when to act on their own initiative and when to seek help and advice from others

14.28 the importance of leaving the work area and equipment in a safe and clean condition on completion of the platework activities (such as removing and storing power leads, isolating machines, cleaning the equipment, and removing and disposing of waste)

Unit 211 Producing platework components and assemblies

Supporting Information

Specific Standard Requirements

In order to prove their ability to combine different platework cutting and forming operations, at least **one** of the assemblies produced must be of a significant nature, and must contain components with a minimum of **three** of the features listed in LO 7 **plus three** of the features listed in LO 9 in the skills requirements section.

Unit guidance

Assessment requirements have been developed by employers for the occupational competency units and qualifications for Advanced Manufacturing and Engineering Sector. These assessment requirements are set down in the relevant Qualification Assessment Strategies available from Semta. Please contact Customer.Services@semta.org.uk quoting Advanced Manufacturing and Engineering Trailblazer Qualification Assessment Strategy and specifying the title of the relevant Trailblazer Standard.

Although all of the content and assessment requirements must be met in full employers can tailor the training outcomes to ensure that the content of the programme is specific to their requirements in terms of products, processes, procedures, tools, equipment, materials, documentation and information systems.

This will allow each organisation to develop their own specific and tailored apprentice training programme that meets their own business requirements whilst at the same time ensuring that the overall generic content is to a high standard in terms of depth and breadth to enable progression and/or transferability to other employers.

Unit 212 Cutting and shaping materials using thermal cutting equipment

Unit level:	Level 2
GLH:	60
Unit aim:	This Employer Unit of Competence (EUC) has been developed by employers in the Maritime Defence Sector and is part of an overall development programme designed to meet the requirements of the Sector, the published Apprenticeship Standard and Employer Occupational Brief. This EUC identifies the training and development required in order that the apprentice can demonstrate that they are competent in being able to demonstrate thermal cutting and shaping (3mm thickness and above) rolled sections, pipe and tube using thermal cutting equipment. The thermal cutting will include equipment such as hand-held oxy-fuel gas cutting equipment, plasma cutting equipment, simple portable machines running on tracks, and fixed bench cutting machines. They will be expected to prepare for the cutting activities by obtaining all necessary information, documentation, tools and equipment required, and to plan how they intend to carry out the required cutting operations. They will be required to assemble and set up the appropriate equipment for the material and thickness to be cut, the type of operation to be carried out and the accuracy to be achieved. Materials to be cut and shaped may include mild steel, stainless steel, special steels and other appropriate materials, and the work will include guided cuts, vertical cuts, overhead cuts, external curved contours, round and square holes, as appropriate. Their responsibilities will require them to comply with health and safety requirements and organisational policy and procedures for the thermal cutting activities undertaken. They will need to take account of any potential difficulties or problems that may arise with the activities, and to seek appropriate help and advice in determining and implementing a suitable solution. They will work under a high level of supervision, whilst taking responsibility for their own actions and for the quality and accuracy of the work that they carry out. Their underpinning knowledge will provide an understanding of their work, and will enable them to apply appropriate thermal cutting techniques and procedures safely. They will understand the cutting process, and its application, and will know about the tools, equipment, materials and consumables used, to the required depth to provide a sound basis for carrying out the activities to the required specification.

	They will understand the safety precautions required when carrying out the thermal cutting activities, and when using the various tools and equipment, especially with regard to fire and potential explosion, and the necessary safeguards for undertaking the activities safely and correctly. They will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace. They will be able to apply the appropriate behaviours required in the workplace to meet the job profile and overall company objectives, such as strong work ethic, positive attitude, team player, dependability, responsibility, honesty, integrity, motivation and commitment.
Relationship to NOS:	EUCL2F-012
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The apprentice must be able to:

1.1 work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines
1.2 demonstrate the required behaviours in line with the job role and company objectives
1.3 plan the thermal cutting activities before they start them
1.4 obtain the appropriate tools and equipment for the cutting operations, and check that they are in a safe and usable condition
1.5 set up the thermal cutting equipment for the operations to be performed
1.6 where appropriate, mark out the components for the required operations, using appropriate tools and techniques
1.7 operate the thermal cutting equipment to produce items/cut shapes to the dimensions and profiles specified
1.8 measure and check that all dimensional and geometrical aspects of the component are to the specification
1.9 deal promptly and effectively with problems within their control, and seek help and guidance from the relevant people if they have problems that they cannot resolve
1.10 shut down the equipment to a safe condition on conclusion of the machining activities
1.11 leave the work area in a safe and tidy condition on completion of the thermal cutting activities

Learning outcome

The learner will:

2 Confirm that the equipment is safe and fit for purpose, by carrying out **all** of the following checks:

2.1 adhere to procedures or systems in place for risk assessment, COSHH, Personal Protective Equipment (PPE) and other relevant safety regulations
2.2 the equipment selected is suitable for the operations to be performed
2.3 regulators, hoses and valves are securely connected and free from leaks and damage
2.4 the correct gas nozzle is fitted to the cutting torch
2.5 a flashback arrestor is fitted to the gas equipment
2.6 appropriate gas pressures are set
2.7 the correct procedure is used for lighting, adjusting and extinguishing the cutting flame
2.8 hoses are safely routed and protected at all times
2.9 gas cylinders are handled and stored safely and correctly

Learning outcome

The learner will:

3 Perform thermal cutting operations, to include **all** of the following:

3.1 down-hand straight cuts (freehand)
3.2 cutting regular shapes
3.3 making radial hole/cuts
3.4 cutting out holes

Plus **three** more from the following:
3.5 making straight cuts (track guided)
3.6 cutting irregular shapes
3.7 gouging/flushing
3.8 making vertical cuts
3.9 making angled cuts
3.10 bevelled edge – weld preparations
3.11 making overhead cuts
3.12 cutting chamfers

Learning outcome

The learner will:

4 Produce thermal cuts in the following form of material (metal of 3mm and above):

4.1 plate

Plus **one** more from the following:
4.2 rolled sections
4.3 pipe/tube
4.4 structures

Learning outcome

The learner will:

5 Produce cut profiles for **one** type of material from the following:

5.1 mild steel
5.2 high tensile/special steel
5.3 stainless steel
5.4 other appropriate metal

Learning outcome

The learner will:

6 Produce thermally-cut components which meet all **of** the following:

6.1 dimensional accuracy is within the tolerances specified on the drawing/specification, or within +/- 3mm
6.2 angled/radial cuts are within specification requirements
6.3 cuts are clean, smooth and free from flutes

Learning outcome

The learner will:

7 Knowledge and understanding - The apprentice must know and understand:

7.1 the specific safety precautions to be taken when working with thermal cutting equipment in a fabrication environment (including general workshop safety; protecting other workers by siting protective screens; fire and explosion prevention; safety in enclosed/confined spaces; fume control)
7.2 the personal protective clothing and equipment (PPE)to be worn when working with thermal cutting equipment (such as leather aprons and gloves, eye/ear protection)
7.3 the correct methods of moving or lifting plate and section materials
7.4 the hazards associated with carrying out thermal cutting activities (including trailing hoses, naked flames, fumes and gases, explosive gas mixtures, oxygen enrichment, spatter, hot metal, enclosed spaces), and how they can be minimised
7.5 safe working practices and procedures for using thermal equipment, in line with British Compressed Gas Association (BCGA) codes of practice (to include setting up procedures, and emergency shutdown procedures)
7.6 the importance of applying the appropriate behaviours in the workplace and the implications for both the apprentice and the business if these are not adhered to
7.7 the procedure for obtaining the required drawings, job instructions and other related specifications
7.8 how to extract information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS or ISO standards) in relation to work undertaken

7.9 how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing

7.10 basic principles of thermal cutting, the various types of thermal cutting equipment available, and typical applications

7.11 the accessories that can be used with hand-held thermal cutting equipment to aid cutting operations (such as cutting guides, trammels, templates); arrangements for attaching cutting aids to the equipment

7.12 the gases used in thermal cutting; gas identification and colour codes; their particular characteristics and safety procedures

7.13 how to set up the thermal cutting equipment (including connection of hoses, regulators and flashback arrestors, selection of cutting torch and nozzle size in relationship to material thickness and operations performed)

7.14 preparations prior to cutting (including checking connections for leaks, setting gas pressures, setting up the material/workpiece, and checking the cleanliness of materials used)

7.15 the holding methods that are used to aid thermal cutting, and the equipment that can be used

7.16 setting of operating conditions (including flame control, and the effects of mixtures and pressures associated with thermal cutting)

7.17 the correct procedure for lighting and extinguishing the flame (to include lighting the cutting torch and adjusting gas controls to produce a neutral flame; methods of starting the cut and controlling the cutting speed, direction and angle of cut; the procedure for extinguishing the flame and the importance of following the procedure)

7.18 procedures to be followed for cutting specific materials, and why these procedures must always be adhered to

7.19 the problems that can occur with thermal cutting (including causes of distortion during thermal cutting and methods of controlling distortion), and how they can be avoided

7.20 the effects of oil, grease, scale or dirt on the cutting process

7.21 the causes of cutting defects, how to recognise them, and methods of correction and prevention

7.22 when to act on their own initiative and when to seek help and advice from others

7.23 the importance of leaving the work area and equipment in a safe and clean condition on completion of the thermal cutting activities (such as safely storing gas cylinders and cutting equipment, removing and disposing of waste)

Unit 212 Cutting and shaping materials using thermal cutting equipment

Supporting Information

Specific Standard Requirements

In order to prove their ability to combine different thermal cutting operations, at least **one** of the components produced must be of a significant nature, and must involve a minimum of **four** of the operations listed in LO 3 in the skills requirement section

Unit guidance

Assessment requirements have been developed by employers for the occupational competency units and qualifications for Advanced Manufacturing and Engineering Sector. These assessment requirements are set down in the relevant Qualification Assessment Strategies available from Semta. Please contact Customer.Services@semta.org.uk quoting Advanced Manufacturing and Engineering Trailblazer Qualification Assessment Strategy and specifying the title of the relevant Trailblazer Standard.

Although all of the content and assessment requirements must be met in full employers can tailor the training outcomes to ensure that the content of the programme is specific to their requirements in terms of products, processes, procedures, tools, equipment, materials, documentation and information systems.

This will allow each organisation to develop their own specific and tailored apprentice training programme that meets their own business requirements whilst at the same time ensuring that the overall generic content is to a high standard in terms of depth and breadth to enable progression and/or transferability to other employers.

Unit 213 Preparing and using manual metal arc welding equipment

Unit level:	Level 2
GLH:	60
Unit aim:	This Employer Unit of Competence (EUC) has been developed by employers in the Maritime Defence Sector and is part of an overall development programme designed to meet the requirements of the Sector, the published Apprenticeship Standard and Employer Occupational Brief. This EUC identifies the training and development required in order that the apprentice can demonstrate that they are competent in being able to prepare the welding equipment and to ensure that all the leads/cables, electrode holder and workpiece earthing arrangements are securely connected and free from damage. They will also need to obtain and check that all the workholding equipment and manipulating devices are in a safe and usable condition. In preparing to weld, they will need to set and adjust the welding conditions in line with instructions and/or the welding procedure specification. They must operate the equipment safely and correctly, and make any necessary adjustments to settings in line with their permitted authority, in order to produce the welded joints to the required specification. On completion of the welding operations, they will be expected to check the quality of the welds using measuring equipment, visual examination and destructive testing techniques, as appropriate to the aspects being checked. They will need to be able to recognise welding defects, to take appropriate action to limit any faults that occur and to ensure that the finished workpiece is within the specification requirements. On completion of the welding activities, they will be expected to return the workholding devices to their designated location, and to leave the welding equipment and work area in a safe and tidy condition. Their responsibilities will require them to comply with health and safety requirements and organisational policy and procedures for the welding activities undertaken. They will need to take account of any potential difficulties or problems that may arise with the welding activities, and to seek appropriate help and advice in determining and implementing a suitable solution. They will work under a high level of supervision, whilst taking responsibility for their own actions and for the quality and accuracy of the work that they carry out.

	Their underpinning knowledge will provide an understanding of their work, and will enable them to apply appropriate manual metal arc welding techniques safely. They will understand the welding process, and its application, and will know about the equipment, materials and consumables, to the required depth to provide a sound basis for carrying out the activities to the required specification. They will understand the safety precautions required when working with the manual metal arc welding equipment, and with the associated tools and equipment. They will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace. They will be able to apply the appropriate behaviours required in the workplace to meet the job profile and overall company objectives, such as strong work ethic, positive attitude, team player, dependability, responsibility, honesty, integrity, motivation and commitment.
Relationship to NOS:	EUCL2F-013
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The apprentice must be able to:

1.1 work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines
1.2 demonstrate the required behaviours in line with the job role and company objectives
1.3 plan the welding activities before they start them
1.4 obtain and prepare the appropriate welding equipment and welding consumables
1.5 prepare and support the joint, using the appropriate methods
1.6 tack weld the joint at appropriate intervals, and check the joint for accuracy before final welding
1.7 weld the joint to the specified quality, dimensions and profile
1.8 use appropriate methods and equipment to check the quality, and check that all dimensional and geometrical aspects of the weld are to the specification
1.9 deal promptly and effectively with problems within their control, and seek help and guidance from the relevant people if they have problems that they cannot resolve
1.10 shut down and make safe the welding equipment on completion of the welding activities

Learning outcome

The learner will:

2 Prepare for the manual metal arc welding process by carrying out **all** of the following:

2.1 adhere to procedures or systems in place for risk assessment, COSHH, Personal Protective Equipment (PPE) and other relevant safety regulations

2.2 check the condition of, and correctly connect, welding leads, earthing arrangements and electrode holder

2.3 set and adjust the welding conditions/parameters, in accordance with the welding procedure specification

2.4 prepare the work area for the welding activities (such as positioning welding screens and fume extraction)

2.5 prepare the materials and joint in readiness for welding (such as cleaning of joint faces, grinding weld preparations, setting up the joint, supporting the joint)

2.6 make sure that the work area is maintained and left in a safe and tidy condition

Learning outcome

The learner will:

3 Use manual metal-arc welding and related equipment to include **either** of the following:

3.1 alternating current (AC) equipment

3.2 direct current (DC) equipment

Learning outcome

The learner will:

4 Use **two** types of electrode from the following:

4.1 rutile

4.2 cellulosic

4.3 basic

4.4 other suitable electrodes

Learning outcome

The learner will:

5 Produce **three** of the following welded joints, of at least 150mm long, using single or multi-run welds (as appropriate), with at least one stop and start included:

5.1 fill

5.2 et lap joints

5.2 corner joints

5.3 Tee fillet joints

5.4 butt joints.

Learning outcome

The learner will:

6 Produce joints as follows:

6.1 One type of material from the following

- carbon steel
- stainless steel

6.2 And **one** form of material from the following:

- sheet (less than 3mm)
- pipe/tube
- plate
- other forms
- section

Learning outcome

The learner will:

7 Weld joints in good access situations, in **two** of the following BS EN ISO 6947 positions:

7.1 Flat (PA)
7.2 Vertical upwards (PF)
7.3 Horizontal vertical (PB)
7.4 Vertical downwards (PG)
7.5 Horizontal (PC).

Learning outcome

The learner will:

8 Check that the welded joint conforms to the specification by checking **all** of the following:

8.1 dimensional accuracy
8.2 size and profile of weld
8.3 number of runs
8.4 alignment/squareness

Learning outcome

The learner will:

9 Carry out non-destructive testing of the welds, using **one** of the following:

9.1 dye penetrant
9.2 fluorescent penetrant
9.3 magnetic particle

Learning outcome

The learner will:

10 Carry out destructive tests on weld specimens, using **one** of the following:

10.1 macroscopic examination
10.2 nick break test
10.3 bend tests (such as face, root or side, as appropriate)

Learning outcome

The learner will:

11 Identify **all** of the following weld defects:

11.1 lack of continuity of the weld
11.2 uneven and irregular ripple formation
11.3 incorrect weld size or profile

Plus **four** more of the following:

11.4 undercutting
11.5 surface cracks
11.6 overlap
11.7 internal cracks
11.8 inclusions
11.9 lack of fusion
11.10 porosity
11.11 lack of penetration

Learning outcome

The learner will:

12 Produce welded joints which meet **all** of the following (with reference to BS 4872 Part 1 Weld test requirements):

12.1 welds meet the required dimensional accuracy

12.2 fillet welds are equal in leg length and slightly convex in profile, with the size of the fillet equivalent to the thickness of the material welded

12.3 the weld contour is linear, of uniform profile, free from excessive undulations, with regular and even ripple

12.4 the welds are adequately fused, and with minimal undercut, overlap and surface inclusions

12.5 weld finishes are built up to the full section of the weld

12.6 joins at stop/start positions merge smoothly, with no pronounced hump or crater in the weld surface

12.7 tack welds are blended in to form part of the finished weld, without excessive hump

12.8 corner joints have minimal burn through to the underside of the joint or, where appropriate, penetration is present to a maximum depth of 3mm for at least 75% of the joint

12.9 the weld surface is free from cracks, and substantially free from porosity, shrinkage cavities and trapped slag

12.10 the weld surface and adjacent parent metal is substantially free from arcing or chipping marks

Learning outcome

The learner will:

Knowledge and understanding - The apprentice must know and understand:

13.1 the safe working practices and procedures to be followed when preparing and using MMA welding equipment (such as general workshop safety; appropriate personal protective equipment (PPE); fire prevention; protecting other workers from the effects of the welding arc; safety in enclosed/confined spaces; fume extraction/control)

13.2 the hazards associated with MMA welding (such as live electrical components; poor earthing; the electric arc; fumes and gases; spatter; hot slag and metal; grinding and mechanical metal/slag removal; elevated working; welding in enclosed spaces; slips, trips and falls), and how they can be minimised

13.3 the personal protective equipment to be worn for the welding activities (such as correctly fitting overalls; leather aprons, welding gloves/gauntlets; safety boots; head/eye shield with correct shade of filter)

13.4 the importance of applying the appropriate behaviours in the workplace and the implications for both the apprentice and the business if these are not adhered to

13.5 the manual metal arc welding process (such as basic principles of fusion welding, AC and DC power sources, power ranges)

13.6 how to use and extract information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS or ISO standards) in relation to work undertaken

13.7 types of electrodes used, and the correct control, storage and drying of electrodes

13.8 the types of welded joints to be produced (such as lap joints, corner joints, tee joints, butt welds, single and multi- run welds)

13.9 terminology used for the appropriate welding positions

13.10 how to prepare the materials in readiness for the welding activity (such as ensuring that the material is free from excessive surface contamination such as rust, scale, paint, oil/grease and moisture); ensuring that edges to be welded are correctly prepared (such as made flat, square or bevelled)

13.11 how to set up and restrain the joint, and the tools and techniques to be used (such as the use of jigs and fixtures, restraining devices - such as clamps and weights/blocks; setting up the joint in the correct position and alignment)

13.12 tack welding size and spacing in relationship to material thickness

13.13 checks to be made prior to welding (such as confirming the correct set-up of the joint; condition of electrical connections, welding return and earthing arrangements; checking operating parameters)

13.14 the techniques of operating the welding equipment to produce a range of joints in the various joint positions (such as striking and initiating the arc; fine adjustment of parameters; correct manipulation and welding speed of electrode; blending in stops/starts and tack welds)

13.15 how to close down the welding equipment safely and correctly

13.16 how to control distortion (such as welding sequence; deposition technique)

13.17 problems that can occur with the welding activities (such as causes of distortion and methods of control; effects of welding on materials and sources of weld defects), and how these can be overcome

13.18 the safe working practices and procedures to be adopted when preparing the welds for examination (such as handling hot materials, using chemicals for cleaning and etching, using equipment to fracture welds)

13.19 how to prepare the welds for examination (such as removing slag, spatter and surface irregularities; cleaning the weld, polishing and making saw cuts on welds to be fracture tested)

13.20 how to check the welded joints for uniformity, alignment, position, weld size and profile

13.21 the various procedures for visual examination of the welds for cracks, porosity and slag inclusions (such as dye penetrant, fluorescent penetrant; magnetic particle testing)

13.22 the various procedures for carrying out destructive tests on the welds (such as macroscopic examination, bend tests, nick break tests)

13.23 methods of removing a specimen of weld from a suitable position in the joint (such as a stop/start position using a non-thermal process, such as hand saws, power saws, abrasive discs)

13.24 how to examine the welds after the tests and check for such defects as the degree of penetration and fusion, inclusions, porosity, cracks, undercut and overlap, uneven and irregular ripple formation

13.25 when to act on their own initiative and when to seek help and advice from others

13.26 the importance of leaving the work area and equipment in a safe condition on completion of the welding activities (such as isolation of electrical supplies; safely storing welding cables and electrode holders; storing electrodes; removing and disposing of waste)

Unit 213 Preparing and using manual metal arc welding equipment

Supporting Information

Specific Standard Requirements

Welded joints must be at least 150mm long, using single or multi-run welds (as appropriate), with at least **one** stop and start included as specified in LO 5 of the skills requirement section.

Unit guidance

Assessment requirements have been developed by employers for the occupational competency units and qualifications for Advanced Manufacturing and Engineering Sector. These assessment requirements are set down in the relevant Qualification Assessment Strategies available from Semta. Please contact Customer.Services@semta.org.uk quoting Advanced Manufacturing and Engineering Trailblazer Qualification Assessment Strategy and specifying the title of the relevant Trailblazer Standard

Although all of the content and assessment requirements must be met in full employers can tailor the training outcomes to ensure that the content of the programme is specific to their requirements in terms of products, processes, procedures, tools, equipment, materials, documentation and information systems.

This will allow each organisation to develop their own specific and tailored apprentice training programme that meets their own business requirements whilst at the same time ensuring that the overall generic content is to a high standard in terms of depth and breadth to enable progression and/or transferability to other employers.

Unit 214 Preparing and using manual TIG or plasma-arc welding equipment

Unit level:	Level 2
GLH:	60
Unit aim:	This Employer Unit of Competence (EUC) has been developed by employers in the Maritime Defence Sector and is part of an overall development programme designed to meet the requirements of the Sector, the published Apprenticeship Standard and Employer Occupational Brief. This EUC identifies the training and development required in order that the apprentice can demonstrate that they are competent in being able to prepare the welding equipment and to ensure that all the leads/cables, hoses and torches are securely connected and free from damage. They will also need to obtain and check that all the workholding equipment is in a safe and usable condition. In preparing to weld, they will need to set and adjust the welding conditions in line with instructions and/or the welding procedure specification. They must operate the equipment safely and correctly, and make any necessary adjustments to settings in line with their permitted authority, in order to produce the welded joints to the required specification. On completion of the welding operations, they will be expected to check the quality of the welds using measuring equipment, visual examination and destructive testing techniques, as appropriate to the aspects being checked. They will need to be able to recognise welding defects, to take appropriate action to limit any faults that occur and to ensure that the finished workpiece is within the specification requirements. On completion of the welding activities, they will be expected to return all tools, equipment and workholding devices to their designated location and to leave the welding equipment and work area in a safe and tidy condition. Their responsibilities will require them to comply with health and safety requirements and organisational policy and procedures for the welding activities undertaken. They will need to take account of any potential difficulties or problems that may arise with the welding activities, and to seek appropriate help and advice in determining and implementing a suitable solution. They will work under a high level of supervision, whilst taking responsibility for their own actions and for the quality and accuracy of the work that they carry out. Their underpinning knowledge will provide an understanding of their work, and will enable them to apply appropriate manual TIG or plasma-arc welding techniques safely. They will understand the

	welding process, and its application, and will know about the equipment, materials and consumables, to the required depth to provide a sound basis for carrying out the activities to the required specification. They will understand the safety precautions required when working with the TIG or plasma-arc welding equipment, and with the associated tools and equipment. They will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace. They will be able to apply the appropriate behaviours required in the workplace to meet the job profile and overall company objectives, such as strong work ethic, positive attitude, team player, dependability, responsibility, honesty, integrity, motivation and commitment.
Relationship to NOS:	EUCL2F-014
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The apprentice must be able to:

1.1 work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines
1.2 demonstrate the required behaviours in line with the job role and company objectives
1.3 plan the welding activities before they start them
1.4 obtain and prepare the appropriate welding equipment and welding consumables
1.5 prepare and support the joint, using the appropriate methods
1.6 tack weld the joint at appropriate intervals, and check the joint for accuracy before final welding
1.7 weld the joint to the specified quality, dimensions and profile
1.8 use appropriate methods and equipment to check the quality, and that all dimensional and geometrical aspects of the weld are to the specification
1.9 deal promptly and effectively with problems within their control, and seek help and guidance from the relevant people if they have problems that they cannot resolve
1.10 shut down and make safe the welding equipment on completion of the welding activities

Learning outcome

The learner will:

2 Prepare for the TIG or plasma-arc welding process by carrying out **all** of the following:

2.1 adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations

2.2 check the condition of and correctly connect welding leads, earthing arrangements, hoses and welding torch

2.3 set and adjust the welding conditions/parameters, in accordance with the welding procedure specification

2.4 prepare the work area for the welding activities (such as positioning welding screens and fume extraction)

2.5 prepare the materials and joint in readiness for welding (such as cleaning of joint faces, grinding weld preparations, setting up the joint, supporting the joint)

2.6 make sure that the work area is maintained and left in a safe and tidy condition

Learning outcome

The learner will:

3 Use manual welding and related equipment, to include **one** of the following welding processes:

3.1 TIG

3.2 Plasma-arc.

Learning outcome

The learner will:

4 Use welding consumables appropriate to the material and application, to include **one** of the following:

4.1 AC current types

4.2 DC current types.

Learning outcome

The learner will:

5 Produce **three** of the following welded joints of at least 150mm long, by single or multi-run (as appropriate), with at least one stop and start included:

5.1 fillet lap joints

5.2 corner joints

5.3 Tee fillet joints

5.4 butt joints

And using **one** of the following methods:

5.5 with filler wire

5.6 without filler wire (autogenously).

Learning outcome

The learner will:

6 Produce joints in the following: **one** type of material from the following:

6.1 carbon steel
6.2 stainless steel
6.3 Aluminium

And **two** forms of material from the following:

6.4 sheet (less than 3mm)
6.5 pipe/tube
6.6 plate
6.7 Section
6.8 other forms

Learning outcome

The learner will:

7 Weld joints in good access situations, in **two** of the following BS EN ISO 6947 positions:

7.1 Flat (PA)
7.2 Vertical upwards (PF)
7.3 Horizontal vertical (PB)
7.4 Vertical downwards (PG)
7.5 Horizontal (PC)

Learning outcome

The learner will:

8 Check that the welded joint conforms to the specification, by checking **all** of the following:

8.1 dimensional accuracy
8.2 size and profile of weld
8.3 number of runs
8.4 alignment/squareness

Learning outcome

The learner will:

9 Carry out non-destructive testing of the welds, using **one** of the following:

9.1 dye penetrant
9.2 fluorescent penetrant
9.3 magnetic particle

Learning outcome

The learner will:

10 Carry out destructive tests on weld specimens, using **one** of the following:

10.1 macroscopic examination
10.2 nick break test
10.3 bend tests (such as face, root or side, as appropriate)

Learning outcome

The learner will:

11 Identify all of the following weld defects:

11.1 lack of continuity of the weld
11.2 uneven and irregular ripple formation
11.3 incorrect weld size or profile

Plus **four** more of the following:
11.4 undercutting
11.5 internal cracks
11.6 overlap
11.7 surface cracks
11.8 inclusions
11.9 lack of fusion
11.10 porosity
11.11 lack of penetration

Learning outcome

The learner will:

12 Produce welded joints which meet **all** of the following (with reference to BS 4872 Part 1 Weld test requirements):

12.1 welds meet the required dimensional accuracy
12.2 fillet welds are equal in leg length and slightly convex in profile (where applicable), with the size of the fillet equivalent to the thickness of the material welded

12.3 the weld contour is linear, of uniform profile, free from excessive undulations, with regular and even ripple

12.4 the welds are adequately fused, and there is minimal undercut, overlap and surface inclusions

12.5 weld finishes are built up to the full section of the weld

12.6 joins at stop/start positions merge smoothly, with no pronounced hump or crater in the weld surface

12.7 tack welds are blended in to form part of the finished weld, without excessive hump

12.8 corner joints have minimal burn through to the underside of the joint or, where appropriate, penetration is present to a maximum depth of 3mm for at least 75% of the joint

12.9 the weld surface is free from cracks, and substantially free from porosity, shrinkage cavities and trapped slag

12.10 the weld surface and adjacent parent metal is substantially free from arcing or chipping marks

Learning outcome

The learner will:

Knowledge and understanding - The apprentice must know and understand:

13.1 the safe working practices and procedures to be followed when preparing and using TIG or plasma-arc welding equipment (such as general workshop safety; appropriate personal protective equipment (PPE); fire prevention; protecting other workers from the effects of the welding arc; safety in enclosed/confined spaces; fume extraction/control)

13.2 the hazards associated with TIG and plasma-arc welding (such as live electrical components; poor earthing; the electric arc; fumes and gases; hot metal; welding in enclosed spaces; slips, trips and falls), and how they can be minimised

13.3 the personal protective equipment to be worn for the welding activities (such as correctly fitting overalls; leather aprons, welding gloves/gauntlets; safety boots; head/eye shield with correct shade of filter)

13.4 the importance of applying the appropriate behaviours in the workplace and the implications for both the apprentice and the business if these are not adhered to

13.5 the correct handling and storage of gas cylinders (such as manual handling and use of cylinder trolley, leak detection procedures, relevant BCGA codes of practice, cylinder identification, gas pressures, cylinder and equipment safety features)

13.6 how to use and extract information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS or ISO standards) in relation to work undertaken

13.7 the manual TIG or plasma-arc welding process (such as basic principles of fusion welding; the major parts of the welding equipment and their function)

13.8 types, selection and application of filler wires and welding electrodes

13.9 reasons for using shielding gases, and the types and application of the various gases

13.10 gas pressures and flow rates (in relationship to the type of material being welded)

13.11 the types of welded joints to be produced (such as lap joints, corner joints, tee joints and butt welds)

13.12 terminology used for the appropriate welding positions

13.13 how to prepare the materials in readiness for the welding activity (such as ensuring that the material is free from excessive surface contamination - such as rust, scale, paint, oil/grease and moisture; ensuring edges to be welded are correctly prepared - such as made flat, square or bevelled)

13.14 how to set up and restrain the joint, and the tools and techniques to be used (such as the use of jigs and fixtures, restraining devices such as clamps and weights/blocks; setting up the joint in the correct position and alignment)

13.15 tack welding size and spacing (in relationship to material thickness)

13.16 checks to be made prior to welding (such as confirming the correct set-up of the joint; the condition of electrical connections, welding return and earthing arrangements; operating parameters)

13.17 the techniques of operating the welding equipment to produce a range of joints in the various joint positions (such as fine adjustment of parameters; correct manipulation of the torch; blending in stops/starts and tack welds)

13.18 how to control distortion (such as welding sequence; deposition technique)

13.19 problems that can occur with the welding activities (such as causes of distortion and methods of control; effects of welding on materials and sources of weld defects), and how these can be overcome

13.20 how to close down the welding equipment safely and correctly

13.21 the safe working practices and procedures to be adopted when preparing the welds for examination (such as handling hot materials, using chemicals for cleaning and etching, using equipment to fracture welds)

13.22 how to prepare the welds for examination (such as removing surface irregularities; cleaning the weld, polishing and making saw cuts on welds to be fracture tested)

13.23 how to check the welded joints for uniformity, alignment, position, weld size and profile

13.24 the various procedures for visual examination of the welds for cracks, porosity and slag inclusions (such as dye penetrant, fluorescent penetrant; magnetic particle testing)

13.25 the various procedures for carrying out destructive tests on the welds (such as macroscopic examination, bend tests, nick break tests)

13.26 methods of removing a specimen of weld from a suitable position in the joint (such as a stop/start position) using a non-thermal process (such as hand saws, power saws, abrasive discs)

13.27 how to examine the welds after the tests and how to check for such defects as the degree of penetration and fusion, inclusions, porosity, cracks, undercut and overlap, uneven and irregular ripple formation

13.28 when to act on their own initiative and when to seek help and advice from others

13.29 the importance of leaving the work area and equipment in a safe condition on completion of the welding activities (such as isolation of electrical supplies, safely storing equipment and consumables, removing and disposing of waste)

Unit 214 Preparing and using manual TIG or plasma-arc welding equipment

Supporting Information

Specific Standard Requirements

Welded joints must be at least 150mm long, using single or multi-run welds (as appropriate), with at least **one** stop and start included as specified in LO 5 of the skills requirement section.

Unit guidance

Assessment requirements have been developed by employers for the occupational competency units and qualifications for Advanced Manufacturing and Engineering Sector. These assessment requirements are set down in the relevant Qualification Assessment Strategies available from Semta. Please contact Customer.Services@semta.org.uk quoting Advanced Manufacturing and Engineering Trailblazer Qualification Assessment Strategy and specifying the title of the relevant Trailblazer Standard

Although all of the content and assessment requirements must be met in full employers can tailor the training outcomes to ensure that the content of the programme is specific to their requirements in terms of products, processes, procedures, tools, equipment, materials, documentation and information systems.

This will allow each organisation to develop their own specific and tailored apprentice training programme that meets their own business requirements whilst at the same time ensuring that the overall generic content is to a high standard in terms of depth and breadth to enable progression and/or transferability to other employers

Unit 215 Preparing and using semi-automatic MIG, MAG and flux cored arc welding equipment

Unit level:	Level 2
GLH:	60
Unit aim:	This Employer Unit of Competence (EUC) has been developed by employers in the Maritime Defence Sector and is part of an overall development programme designed to meet the requirements of the Sector, the published Apprenticeship Standard and Employer Occupational Brief. This EUC identifies the training and development required in order that the apprentice can demonstrate that they are competent in being able to set and operate a broad range of basic semi-automatic MIG, MAG or flux cored-wire arc welding equipment that will prepare them for entry into the engineering or manufacturing sectors, creating a progression between education and employment, or that will provide a basis for the development of additional skills and occupational competences in the working environment. They will be expected to prepare the welding equipment and to ensure that all leads/cables, shielding gas system, hoses and wire feed mechanisms are securely connected and free from damage. They will also need to obtain and check that all the workholding equipment is in a safe and usable condition. In preparing to weld, they will need to set and adjust the welding conditions, in line with instructions and/or the welding procedure specification.They must operate the equipment safely and correctly, and make any necessary adjustments to settings in line with their permitted authority, in order to produce the welded joints to the required specification. On completion of the welding operations, they will be expected to check the quality of the welds using measuring equipment, visual examination and destructive testing techniques, as appropriate to the aspects being checked. They will need to be able to recognise welding defects, to take appropriate action to limit any faults that occur and to ensure that the finished workpiece is within the specification requirements. On completion of the welding activities, they will be expected to return all tools, equipment and workholding devices to their designated location, and to leave the welding equipment and work area in a safe and tidy condition. Their responsibilities will require them to comply with health and safety requirements and organisational policy and procedures for the welding activities undertaken. They will need to take account of any potential difficulties or problems that may arise with the

	welding activities, and to seek appropriate help and advice in determining and implementing a suitable solution. They will work under a high level of supervision, whilst taking responsibility for their own actions and for the quality and accuracy of the work that they carry out. Their underpinning knowledge will provide an understanding of their work, and will enable them to apply appropriate semi-automatic MIG, MAG or flux cored-wire welding techniques safely. They will understand the welding process, and its application, and will know about the equipment, materials and consumables, to the required depth to provide a sound basis for carrying out the activities to the required specification. They will understand the safety precautions required when working with the MIG, MAG or flux cored-wire welding equipment, and with the associated tools and equipment. They will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace.
Relationship to NOS:	EUCL2F-015
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The apprentice must be able to:

1.1 work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines
1.2 demonstrate the required behaviours in line with the job role and company objectives
1.3 plan the welding activities before they start them
1.4 obtain and prepare the appropriate welding equipment and welding consumables
1.5 prepare and support the joint, using the appropriate methods
1.6 tack weld the joint at appropriate intervals, and check the joint for accuracy before final welding
1.7 weld the joint to the specified quality, dimensions and profile
1.8 use appropriate methods and equipment to check the quality, and that all dimensional and geometrical aspects of the weld are to the specification
1.9 deal promptly and effectively with problems within their control, and seek help and guidance from the relevant people if they have problems that they cannot resolve
1.10 shut down and make safe the welding equipment on completion of the welding activities

Learning outcome

The learner will:

2 Prepare for the MIG, MAG or flux cored-wire arc welding process by carrying out **all** of the following:

2.1 adhere to procedures or systems in place for risk assessment, COSHH, Personal Protective Equipment (PPE) and other relevant safety regulations

2.2 check the condition of, and correctly connect, welding leads/cables, hoses, shielding gas supply and wire feed mechanisms

2.3 set and adjust the welding conditions/parameters, in accordance with the welding procedure specification

2.4 prepare the work area for the welding activities (such as positioning welding screens and fume extraction)

2.5 prepare the materials and joint in readiness for welding (such as cleaning of joint faces, grinding weld preparations, setting up the joint, supporting the joint)

2.6 make sure the work area is maintained and left in a safe and tidy condition

Learning outcome

The learner will:

3 Use manual/semi-automatic welding and related equipment to include **one** of the following:

3.1 MIG

3.2 MAG

3.3 Flux cored wire welding equipment.

Learning outcome

The learner will:

4 Use consumables appropriate to the material and application, to include **one** of the following wire types:

4.1 solid wire

4.2 cored wire

Plus **one** of the following types of shielding gas:

4.3 inert

4.4 active

Learning outcome

The learner will:

5 Produce **three** of the following welded joints of at least 150mm long, by single or multi-run (as appropriate), with at least one stop and start included:

5.1 fillet lap joints

5.2 corner joints

5.3 Tee fillet joints
5.4 butt joints

Learning outcome

The learner will:

6 Produce joints as follows: **one** type of material from the following:

6.1 carbon steel
6.2 stainless steel
6.3 aluminium

And **two** forms of material from the following:

6.4 plate
6.5 sheet (less than 3mm)
6.6 pipe/tube
6.7 section
6.8 other forms.

Learning outcome

The learner will:

7 Weld joints in good access situations in **two** of the following BS EN ISO 6947 positions:

7.1 Flat (PA)
7.2 Vertical upwards (PF)
7.3 Horizontal vertical (PB)
7.4 Vertical downwards (PG)
7.5 Horizontal (PC).

Learning outcome

The learner will:

8 Check that the welded joint conforms to the specification, by checking **all** of the following:

8.1 dimensional accuracy
8.2 size and profile of weld
8.3 number of runs
8.4 alignment/squareness

Learning outcome

The learner will:

9 Carry out non-destructive testing of the welds, using **one** of the following:

9.1 dye penetrant
9.2 fluorescent penetrant
9.3 magnetic particle.

Learning outcome

The learner will:

10 Carry out destructive tests on weld specimens using **one** of the following:

10.1 macroscopic examination
10.2 nick break test
10.3 bend tests (such as face, root or side, as appropriate).

Learning outcome

The learner will:

11 Identify **all** of the following weld defects:

11.1 lack of continuity of the weld
11.2 uneven and irregular ripple formation
11.3 incorrect weld size or profile

Plus **four** more of the following:

11.4 undercutting
11.5 internal cracks
11.6 overlap
11.7 surface cracks
11.8 inclusions
11.9 lack of fusion
11.10 porosity
11.11 lack of penetration

Learning outcome

The learner will:

12 Produce welded joints which meet **all** of the following (with reference to BS 4872 Part 1 Weld test requirements):

12.1 welds meet the required dimensional accuracy

12.2 fillet welds are equal in leg length and slightly convex in profile, with the size of the fillet equivalent to the thickness of the material welded

12.3 the weld contour is linear, of uniform profile, free from excessive undulations, with regular and even ripple

12.4 the welds are adequately fused, and there is minimal undercut, overlap and surface inclusions

12.5 weld finishes are built up to the full section of the weld

12.6 joins at stop/start positions merge smoothly, with no pronounced hump or crater in the weld surface

12.7 tack welds are blended in to form part of the finished weld, without excessive hump

12.8 corner joints have minimal burn through to the underside of the joint or, where appropriate, penetration is present to a maximum depth of 3mm for at least 75% of the joint

12.9 the weld surface is free from cracks, and substantially free from porosity, shrinkage cavities and trapped slag

12.10 the weld surface and adjacent parent metal is substantially free from arcing or chipping marks

Learning outcome

The learner will:

13 Knowledge and understanding - The apprentice must know and understand:

13.1 the safe working practices and procedures to be followed when preparing and using MIG, MAG or flux cored wire arc welding equipment (such as general workshop safety; appropriate personal protective equipment (PPE); fire prevention; protecting other workers from the effects of the welding arc; safety in enclosed/confined spaces; fume extraction/control)

13.2 the hazards associated with MIG, MAG or flux cored-wire arc welding (such as live electrical components; poor earthing; the electric arc; fumes and gases; spatter; hot slag and metal; grinding and mechanical metal/slag removal; elevated working; enclosed spaces; slips, trips and falls), and how they can be minimised

13.3 the personal protective equipment to be worn for the welding activities (such as correctly fitting overalls; leather aprons, welding gloves/gauntlets; safety boots; head/eye shield with correct shade of filter)

13.4 the correct handling and storage of gas cylinders (such as manual handling and use of cylinder trolley, leak detection procedures, relevant BCGA codes of practice, cylinder identification, gas pressures, cylinder and equipment safety features)

13.5 the importance of applying the appropriate behaviours in the workplace and the implications for both the apprentice and the business if these are not adhered to

13.6 how to use and extract information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS or ISO standards) in relation to work undertaken

13.7 the semi-automatic MIG, MAG or flux cored wire arc welding process (such as basic principles of fusion welding, power sources, the major parts of the welding equipment and their function)

13.8 types, selection and application of electrode wires (such as solid and cored)

13.9 reasons for using shielding gases, and the types and application of the various gases

13.10 gas pressures and flow rates (in relation to the type of material being welded)

13.11 the types of welded joints to be produced (such as lap joints, corner joints, tee joints and butt welds)

13.12 terminology used for the appropriate welding positions

13.13 how to prepare the materials in readiness for the welding activity (such as ensuring that the material is free from excessive surface contamination - such as rust, scale, paint, oil/grease and moisture; ensuring edges to be welded are correctly prepared - such as made flat, square or bevelled)

13.14 how to set up and restrain the joint, and the tools and techniques to be used (such as the use of jigs and fixtures, restraining devices - such as clamps and weights/blocks; setting up the joint in the correct position and alignment)

13.15 tack welding size and spacing (in relation to material thickness)

13.16 checks to be made prior to welding (such as confirming the correct set-up of the joint; the condition of electrical connections, welding return and earthing arrangements; wire feed mechanisms; gas supply; operating parameters)

13.17 the techniques of operating the welding equipment to produce a range of joints in the various joint positions (such as fine adjustment of parameters; correct manipulation of the welding gun; blending in stops/starts and tack welds)

13.18 methods/modes of metal transfer and their uses (such as dip, globular, free flight, spray and pulsed)

13.19 how to close down the welding equipment safely and correctly

13.20 how to control distortion (such as welding sequence; deposition technique)

13.21 problems that can occur with the welding activities (such as causes of distortion and methods of control; effects of welding on materials and sources of weld defects), and how these can be overcome

13.22 the safe working practices and procedures to be adopted when preparing the welds for examination (such as handling hot materials, using chemicals for cleaning and etching, using equipment to fracture welds)

13.23 how to prepare the welds for examination (such as removing surface irregularities; cleaning the weld, polishing and making saw cuts on welds to be break tested)

13.24 how to check the welded joints for uniformity, alignment, position, weld size and profile

13.25 the various procedures for visual examination of the welds for cracks, porosity and slag inclusions (such as dye penetrant, fluorescent penetrant; magnetic particle testing)

13.26 the various procedures for carrying out destructive tests on the welds (such as macroscopic examination, bend tests, nick break tests)

13.27 methods of removing a specimen of weld from a suitable position in the joint (such as a stop/start position), using a non-thermal process (such as hand saws, power saws, abrasive discs)

13.28 how to examine the welds after the tests, and how to check for such defects as the degree of penetration and fusion, inclusions, porosity, cracks, undercut and overlap, uneven and irregular ripple formation

13.29 when to act on their own initiative and when to seek help and advice from others

13.30 the importance of leaving the work area and equipment in a safe condition on completion of the welding activities (such as isolation of electrical supplies; safely storing welding cables and electrode holders; storing electrodes; removing and disposing of waste)

Unit 215 Preparing and using semi-automatic MIG, MAG and flux cored arc welding equipment

Supporting Information

Specific Standard Requirements

Welded joints must be at least 150mm long, using single or multi-run welds (as appropriate), with at least **one** stop and start included as specified in LO 5 of the skills requirement section.

Unit guidance

Assessment requirements have been developed by employers for the occupational competency units and qualifications for Advanced Manufacturing and Engineering Sector. These assessment requirements are set down in the relevant Qualification Assessment Strategies available from Semta. Please contact Customer.Services@semta.org.uk quoting Advanced Manufacturing and Engineering Trailblazer Qualification Assessment Strategy and specifying the title of the relevant Trailblazer Standard.

Although all of the content and assessment requirements must be met in full employers can tailor the training outcomes to ensure that the content of the programme is specific to their requirements in terms of products, processes, procedures, tools, equipment, materials, documentation and information systems.

This will allow each organisation to develop their own specific and tailored apprentice training programme that meets their own business requirements whilst at the same time ensuring that the overall generic content is to a high standard in terms of depth and breadth to enable progression and/or transferability to other employers

Unit 216 Preparing and using manual flame brazing and braze welding equipment

Unit level:	Level 2
GLH:	60
Unit aim:	This Employer Unit of Competence (EUC) has been developed by employers in the Maritime Defence Engineering Sector and is part of an overall development programme designed to meet the requirements of the Sector, the published Apprenticeship Standard and Employer Occupational Brief. This EUC identifies the training and development required in order that the apprentice can demonstrate that they are competent in being able to prepare the manual flame brazing or braze welding equipment, and to check that all hoses and equipment are correctly connected, free from leaks or damage, and are ready for use. They will also need to obtain and check that all the workholding equipment required is in a safe and usable condition. They must operate the equipment safely and correctly, and set and adjust the brazing or braze welding conditions, in line with instructions and safe operating procedures. They will be expected to check the quality of the brazed or braze welded joints by visual examination and destructive testing techniques, as appropriate to the aspects being checked. They will need to be able to recognise brazing or braze welding defects, to take appropriate action to limit any faults that occur and to ensure that the finished workpiece is within the specification requirements. On completion of the brazing or braze welding activities, they will be expected to return all tools, equipment and workholding devices to their designated location, and to leave the brazing or braze welding equipment and work area in a safe and tidy condition. Their responsibilities will require them to comply with health and safety requirements and organisational policy and procedures for the brazing or braze welding activities undertaken. They will need to take account of any potential difficulties or problems that may arise with the brazing or braze welding activities, and to seek appropriate help and advice in determining and implementing a suitable solution. They will work under a high level of supervision, whilst taking responsibility for their own actions and for the quality and accuracy of the work that they carry out. Their underpinning knowledge will provide an understanding of their work, and will enable them to apply appropriate manual flame brazing or braze welding techniques safely. They will understand the brazing or braze welding process, and its application, and will know about the equipment, materials and consumables, to the required depth to provide a sound basis for

	carrying out the activities to the required specification. They will understand the safety precautions required when working with the manual flame brazing or braze welding equipment, and with the associated tools and equipment. They will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace. They will be able to apply the appropriate behaviours required in the workplace to meet the job profile and overall company objectives, such as strong work ethic, positive attitude, team player, dependability, responsibility, honesty, integrity, motivation and commitment.
Relationship to NOS:	EUCL2F-016
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The apprentice must be able to:

1.1 work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines
1.2 demonstrate the required behaviours in line with the job role and company objectives
1.3 plan the brazing or braze welding activities before they start them
1.4 obtain and prepare the appropriate manual flame brazing or braze welding equipment and consumables
1.5 prepare and support the joint, using the appropriate methods
1.6 tack the joint at appropriate intervals, and check the joint for accuracy before final brazing or braze welding
1.7 produce the brazed or braze welded joints of the required quality and of specified dimensional accuracy
1.8 use appropriate methods and equipment to check the quality, and that all dimensional and geometrical aspects of the joint are to the specification
1.9 deal promptly and effectively with problems within their control, and seek help and guidance from the relevant people if they have problems that they cannot resolve
1.10 shut down and make safe the brazing or braze welding equipment on completion of the activities

Learning outcome

The learner will:

2 Prepare for the manual flame brazing or braze welding process by carrying out **all** of the following:

2.1 adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations
2.2 check that hoses, regulators and valves are securely connected and free from leaks and damage
2.3 check/fit the correct size gas nozzle to the torch
2.4 check that a flashback arrestor and check valves are fitted
2.5 set appropriate gas pressures
2.6 use the correct procedure for lighting, adjusting and extinguishing the flame
2.7 use appropriate and safe procedures for handling and storing of gas cylinders (where appropriate)
2.8 prepare the work area for the activities (such as positioning screens and fume extraction equipment)
2.9 prepare the materials and joint in readiness for brazing or braze welding (such as cleaning of joint faces, setting up the joint, supporting the joint)
2.10 make sure the work area is maintained and left in a safe and tidy condition

Learning outcome

The learner will:

3 Set up, check, adjust and use **both** of the following manual flame processes and related equipment:

3.1 brazing
3.2 braze welding

Learning outcome

The learner will:

4 Use specified consumables appropriate to the parent metals, to include **one** of the following:

4.1 self-fluxing rods
4.2 powder/paste flux and rods
4.3 flux coated/impregnated rods

Learning outcome

The learner will:

5 Produce joints in **two** of the following materials

5.1 copper to copper
5.2 copper to carbon

5.3 brass to brass
5.4 copper to brass
5.5 other appropriate materials

Learning outcome

The learner will:

6 Produce joints in good access situations, covering **two** of the following:

6.1 lap joints
6.2 Tee joints
6.3 corner joints
6.4 butt joints
6.5 socket joints

Learning outcome

The learner will:

7 Produce joints in the following positions:

For brazing, use **two** of the following:
7.1 horizontal flow
7.2 vertical up flow
7.3 vertical down flow

For braze welding, use **one** of the following:
7.4 flat position
7.5 horizontal-vertical position

Learning outcome

The learner will:

8 Produce joints in **both** of the following:

8.1 sheet/plate
8.2 pipe/tube

Learning outcome

The learner will:

9 Carry out destructive tests on weld specimens, using **one** of the following:

9.1 macroscopic examination
9.2 nick break test

Learning outcome

The learner will:

10 Identify **all** of the following brazing and braze welding defects:

10.1 lack of continuity of the brazed and braze welded joint
10.2 uneven and irregular ripple formation
10.3 incorrect joint size or profile

Plus **three** more of the following:

10.4 overlap
10.5 surface cracks
10.6 inclusions
10.7 lack of penetration
10.8 porosity

Learning outcome

The learner will:

11 Produce brazed and braze welded components which meet **all** of the following:

11.1 achieve the specified joint quality
11.2 meet the required dimensional accuracy within specified tolerance
11.3 are of good appearance, free from flux residues and excess filler metal

Learning outcome

The learner will:

12 Knowledge and understanding - The apprentice must know and understand:

12.1 the safe working practices and procedures to be observed when working with manual flame gas brazing and braze/braze welding equipment (such as general workshop safety; appropriate personal protective equipment; fire and explosion prevention, protecting other workers, safety in enclosed/confined spaces; fume extraction/control)
12.2 the hazards associated with flame brazing and braze/braze welding (such as naked flames, explosive gas mixes, oxygen enrichment, fumes and gasses, hot metal, enclosed spaces), and how they can be minimised

12.3 the personal protective equipment to be worn for the brazing and braze welding activities (such as correctly fitting overalls; leather aprons, eye protection with the appropriate shade of filter)

12.4 the correct handling and storage of gas cylinders (such as manual handling and use of cylinder trolley, leak detection procedures, relevant BCGA codes of practice, cylinder identification, gas pressures, cylinder and equipment safety features)

12.5 the importance of applying the appropriate behaviours in the workplace and the implications for both the apprentice and the business if these are not adhered to

12.6 how to use and extract information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS or ISO standards) in relation to work undertaken

12.7 the manual flame brazing and braze welding process (such as basic principles of the process, wetting and capillary flow, deposition of brazed beads, role of fluxes)

12.8 types of filler metal and fluxes; forms of filler metal

12.9 the types of joints to be produced (such as lap, tee, corner, butt)

12.10 setting up and supporting the joint (such as methods of cleaning joint faces; use of jigs and fixtures, restraining devices; self-locating joints; pre-placement of filler metal and flux)

12.11 preparing the brazing and braze welding equipment, and the checks to be made to ensure that it is safe and ready to use (such as connection of hoses, torch, flashback arrestors, hose check valves and regulators)

12.12 checking hose connections for leaks, and the methods that are used

12.13 setting gas working pressures; reading the gauges to establish content and pressures

12.14 how to prepare the materials in readiness for the brazing and braze welding activity (such as ensuring that the material is free from surface contamination -such as rust, scale, paint, oil/grease and moisture; ensuring edges to be brazed/braze welded are correctly prepared - such as made flat, square)

12.15 the correct use of the torch to produce a range of joints (such as selection of nozzle, adjustment of the flame, application of flux and the correct manipulation of torch and filler wire)

12.16 control of heat input to prevent filler material and parent material faults (such as brazing/braze welding sequence; deposition technique)

12.17 the safe and correct sequence for shutting down the brazing or braze welding equipment (such as sequence of turning off the gases, extinguishing the flame and closing valves on gas supply/cylinders)

12.18 the importance of complying with job instructions and the joining procedure specification

12.19 problems that can occur with the joining activities (such as incorrect heat pattern (hot or cold spots); fluxing technique; formation of oxides during the process; distortion of the joint due to overheating), and how these can be overcome

12.20 methods of removing flux residues and cleaning the finished joint

12.21 the safe working practices and procedures to be adopted when preparing the brazed and braze welded joints for examination (such as handling hot materials, using chemicals for cleaning, using equipment to fracture joints)

12.22 how to prepare the joints for examination (such as removing surface irregularities; cleaning and degreasing the brazed or braze welded joint, making saw cuts on joints to be fracture tested)

12.23 how to check the brazed or braze welded joints for uniformity, alignment, position, joint size and profile

12.24 the various procedures for carrying out destructive tests on the joints (such as macroscopic examination and nick break tests)

12.25 how to examine the joints after the tests and check for such defects as the degree of penetration, inclusions, porosity, cracks

12.26 when to act on their own initiative and when to seek help and advice from others

12.27 the importance of leaving the work area and equipment in a safe condition on completion of the brazing or braze welding activities (such as isolation of gas cylinders; safely storing cylinders, hoses and torches; storing filler rods; removing and disposing of waste)

Unit 216 Preparing and using manual flame brazing and braze welding equipment

Supporting Information

Specific Standard Requirements

Brazed or braze welded joints must be at least 100mm long (except for joints in pipe or tube).

Unit guidance

Assessment requirements have been developed by employers for the occupational competency units and qualifications for Advanced Manufacturing and Engineering Sector. These assessment requirements are set down in the relevant Qualification Assessment Strategies available from Semta. Please contact Customer.Services@semta.org.uk quoting Advanced Manufacturing and Engineering Trailblazer Qualification Assessment Strategy and specifying the title of the relevant Trailblazer Standard

Although all of the content and assessment requirements must be met in full employers can tailor the training outcomes to ensure that the content of the programme is specific to their requirements in terms of products, processes, procedures, tools, equipment, materials, documentation and information systems.

This will allow each organisation to develop their own specific and tailored apprentice training programme that meets their own business requirements whilst at the same time ensuring that the overall generic content is to a high standard in terms of depth and breadth to enable progression and/or transferability to other employers

Unit 217 Wiring and testing electrical equipment and circuits

Unit level:	Level 2
GLH:	60
Unit aim:	This Employer Unit of Competence (EUC) has been developed by employers in the Maritime Defence Sector and is part of an overall development programme designed to meet the requirements of the Sector, the published Apprenticeship Standard and Employer Occupational Brief. This EUC identifies the training and development required in order that the apprentice can demonstrate that they are competent in being able to wire and terminate of a range of cables, such as single and multicore cables, screened cables, fire resistant and armoured cables. They will be required to make a variety of terminations and to connect a range of electrical components, such as switches/switchgear, distribution panels, motors and starters, control systems, sensors and actuators, safety devices, and luminaires. They will be required to select the appropriate tools, materials and equipment to use, based on the operations to be performed and the components to be connected. They will be expected to use appropriate tools and techniques for the wiring of the various electrical components and connectors that make up the electrical system/circuit. In addition, they will be expected to make all necessary electrical connections to the switches, relays, sensors/actuators and other devices, as appropriate to the equipment and circuit being produced. The wiring and testing activities will include making all necessary checks and adjustments to the circuit, including continuity, polarity, insulation resistance values, and ensuring that the equipment functions to the specification. Their responsibilities will require them to comply with health and safety requirements and organisational policy and procedures for the wiring and testing activities undertaken. They will need to take account of any potential difficulties or problems that may arise with the wiring and testing activities, or with the tools and equipment used, and to seek appropriate help and advice in determining and implementing a suitable solution. They will work under a high level of supervision, whilst taking responsibility for their own actions and for the quality and accuracy of the work that they carry out. Their underpinning knowledge will provide an understanding of their work, and will enable them to apply appropriate electrical wiring and testing procedures and techniques safely. They will

	understand the wiring and testing methods and procedures used, and their application, and will know about the various cables and components used to produce the circuits, to the required depth to provide a sound basis for carrying out the activities to the required specification. They will understand the safety precautions required when carrying out the wiring and testing activities, especially those for ensuring the safe isolation of the equipment and circuits produced. They will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace. They will be able to apply the appropriate behaviours required in the workplace to meet the job profile and overall company objectives, such as strong work ethic, positive attitude, team player, dependability, responsibility, honesty, integrity, motivation and commitment.
Relationship to NOS:	EUCL2F-017
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The apprentice must be able to:

1.1 work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines

1.2 demonstrate the required behaviours in line with the job role and company objectives

1.3 plan the wiring and testing activities before they start them

1.4 use appropriate sources to obtain the required specifications, circuit diagrams and test information

1.5 obtain the correct tools and equipment for the wiring and testing operations, and check that they are in a safe and usable condition

1.6 mount and secure the electrical components safely and correctly, to meet specification requirements

1.7 install and terminate the cables to the appropriate connections on the components

1.8 use appropriate test methods and equipment to check that the completed circuit is safe and meets all aspects of the specification

1.9 deal promptly and effectively with problems within their control, and seek help and guidance from the relevant people if they have problems that they cannot resolve

1.10 leave the work area in a safe and tidy condition on completion of the wiring and testing activities

Learning outcome

The learner will:

2 Carry out **all** of the following activities during the wiring and testing activities:

2.1 adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations
2.2 ensure the safe isolation from all service supplies during the wiring and testing activities
2.3 follow job instructions, circuit drawings and test procedures at all times
2.4 check that tools and test instruments to be used are within calibration (where applicable), and are in a safe and usable condition, including PAT tested
2.5 ensure that the electrical system is kept free from foreign objects, dirt or other contamination
2.6 where appropriate, apply procedures and precautions to eliminate electrostatic discharge (ESD) hazards
2.7 return all tools and equipment to the correct location on completion of the wiring and testing activities

Learning outcome

The learner will:

3 Wire circuits using **three** of the following types of cables:

3.1 single core
3.2 data/communication
3.3 ribbon cables
3.4 multicore
3.5 fibre-optics
3.6 mineral insulated
3.7 PVC twin and earth
3.8 screened
3.9 armoured
3.10 flexible (such as cotton or rubber covered)
3.11 coaxial
3.12 wiring loom/harness.

Learning outcome

The learner will:

4 Connect up **ten** of the following electrical modules/components to produce circuits:

4.1 isolators
4.2 blowers

4.3 cable connectors
4.4 switches
4.5 lamp holders
4.6 fuses
4.7 sockets
4.8 panel lamps
4.9 circuit breakers
4.10 contactors
4.11 luminaires
4.12 sensors
4.13 motor starters
4.14 ballast chokes
4.15 actuators
4.16 solenoids
4.17 consumer units
4.18 junction boxes
4.19 relays
4.20 residual current device (RCD)
4.21 terminal blocks
4.22 alarm devices
4.23 instruments
4.24 electronic modules/units
4.25 motors
4.26 transformers
4.27 control devices
4.28 pumps
4.29 panels or sub-assemblies
4.30 heaters
4.31 fibre termination boxes/junctions
4.32 other electrical components

Learning outcome

The learner will:

5 Apply wiring methods and techniques to include **five** of the following:

5.1 positioning and securing of equipment and components
5.2 levelling and alignment of components
5.3 determining current rating and lengths of cables required
5.4 securing by using mechanical fixings (such as screws, nuts and bolts)
5.5 laying in cables without twisting or plaiting
5.6 feeding cables into conduit without twisting or plaiting
5.7 leaving sufficient slack for termination and movement

Learning outcome

The learner will:

6 Carry out **eight** of the following cable termination activities:

6.1 stripping cable sheaths without damage to conductor insulation
6.2 terminating mineral insulated cables
6.3 removing cable insulation
6.4 sealing/protecting cable connections
6.5 connecting accessories (such as plugs, sockets multi-way connectors
6.6 attaching suitable cable identification
6.7 making mechanical/screwed/clamped connections
6.8 crimping (such as spade end, loops, tags and pins)
6.9 soldering and de-soldering
6.10 securing wires and cables (such as clips, plastic strapping, lacing, harnessing)
6.11 terminating armoured cables
6.12 heat shrinking (devices and boots)
6.13 earth bonding
6.14 cable glands and grips

Learning outcome

The learner will:

7 Wire up **five** of the following electrical systems:

7.1 lighting circuits
7.2 air conditioning control circuits
7.3 power circuits
7.4 refrigeration control circuits
7.5 motor start and control
7.6 heating/boiler control circuits
7.7 heating or ventilating
7.8 power generation and control circuits
7.9 starting and ignition system/components
7.10 instrumentation and control circuits
7.11 emergency lighting systems
7.12 alarm systems (such as fire, process control)
7.13 communication systems
7.14 electro-pneumatic or electro-hydraulic control circuits
7.15 computer systems
7.16 other control circuits (such as pumps, fans, blowers, extractors)
7.17 other specific electrical circuits

Learning outcome

The learner will:

8 Use **two** of the following test instruments during the wiring and testing activities:

8.1 multimeter
8.2 earth-loop impedance tester
8.3 insulation resistance tester
8.4 polarity tester/indicator
8.5 RCD tester
8.6 other specific test equipment to be specified by the employer

Learning outcome

The learner will:

9 Carry out checks and adjustments, appropriate to the equipment and circuits being wired, to include **all** of the following:

9.1 making visual checks (such as completeness, signs of damage, incorrect termination)
9.2 movement checks (such as loose fittings and connections)
9.3 testing that the equipment operates to the circuit specification
9.4 carrying out fault finding techniques (such as half-split, input/output, unit substitution)

Plus **three** more from the following:

9.5 protective conductor resistance values
9.6 load current
9.7 power rating
9.8 insulation resistance values
9.9 polarity
9.10 frequency values
9.11 continuity
9.12 resistance
9.13 inductance
9.14 voltage levels
9.15 capacitance
9.16 RCD disconnection time
9.17 specialised tests (such as speed, sound, light, temperature)

Learning outcome

The learner will:

10 Produce electrical circuits in accordance with **two** of the following standards:

10.1 BS 7671/IET wiring regulations

10.2 other BS and/or ISO standards

10.3 company standards and procedures

Learning outcome

The learner will:

11 Knowledge and understanding - The apprentice must know and understand:

11.1 the specific safety practices and procedures that they need to observe when wiring and testing electrical equipment (including any specific legislation, regulations or codes of practice for the activities, equipment or materials)

11.2 the hazards associated with wiring and testing electrical equipment, and with the tools and equipment used, (such as using sharp instruments for stripping cable insulation), and how they can be minimised

11.3 the importance of wearing appropriate protective clothing and equipment (PPE), and keeping the work area safe and tidy

11.4 the specific safety practices and procedures that they need to observe when wiring and testing electrical equipment (including any specific legislation, regulations or codes of practice for the activities, equipment or materials)

11.5 how to reduce the risks of an electric shock (such as insulated tools, rubber mating and isolating transformers)

11.6 the importance of applying the appropriate behaviours in the workplace and the implications for both the apprentice and the business if these are not adhered to

11.7 the interpretation of circuit diagrams, wiring diagrams, and other relevant specifications (including BS and ISO schematics, wiring regulations, symbols and terminology)

11.8 the basic principles of operation of the equipment/circuits being produced, and the purpose of the individual modules/components used

11.9 the different types of cabling and their application (such as multicore cables, single core cables, solid and multi- stranded cables, steel wire armoured (SWA), mineral insulated (MI), screened cables, data/communications cables, fibre-optics)

11.10 the application and use of a range of electrical components (such as plugs, switches, sockets, lighting and fittings, junction boxes, consumer units, relays, solenoids, transformers, sensors and actuators)

11.11 the application and use of circuit protection equipment (such as fuses and other overload protection devices, trips, residual current device (RCD))

11.12 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)

11.13 methods of mounting and securing electrical equipment/components to various surfaces (such as the use of nuts and bolts, screws and masonry fixing devices)

11.14 checking that the positions selected for mounting the components do not interfere with or damage existing services (such as cable harnesses, pipework or electricity supplies)

11.15 methods of laying in or drawing cables into conduit, trunking and traywork systems, and the need to ensure the cables are not twisted or plaited

11.16 the techniques used to terminate electrical equipment (such as plugs and sockets; soldering; screwed, clamped and crimped connections, glands and sealed connectors)

11.17 the use of BS7671/IET wiring regulations when selecting wires and cables and when carrying out tests on systems

11.18 methods of attaching markers/labels to components or cables to assist with identification (such as colour coding conductors, using coded tabs)

11.19 the tools and equipment used in the wiring and testing activities (including the use of cable stripping tools, crimping tools, soldering irons and gland connecting tools)

11.20 how to check that tools and equipment are free from damage or defects, and are in a safe, PAT tested, calibrated and usable condition

11.21 the importance of conducting inspections and checks before connecting to the supply (such as visual examination for loose or exposed conductors, excessive solder or solder spikes which may allow short circuits to occur, strain on terminations, insufficient slack cable at terminations, continuity and polarity checks, insulation checks)

11.22 the care, handling and application of electrical test and measuring instruments (such as multimeter, insulation resistance tester, loop impedance test instruments)

11.23 applying approved test procedures; the safe working practices and procedures required when carrying out the various tests, and the need to use suitably fused test probes and clips

11.24 how to identify suitable test points within the circuit, and how to position the test instruments into the circuit whilst ensuring the correct polarity and without damaging the circuit components and the test equipment

11.25 how to set the instrument's zero readings; obtaining instrument readings and comparing them with circuit parameters

11.26 why electrical bonding/earthing is critical, and why it must be both mechanically and electrically secure

11.27 the problems that can occur with the wiring and testing operations, and how these can be overcome

11.28 the fault-finding techniques to be used if the equipment fails to operate correctly (such as half split, unit substitution and input/output)

11.29 when to act on their own initiative and when to seek help and advice from others

11.30 the importance of leaving the work area in a safe and clean condition on completion of the wiring and testing activities (such as returning hand tools and test equipment to is designated location, cleaning the work area, and removing and disposing of waste)

Unit 217 Wiring and testing electrical equipment and circuits

Supporting Information

Specific Standard Requirements

In order to prove their ability to combine different electrical assembly and wiring activities, at least **one** of the electrical assemblies produced must be of a significant nature, and must contain a minimum of **five** of the components listed in LO 4 **plus five** of the activities listed in LO 6 in the skills requirement section.

Unit guidance

Assessment requirements have been developed by employers for the occupational competency units and qualifications for Advanced Manufacturing and Engineering Sector. These assessment requirements are set down in the relevant Qualification Assessment Strategies available from Semta. Please contact Customer.Services@semta.org.uk quoting Advanced Manufacturing and Engineering Trailblazer Qualification Assessment Strategy and specifying the title of the relevant Trailblazer Standard

Although all of the content and assessment requirements must be met in full employers can tailor the training outcomes to ensure that the content of the programme is specific to their requirements in terms of products, processes, procedures, tools, equipment, materials, documentation and information systems.

This will allow each organisation to develop their own specific and tailored apprentice training programme that meets their own business requirements whilst at the same time ensuring that the overall generic content is to a high standard in terms of depth and breadth to enable progression and/or transferability to other employers

Unit 218 Forming and assembling electrical cable enclosure and support systems

Unit level:	Level 2
GLH:	60
Unit aim:	This Employer Unit of Competence (EUC) has been developed by employers in the Maritime Sector and is part of an overall development programme designed to meet the requirements of the Sector, the published Apprenticeship Standard and Employer Occupational Brief. This EUC identifies the training and development required in order that the apprentice can demonstrate that they are competent in being able to form and assemble metallic and non-metallic systems, and will cover the selection of the appropriate materials, cutting and bending/forming the appropriate pieces that make up the enclosure. They will need to assemble the prepared pieces, using a range of connection devices and to position, align and secure them in the correct locations, using the specified/appropriate techniques, wall/screen penetration and fastening devices. Their responsibilities will require them to comply with health and safety requirements and organisational policy and procedures for the cable enclosure forming and assembly activities undertaken. They will need to take account of any potential difficulties or problems that may arise with the activities, or with the tools and equipment used, and to seek appropriate help and advice in determining and implementing a suitable solution. They will work under a high level of supervision, whilst taking responsibility for their own actions and for the quality and accuracy of the work that they carry out. Their underpinning knowledge will provide an understanding of their work, and will enable them to apply appropriate cutting, bending forming and installation techniques and procedures safely. They will understand the forming and assembly methods and procedures used, and their application, and will know about the various enclosure systems and components used to produce the assemblies, to the required depth to provide a sound basis for carrying out the activities to the required specification. They will understand the safety precautions required when carrying out the assembly and installation activities, especially those for handling long lengths of conduit or trunking. They will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace.

	They will be able to apply the appropriate behaviours required in the workplace to meet the job profile and overall company objectives, such as strong work ethic, positive attitude, team player, dependability, responsibility, honesty, integrity, motivation and commitment.
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The apprentice must be able to:

1.1 work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines
1.2 demonstrate the required behaviours in line with the job role and company objectives
1.3 plan the assembly and installation of the cable enclosure system before they start
1.4 obtain the correct tools and equipment for the cutting, forming and assembly operations, and check that they are in a safe and usable condition
1.5 cut and form the cable enclosure components to the required size and shape, using appropriate tools and techniques
1.6 assemble the cable enclosure system, using the appropriate connectors
1.7 mount and secure the cable enclosure components safely and correctly to meet the specification requirements
1.8 check the completed assembly to ensure that all operations have been completed, and that the finished assembly is secure and meets the required specification
1.9 deal promptly and effectively with problems within their control, and seek help and guidance from the relevant people if they have problems that they cannot resolve
1.10 leave the work area in a safe and tidy condition on completion of the forming and assembly activities

Learning outcome

The learner will:

2 Carry out **all** of the following during the electrical cable enclosure forming and assembly activities:

2.1 adhere to procedures or systems in place for risk assessment, COSHH, Personal Protective Equipment (PPE) and other relevant safety regulations
2.2 follow job instructions and assembly/installation drawings at all times
2.3 ensure that the electrical cable enclosure system is kept free from foreign objects, dirt or other contamination
2.4 return all tools and equipment to the correct location on completion of the installation activities

Learning outcome

The learner will:

3 Form and assemble **all** of following types of electrical cable enclosures/support systems:

3.1 metal conduit systems
3.2 non-metallic conduit systems
3.2 metal trunking system
3.4 non-metallic trunking systems
3.5 traywork systems

Learning outcome

The learner will:

4 Construct cable enclosures/support system components, to include carrying out **all** of the following:

4.1 selecting the correct type and size of conduit, trunking or traywork (with regard to number of cables and climatic conditions)
4.2 cutting the materials to the correct lengths (taking into account allowances for bends or joints required)
4.3 removing all burrs and sharp edges
4.4 producing external threads on conduit
4.5 producing or fabricating bends, up to and including 90°
4.6 producing or fabricating bends over 90°
4.7 making tee/multiple junctions in trunking/traywork (where applicable)
4.8 producing or fabricating offsets
4.9 producing or fabricating bridge/saddle sets

Learning outcome

The learner will:

5 Assemble cable enclosure/support systems that include **all** of the following:

5.1 bends/elbows (solid or inspection type)
5.2 horizontal runs
5.3 boxes (such as circular or square, terminal or multi branch)
5.4 vertical drops
5.5 through solid sections (such as bulk head, deck tubes and cable transits)

Plus **three** more from the following:

5.6 straight connectors/couplings

5.7 conversion units and adaptors
5.8 tee pieces (such as solid or inspection type)
5.9 cross over units (such as bridge or saddle sets)
5.10 reducers
5.11 off sets.

Learning outcome

The learner will:

6 Apply **all** of the following installation methods and techniques:

6.1 marking out the location of the trunking, traywork or conduit
6.2 positioning and securing the trunking, traywork or conduit using mechanical fixings
6.3 drilling and preparing holes for the trunking, traywork or conduit
6.4 levelling and alignment of the wiring enclosures and components
6.5 marking out and installing applicable fittings (such as bulk head glands and deck penetrations)

Learning outcome

The learner will:

7 Check the completed assembly, to include carrying out **all** of the following:

7.1 checking for level and alignment
7.2 checking that all connections are secure
7.3 checking that sufficient supports are used and that they are correctly spaced
7.4 checking that correct outlets are used (such as for sockets, switches, light fittings, wire junction and inspection fittings)
7.5 check correct installation and packing of glands (where applicable)

Learning outcome

The learner will:

8 Produce cable enclosure/support systems in accordance with **one** or more of the following standards:

8.1 BS 7671/IET wiring regulations
8.2 other BS and/or ISO standards
8.3 company standards and procedures.

Learning outcome

The learner will:

9 Knowledge and understanding - The apprentice must know and understand:

9.1 the specific safety practices and procedures that they need to observe when forming and assembling cable enclosure/support systems (including any specific legislation, regulations or codes of practice for the activities, equipment or materials)

9.2 the hazards associated with forming and assembling cable enclosure/support systems, and with the tools and equipment used (such as using bending and forming equipment, handling long lengths of pipe and trunking, using solvents and adhesives), and how they can be minimised

9.3 the importance of wearing appropriate protective clothing and equipment (PPE), and keeping the work area safe and tidy

9.4 the importance of applying the appropriate behaviours in the workplace and the implications for both the apprentice and the business if these are not adhered to

9.5 the interpretation of circuit and wiring diagrams, and specifications used for the installation (including BS and ISO schematics, wiring regulations, symbols and terminology)

9.6 the various types of electrical cable enclosure and support systems used, and their typical applications

9.7 the factors to be taken into account when choosing metallic or non-metallic systems, and the effects of ambient temperatures within conduit and trunking systems

9.8 marking out lengths to be cut, taking into account any allowances (such as for bending, screwing, gluing)

9.10 the tools and equipment used in the cutting, bending and forming operations (such as the use of conduit bending machines, threading equipment, hot air torches and bending springs)

9.11 methods of producing bends and sets in conduit materials (such as 90° bends, offsets, bridge sets)

9.13 how to produce fabricated bends in trunking and traywork section material (such as bends, tee junctions, double and saddle sets)

9.14 the methods of forming screw threads on ends of conduit, and of using appropriate tools to remove all sharp edges and burrs

9.15 the various fittings used to assemble conduit, trunking and traywork systems (including screwed fittings, cemented fittings, straight connectors, bends, tees, inspection fittings, light, power and control outlet boxes)

9.16 the importance and use of inspection fittings (such as elbows and junction boxes)

9.17 the problems to look for when checking finished components/installations (such as dimensional checks, position and angle of bends/sets, out of alignment, loose connections, insufficient supports, damaged threads, deformed pipe around area of bend, burrs and sharp edges that could damage cables, ensuring that trunking lengths are free from swarf or other obstructions before connecting into the system)

9.18 how to join the system components (such as using screw fittings, cemented fittings, fabricated components, nuts and bolts)

9.19 how to check alignment of components (including use of plumb bobs, levels and by visual means)

9.20 the methods of supporting and securing the components (such as position and spacing of supporting brackets and devices, using pipe clips, saddles and supports)

9.21 drilling masonry, and the types and application of masonry fixing devices used in installation work

9.22 the need to ensure that components are clear of services (such as gas, water or electricity) before drilling walls

9.25 the importance of leaving the work area in a safe and clean condition on completion of the assembly/installation activities (such as returning tools and equipment to its designated location, cleaning the work area, and removing and disposing of waste)

Unit 218 Forming and assembling electrical cable enclosure and support systems

Supporting Information

Specific Standard Requirements

In order to prove their ability to combine different pattern, model or woodworking operations, at least **one** of the components produced must be of a significant nature, and must have a minimum of **seven** of the features listed in LO 9 in the skills requirements section.

Unit guidance

Assessment requirements have been developed by employers for the occupational competency units and qualifications for Advanced Manufacturing and Engineering Sector. These assessment requirements are set down in the relevant Qualification Assessment Strategies available from Semta. Please contact Customer.Services@semta.org.uk quoting Advanced Manufacturing and Engineering Trailblazer Qualification Assessment Strategy and specifying the title of the relevant Trailblazer Standard

Although all of the content and assessment requirements must be met in full employers can tailor the training outcomes to ensure that the content of the programme is specific to their requirements in terms of products, processes, procedures, tools, equipment, materials, documentation and information systems.

This will allow each organisation to develop their own specific and tailored apprentice training programme that meets their own business requirements whilst at the same time ensuring that the overall generic content is to a high standard in terms of depth and breadth to enable progression and/or transferability to other employers

Unit 219 Assembling, wiring and testing electrical panels/components mounted in enclosures

Unit level:	Level 2
GLH:	60

This Employer Unit of Competence (EUC) has been developed by employers in the Maritime Defence Sector and is part of an overall development programme designed to meet the requirements of the Sector, the published Apprenticeship Standard and Employer Occupational Brief.

This EUC identifies the training and development required in order that the apprentice can demonstrate that they are competent in being able to assemble, wire and test electrical panels and components mounted in enclosures. It will prepare them for entry into the engineering or manufacturing sectors, creating a progression between education and employment, or it will provide a basis for the development of additional skills and occupational competences in the working environment. The activities will include the assembly of a range of electrical components such as component panels, isolator switches, fuses and circuit breakers, contactors and relays, bases for plug-in devices, rail-mounted terminal blocks, trunking, earthing bonding, and sub-assemblies such as power supplies, card racks, and process controller units.

This will involve using a range of tools and equipment along with soldering techniques and anti-static protection techniques. The assembly activities will also include making all necessary checks and adjustments to ensure that components are free from damage, correctly positioned and secured, are terminated correctly and pass the required insulation and resistance checks.

Their responsibilities will require them to comply with health and safety requirements and organisational policy and procedures for the electrical component assembly and wiring activities undertaken. They will need to take account of any potential difficulties or problems that may arise with the assembly and wiring activities, or with the tools and equipment used, and to seek appropriate help and advice in determining and implementing a suitable solution. They will work under a high level of supervision, whilst taking responsibility for their own actions and for the quality and accuracy of the work that they carry out.

Their underpinning knowledge will provide an understanding of their work, and will enable them to apply appropriate electrical assembly, wiring and testing procedures and techniques safely. They will understand the assembly methods and procedures used, and their application, and will know about the various components

	used, to the required depth to provide a sound basis for carrying out the activities to the required specification. They will understand the safety precautions required when mounting electrical components in enclosures, and with using the associated tools and equipment. They will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace. They will be able to apply the appropriate behaviours required in the workplace to meet the job profile and overall company objectives, such as strong work ethic, positive attitude, team player, dependability, responsibility, honesty, integrity, motivation and commitment.
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The apprentice must be able to:

1.1 work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines

1.2 demonstrate the required behaviours in line with the job role and company objectives

1.3 plan the electrical assembly, wiring and testing activities before they start them

1.4 use appropriate sources to obtain the required specifications, circuit diagrams, components, assembly and test

1.5 obtain the correct tools and equipment for the assembly and test operations, and check that they are in a safe and usable condition

1.6 use the appropriate methods and techniques to assemble the components in their correct positions

1.7 secure the components, using the specified connectors and securing devices

1.8 wire and terminate cables to the appropriate connections on the components

1.9 use appropriate test methods and equipment to check that the completed assembly is safe and meets all aspects of the specification

1.10 deal promptly and effectively with problems within their control, and seek help and guidance from the relevant people if they have problems that they cannot resolve

1.11 leave the work area in a safe and tidy condition on completion of the electrical assembly and testing activities

Learning outcome

The learner will:

2 Carry out **all** of the following during the mounting of the electrical components:

2.1 adhere to procedures or systems in place for risk assessment, COSHH, Personal Protective Equipment (PPE) and other relevant safety regulations

2.2 follow job instructions, assembly drawings and test procedures at all times

2.3 ensure that the components are free from damage, foreign objects, dirt or other contamination

2.4 check that the tools and test instruments are within calibration date and are in a safe, tested and usable condition

2.5 prepare the electrical components and enclosures for the assembly operations

2.6 use safe and approved techniques to mount the electrical components in the enclosures

2.7 where appropriate, apply procedures and precautions to Eliminate Electrostatic Discharge (ESD) hazards (such as the use of grounded wrist straps and mats)

2.8 return all tools and equipment to the correct location on completion of the assembly activities

Learning outcome

The learner will:

3 Mount electrical components on panels or into enclosures, to include **twelve** of the following items:

3.1 enclosure partitions

3.2 bases for plug-in devices

3.3 soft starters

3.4 component mounting plates

3.5 switches (push button, toggle)

3.6 variable speed drives

3.7 component marking

3.8 capacitors

3.9 limit switches

3.10 trunking

3.11 resistors

3.12 sensors

3.13 conduit

3.14 rectifiers

3.15 programmable controllers

3.16 contactors

3.17 timers

3.18 plugs/sockets

3.19 overload and other relays

3.20 power supplies

3.21 grommets/grommet strip

3.22 transformers/chokes

3.23 circuit boards

3.24 lighting fixtures
3.25 circuit breakers/fuses
3.26 thermistors/thermocouples
3.27 batteries
3.28 panel meters (voltage, current)
3.29 indicators (lamps, LEDs)
3.30 connector rails
3.31 terminal blocks/junction boxes
3.32 thermostats
3.33 solenoids
3.34 safety interlocks
3.35 busbars
3.36 isolators
3.37 other specific components.

Learning outcome

The learner will:

4 Carry out **eight** of the following activities during the mounting of the electrical components:

4.1 setting working clearance
4.2 aligning components
4.3 applying sealants/adhesives
4.4 drilling
4.5 torque setting fasteners
4.6 clamping
4.7 filing
4.8 earth bonding
4.9 crimping
4.10 riveting
4.11 securing using mechanical fasteners/threaded devices
4.12 component marking
4.13 sawing/cutting
4.14 making screw connections
4.15 forming
4.16 punching
4.17 measuring

Learning outcome

The learner will:

5 Wire up electrical components on panels or in enclosures, using **five** of the following cable/wire types:

5.1 single core cable
5.2 mineral insulated cable
5.3 twisted pair/ribbon cable
5.4 multicore cable
5.5 screened cable
5.6 braided copper
5.7 laminated copper
5.8 fibre-optic
5.9 data/communication cable
5.10 other specialist cable

Learning outcome

The learner will:

6 Use **all** of the following methods and techniques (and the appropriate tools) during the wiring activities:

6.1 cable forming/bending
6.2 making screwed connections
6.3 cable supporting/tying
6.4 soldering (where appropriate)
6.5 cable/wire clamping
6.6 cable routing
6.7 cable protection (such as sleeving, grommets)
6.8 connecting pre-formed looms
6.9 cable/wire crimping
6.10 wire marking/colour coding
6.11 insulation stripping

Learning outcome

The learner will:

7 Carry out quality checks, to include **all** of the following:

7.1 positional accuracy of all components
7.2 correct termination of all wires to components
7.3 correct orientation
7.4 completeness
7.5 correct alignment
7.6 ensuring enclosure is free of debris (such as cable offcuts/ insulation, enclosure/trunking breakouts)
7.7 component security

7.8 security of all terminations
7.9 ensuring freedom from damage

Plus **all** of the following electrical checks:
7.10 continuity of cable/wiring connections (such as battery and lamp checks)
7.11 polarity
7.12 protective conductor resistance values
7.13 earth continuity
7.14 insulation resistance

Learning outcome

The learner will:

8 Assemble electrical components on panels or in enclosures, in accordance with **two** or more of the following:

8.1 BS7671/IET wiring regulations
8.2 other BS or ISO standards and procedures
8.3 company standards and procedures

Learning outcome

The learner will:

9 Knowledge and understanding - The apprentice must know and understand:

9.1 the specific safety practices and procedures that they need to observe when assembling, wiring and testing electrical components mounted in enclosures (including any specific legislation, regulations or codes of practice for the activities, equipment or materials)
9.2 the hazards associated with assembling, wiring and testing electrical panels (such as using sharp instruments for stripping cable insulation, use of soldering irons, carrying out insulation tests), and how they can be minimised
9.3 the importance of wearing appropriate protective clothing and equipment (PPE), and keeping the work area safe and tidy
9.4 the precautions to be taken to prevent Electrostatic Discharge (ESD) damage to circuits and sensitive components (such as use of earthed wrist straps, anti-static mats, special packaging and handling areas)
9.5 what constitutes a hazardous voltage and how to recognise victims of electric shock
9.6 how to reduce the risks of a phase to earth shock (such as insulated tools, rubber matting and isolating transformers)
9.7 the importance of applying the appropriate behaviours in the workplace and the implications for both the apprentice and the business if these are not adhered to
9.8 how to obtain and interpret drawings, circuit and physical layouts, charts, specifications, graphical electrical symbols, BS and ISO wiring regulations, and other documents needed for the electrical component mounting, wiring and testing activities

9.9 the basic principle of operation of the equipment/circuits being assembled and wired, and the purpose of individual components within the circuit

9.10 the assembly methods and techniques to be used when wiring electrical panels or components mounted in enclosures (such as cable stripping, soldering, crimping, securing cables using cable ties, lacing/strapping of wires)

9.11 the type of components and sub-assemblies that are used in the assembly activities (such as contactors, relays, circuit breakers/fuses, solenoids, switches, transformers, ballast chokes, terminal blocks, sub-assemblies)

9.12 preparations to be undertaken on the components and enclosure, prior to the mounting activities

9.13 how the components are to be aligned and positioned prior to securing, and the tools and equipment that are used

9.14 how to identify any orientation requirements, values or polarity for the components used in the electrical wiring activities

9.15 methods of attaching identification markers/labels during electrical assembly activities

9.16 the different types of cabling, and their application (such as multicore cables, single core cables, single insulated, double insulated, steel wire armoured (SWA), mineral insulated (MI), screened cables)

9.17 why electrical bonding/earthing is critical, and why it must be both mechanically and electrically secure

9.18 the use of BS7671/IET wiring, and other regulations, when selecting wires and cables and when carrying out tests on electrical circuits

9.19 how to conduct any necessary checks to ensure the accuracy and quality of the assembly produced (such as visual checks for completeness and freedom from damage to conductors or components, mechanical checks for security of components and connections, ingress protection, electrical checks for electrical continuity and earth continuity, insulation resistance and polarity checks)

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

9.21 the problems that can occur with the wiring and testing operations, and how these can be overcome

9.22 when to act on their own initiative and when to seek help and advice from others

9.23 the importance of leaving the work area in a safe and clean condition on completion of the electrical assembly and wiring activities (such as returning hand tools and test equipment to the designated locations, cleaning the work area, removing and disposing of waste)

Unit 219 Assembling, wiring and testing electrical panels/components mounted in enclosures

Supporting Information

Specific Standard Requirements

In order to prove their ability to combine different electrical panel assembly and wiring operations, at least **one** of the assemblies produced must be of a significant nature, and must contain a minimum of **eight** of the components listed in LO 3 **plus six** of the activities listed in LO 6 in the skills requirement section.

Unit guidance

Assessment requirements have been developed by employers for the occupational competency units and qualifications for Advanced Manufacturing and Engineering Sector. These assessment requirements are set down in the relevant Qualification Assessment Strategies available from Semta. Please contact Customer.Services@semta.org.uk quoting Advanced Manufacturing and Engineering Trailblazer Qualification Assessment Strategy and specifying the title of the relevant Trailblazer Standard.

Although all of the content and assessment requirements must be met in full employers can tailor the training outcomes to ensure that the content of the programme is specific to their requirements in terms of products, processes, procedures, tools, equipment, materials, documentation and information systems.

This will allow each organisation to develop their own specific and tailored apprentice training programme that meets their own business requirements whilst at the same time ensuring that the overall generic content is to a high standard in terms of depth and breadth to enable progression and/or transferability to other employers.

Unit 220 Maintaining electrical equipment/systems

Unit level:	Level 2
GLH:	60
Unit aim:	This Employer Unit of Competence (EUC) has been developed by employers in the Maritime Defence Sector and is part of an overall development programme designed to meet the requirements of the Sector, the published Apprenticeship Standard and Employer Occupational Brief. This EUC identifies the training and development required in order that the apprentice can demonstrate that they are competent in being able to prepare for the electrical maintenance activities by obtaining all necessary information, documentation, tools and equipment required, and to plan how they intend to carry out the required maintenance activities and the sequence of operations they intend to use. They will be required to select the appropriate equipment to use, based on the maintenance operations to be carried out and the type of electrical equipment/systems being maintained. This will include electrical equipment that uses single, three-phase or direct current power supplies, and includes equipment such as control systems, motors and starters, switchgear and distribution panels, electrical plant, pumps, fans, alternators, generators, transformers, wiring enclosures and luminaires, portable appliances and other specific electrical equipment. They will be expected to use a variety of maintenance diagnostic techniques and procedures, such as gathering information from fault reports, using recognised fault finding techniques and diagnostic aids, measuring, inspecting and operating the equipment. They will be expected to cover a range of maintenance activities, such as isolating and locking off, disconnecting, removing and reconnecting electrical components, wires and cables, attaching cable identification markers, replacing damaged or defective components, cables and wires, setting and adjusting components, and making `off-load' checks before testing the equipment, using appropriate techniques and procedures. Their responsibilities will require them to comply with health and safety requirements and organisational policy and procedures for the electrical maintenance activities undertaken. They will need to take account of any potential difficulties or problems that may arise with the maintenance activities, and to seek appropriate help and advice in determining and implementing a suitable solution. They will work under a high level of supervision, whilst taking responsibility for their own actions and for the quality and accuracy of the work that they carry out.

	Their underpinning knowledge will provide an understanding of their work, and will enable them to apply appropriate electrical maintenance techniques and procedures safely. They will understand the electrical maintenance process, and its application, and will know about the electrical equipment and systems being maintained, the components, tools and consumables used, to the required depth to provide a sound basis for carrying out the activities to the required specification. They will understand the safety precautions required when carrying out the maintenance activities (especially those for ensuring that the equipment is correctly isolated), and when using maintenance tools and equipment. They 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. They will be able to apply the appropriate behaviours required in the workplace to meet the job profile and overall company objectives, such as strong work ethic, positive attitude, team player, dependability, responsibility, honesty, integrity, motivation and commitment.
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The apprentice must be able to:

1.1 work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines

1.2 demonstrate the required behaviours in line with the job role and company objectives

1.3 plan the maintenance activities before they start them

1.4 obtain all the information they need for the safe removal and replacement of the equipment/system components

1.5 obtain and prepare the appropriate tools and equipment

1.6 apply appropriate maintenance diagnostic techniques and procedures

1.7 use the appropriate methods and techniques to remove and replace the required components

1.8 carry out tests on the maintained equipment, in accordance with the test schedule/defined test procedures

1.9 deal promptly and effectively with problems within their control, and seek help and guidance from the relevant people if they have problems that they cannot resolve

1.10 leave the work area in a safe and tidy condition on completion of the maintenance activities

1.11 work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines

Learning outcome

The learner will:

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

2.1 adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment (PPE) and other relevant safety regulations
2.2 ensure the safe isolation and zero energy checks from all service supplies during the maintenance activities (such as electrical, mechanical, gas, air or fluids), where appropriate
2.3 follow job instructions, maintenance drawings and procedures
2.4 check that the tools and test instruments are within calibration date (where applicable) and are in a safe, PAT tested and usable condition
2.5 ensure that the system is kept free from foreign objects, dirt or other contamination
2.6 return all tools and equipment to the correct location on completion of the maintenance activities

Learning outcome

The learner will:

3 Carry out maintenance/repair activities on **four** of the following types of electrical:

3.1 electrical plant
3.2 motors and starters
3.3 transformers
3.4 wiring enclosures
3.5 heaters
3.6 pumps
3.7 portable appliances
3.8 luminaires
3.9 fans/blowers
3.10 generators
3.11 switchgear
3.12 distribution panels
3.13 alternators
3.14 other electrical equipment to be specified by the employer

Learning outcome

The learner will:

4 Carry out maintenance/repair activities on **five** of the following electrical systems:

4.1 single-phase lighting circuits
4.2 air conditioning control circuits

4.3 single-phase power circuits
4.4 refrigeration control circuits
4.5 three-phase power supplies
4.6 heating/boiler control circuits
4.7 direct current power supplies
4.8 motor start and control
4.9 power generation and control circuits
4.10 emergency lighting systems
4.11 starting and ignition systems/equipment
4.12 communication systems
4.13 instrumentation and control circuits
4.14 computer systems
4.15 alarm systems (such as fire, process control)
4.16 electro-pneumatic or electro-hydraulic control circuits
4.17 weapons systems
4.18 sensor systems
4.19 other electrical/control systems to be specified by the employer.

Learning outcome

The learner will:

5 Use **four** of the following maintenance diagnostic techniques, tools and aids:

5.1 fault finding techniques (such as six point, half-split, input/output, unit substitution)
5.2 diagnostic aids (such as manuals, flow charts, troubleshooting guides, maintenance records)
5.3 information gathered from fault reports
5.4 visual checks (such as signs of damage, overheating, missing parts, wear/deterioration)
5.5 movement checks (such as loose fittings and connections)
5.6 monitoring equipment or gauges
5.7 test instrumentation measurement (such as voltage, resistance, current)
5.8 other to be specified by the employer

Learning outcome

The learner will:

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

6.1 removing excessive dirt and grime
6.2 making mechanical/screwed/clamped connections
6.3 dismantling/disconnecting equipment to the required level
6.4 crimping (such as tags and pins)
6.5 disconnecting and reconnecting wires and cables

6.6 stripping cable insulation/protection
6.7 attaching suitable cable identification markers
6.8 setting and adjusting replaced and or refitted components
6.9 removing electrical units/component
6.10 making off-load checks before reconnecting power supply
6.11 checking components for serviceability

Plus **one** from the following:
6.12 soldering and de-soldering
6.13 replacing damaged/defective components
6.14 removing and replacing damaged wires and cables
6.15 removing/replacing cable end fittings

Learning outcome

The learner will:

7 Replace/refit a range of electrical components, to include **six** of the following:

7.1 cables and connectors
7.2 capacitors
7.3 batteries
7.4 locking and retaining devices
7.5 circuit boards
7.6 transformers
7.7 overload protection devices
7.8 luminaires
7.9 solenoids
7.10 inverter and servo controllers
7.11 switches or sensors
7.12 thermistors or thermocouples
7.13 relay components
7.14 contactors
7.15 encoders or resolvers
7.16 rectifiers
7.17 other components to be specified by the employer

Learning outcome

The learner will:

8 Carry out checks and tests on the maintained equipment, to include **all** of the following:

8.1 making visual checks for completeness and freedom from damage
8.2 insulation resistance values

8.3 voltage levels

Plus **three** more from:

8.4 load current
8.5 power rating
8.6 polarity
8.7 frequency values
8.8 continuity
8.9 resistance
8.10 inductance
8.11 capacitance
8.12 RCD disconnection time
8.13 other specialised tests (such as speed, sound, light, temperature) to be specified by the employer

Learning outcome

The learner will:

9 Maintain electrical equipment, in accordance with **three** of the following quality and accuracy standards:

9.1 BS 7671/IET wiring regulations
9.2 other BS and/or ISO standards
9.3 company standards and procedures
9.4 equipment manufacturer's technical publications

Learning outcome

The learner will:

10 Knowledge and understanding - The apprentice must know and understand:

10.1 the health and safety requirements, and safe working practices and procedures required for the electrical maintenance activities undertaken
10.2 the isolation and lock-off procedure or permit-to-work procedure that applies to electrical maintenance activities (to include electrical isolation, locking off switchgear, removal of fuses, placing of maintenance warning notices, proving that isolation has been achieved and secured)
10.3 hazards associated with carrying out electrical maintenance activities (such as dangers of electric shock, capacitor discharge, misuse of tools, using damaged or badly maintained tools and equipment, not following laid-down maintenance procedures), and how to minimise them
10.4 what constitutes a hazardous voltage and 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 how to obtain first aid assistance)

10.5 the importance of wearing appropriate protective clothing and equipment (PPE), and keeping the work area safe and tidy

10.6 the importance of applying the appropriate behaviours in the workplace and the implications for both the apprentice and the business if these are not adhered to

10.7 the procedure for obtaining drawings, job instructions, related specifications, replacement parts, materials and other consumables necessary for the maintenance activities

10.8 how to obtain and interpret information from job instructions and other documentation used in the maintenance activities (such as drawings, specifications, manufacturers' manuals, BS and ISO wiring regulations, symbols and terminology)

10.9 the basic principles of how the equipment functions, and the working purpose of individual units/components

10.10 the various maintenance diagnostic techniques and aids that can be used (such as fault reports, visual checks, measuring, movement and alignment checks, testing)

10.11 the various fault location techniques that can be used, and how they are applied (such as half-split, input-to-output, function testing, unit substitution, and equipment self-diagnostics)

10.12 how to use a range of fault diagnostic equipment to investigate the problem

10.13 the care, handling and application of electrical measuring instruments

10.14 the different types of cabling used in the maintenance activities, and their methods of termination

10.15 the techniques used to dismantle/assemble electrical equipment (such as unplugging, de-soldering, removal of screwed, clamped and crimped connections)

10.16 methods of removing and replacing cables and wires in wiring enclosures without causing damage to existing cables

10.17 the use of BS 7671/IET wiring, and other regulations, when selecting wires and cables and when carrying out tests on systems

10.18 methods of attaching identification markers/labels to removed components or cables, to assist with re-assembly

10.19 the tools and equipment used in the maintenance activities including the use of cable stripping tools, crimping tools, soldering irons and gland connecting tools

10.20 methods of checking that components are serviceable, and the need to replace `lifed' items (such as seals and gaskets overload protection devices) and implications is 'lifed' items are not replaced

10.21 how to check that tools and equipment are free from damage or defects, and are in a safe and usable condition

10.22 the importance of completing documentation and/or reports following the maintenance activity

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

10.24 how to use appropriate lifting and handling equipment in the maintenance activity

10.25 the problems that can occur during the electrical maintenance activity, and how they can be overcome

10.26 when to act on their own initiative and when to seek help and advice from others

10.27 the importance of leaving the work area in a safe and clean condition on completion of the maintenance activities (such as returning hand tools and test equipment to is designated location, cleaning the work area, and removing and disposing of waste)

Unit 220 Maintaining electrical equipment/systems

Supporting Information

Specific Standard Requirements

In order to prove their ability to combine different electrical maintenance operations, at least **one** of the electrical maintenance activities carried out must be of a significant nature, and must cover a minimum of **eight** of the activities listed in LO 6 in the skills requirement section.

Unit guidance

Assessment requirements have been developed by employers for the occupational competency units and qualifications for Advanced Manufacturing and Engineering Sector. These assessment requirements are set down in the relevant Qualification Assessment Strategies available from Semta. Please contact Customer.Services@semta.org.uk quoting Advanced Manufacturing and Engineering Trailblazer Qualification Assessment Strategy and specifying the title of the relevant Trailblazer Standard

Although all of the content and assessment requirements must be met in full employers can tailor the training outcomes to ensure that the content of the programme is specific to their requirements in terms of products, processes, procedures, tools, equipment, materials, documentation and information systems.

This will allow each organisation to develop their own specific and tailored apprentice training programme that meets their own business requirements whilst at the same time ensuring that the overall generic content is to a high standard in terms of depth and breadth to enable progression and/or transferability to other employers

Unit 221 Using wood for pattern, modelmaking and other engineering applications

Unit level:	Level 2
GLH:	60
Unit aim:	This Employer Unit of Competence (EUC) has been developed by employers in the Maritime Defence Sector and is part of an overall development programme designed to meet the requirements of the Sector, the published Apprenticeship Standard and Employer Occupational Brief. This EUC identifies the training and development required in order that the apprentice can demonstrate that they are competent in being able to prepare for the pattern, modelmaking or engineering woodworking activities by obtaining all the necessary information, documentation, tools and equipment required, and to plan how they intend to carry out the cutting and shaping activities and the sequence of operations they intend to use. They will be required to select the appropriate hand tools and machinery, based on the operations to be carried out and the accuracy to be achieved. The production of the components will involve roughing out the components using fixed or portable machine tools, and finishing them using hand tools. The components produced will be used to produce patterns for sand castings, moulds for composite manufacture, full size and scale models, frames, cases, storage units, furniture and other structures. During, and on completion of, the cutting and shaping operations, they will be expected to check the quality of the workpiece, using measuring equipment appropriate to the aspects being checked and the tolerances to be achieved. They will need to be able to recognise material and cutting and shaping defects, to take appropriate action to remedy any faults that occur and to ensure that the finished workpiece is within the drawing requirements. On completion of the activities, they will be expected to return all tools and equipment to the correct locations, and to leave the work area in a safe and tidy condition. Their responsibilities will require them to comply with health and safety requirements and organisational policy and procedures for the woodworking activities undertaken. They will need to take account of any potential difficulties or problems that may arise with the activities, and to seek appropriate help and advice in determining and implementing a suitable solution. They will work under a high level of supervision, whilst taking responsibility for their own actions and for the quality and accuracy of the work that they carry out.

	Their underpinning knowledge will provide an understanding of their work, and will enable them to apply appropriate hand and wood machining techniques safely. They will understand the cutting and shaping process, and its application, and will know about the equipment, materials and consumables, to the required depth to provide a sound basis for carrying out the activities to the required specification. They will understand the safety precautions required when carrying out the cutting and shaping activities, especially those for using woodworking machines and portable power tools. They will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace. They will be able to apply the appropriate behaviours required in the workplace to meet the job profile and overall company objectives, such as strong work ethic, positive attitude, team player, dependability, responsibility, honesty, integrity, motivation and commitment.
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Learning outcome

1 Performance Requirements - The apprentice must be able to:

1.1 work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines

1.2 demonstrate the required behaviours in line with the job role and company objectives

1.3 plan the pattern, model or engineering woodworking activities before they start them

1.4 obtain the appropriate tools and equipment for the operations, and check that they are in a safe and usable condition

1.5 mark out the components for the required operations, using appropriate tools and techniques

1.6 cut and shape the materials to the required specification, using appropriate tools and techniques

1.7 measure and check that all dimensional and geometrical aspects of the component are to the specification

1.8 deal promptly and effectively with problems within their control, and seek help and guidance from the relevant people if they have problems that they cannot resolve

1.9 leave the work area in a safe and tidy condition on completion of the pattern, modelmaking or engineering woodworking activities

Learning outcome

The learner will:

2 Carry out **all** of the following during the cutting and shaping activities:

2.1 obtain all the necessary information to carry out the cutting and shaping activities (drawings, specifications)
2.2 check that the equipment to be used are fit for purpose, and is in a safe, tested and usable condition (such as hand tools, machines and machine cutting tools)
2.3 ensure that the work area is free from hazards
2.4 ensure that all machine guards and safety devices are correctly positioned
2.5 check that dust extraction equipment is functioning correctly
2.6 set and adjust the machines to produce the components to the required specification
2.7 use safe and approved hand and machine shaping techniques at all times
2.8 maintain the cutting tools in a serviceable condition

Learning outcome

The learner will:

3 Identify and isolate any materials that have defects, to include **all** of the following:

3.1 structural
3.2 dimensional
3.3 cosmetic
3.4 distortion

Learning outcome

The learner will:

4 Use marking out methods and techniques, including:

4.1 direct marking, using instruments

Plus **one** more of the following:
4.2 use of templates
4.3 tracing/transfer methods
4.4 other specific method
4.5 direct marking, using instruments

Learning outcome

The learner will:

5 Use a range of marking out equipment, to include **all** of the following:

5.1 pencil
5.2 rule or tape

5.3 square
5.4 dividers, compass or trammels
5.5 marking knife
5.6 straight edge
5.7 protractor or sliding bevel
5.8 marking gauge

Learning outcome

The learner will:

6 Mark out material, to include **all** of the following features:

6.1 datum and centre lines
6.2 cutting detail
6.3 hole centring and outlining
6.4 square/rectangular profiles
6.5 circles

Plus **two** more from the following:

6.6 angles
6.7 joints
6.8 curved profiles
6.9 assembly positions

Learning outcome

The learner will:

7 Use hand tools to cut and shape materials, to include **all** of the following:

7.1 rip saws
7.2 chisels/gouges
7.3 drills/braces
7.4 tenon saws
7.5 jack or smoothing planes
7.6 sanding blocks/paper

Plus **two** more from the following:

7.7 fret/bow saws
7.8 spokeshaves
7.9 portable powered hand tools
7.10 rebating planes
7.11 files/rasps
7.12 other specific hand tools

Learning outcome

The learner will:

8 Use fixed and portable machines, to include **all** of the following:

8.1 circular saw
8.2 planer/thicknesser
8.3 bench or pedestal drill

Plus **two** more from the following:
8.4 band saw
8.5 morticer/tenoner
8.6 spindle moulder (single or double)
8.7 sander (such as face, belt, bobbin)
8.8 combing machine
8.9 lathe
8.10 router
8.11 other special purpose machine

Learning outcome

The learner will:

9 Produce components which combine different features and cover **all** of the following profiles:

9.1 flat faces
9.2 angular/tapered faces
9.3 drilled holes
9.4 parallel faces
9.5 curved profiles
9.6 countersunk/counterbored holes
9.7 square faces

Plus **six** more from the following:
9.8 plain diameters
9.9 tenons
9.10 concave profiles
9.11 stepped diameters
9.12 mortices
9.13 convex profiles
9.14 tapered diameters
9.15 half lap joints
9.16 dovetail joints
9.17 slots/grooves

9.18 combed joints
9.19 rebates
9.20 other specific joints

Learning outcome

The learner will:

10 Produce components made from **four** of the following materials:

10.1 soft woods
10.2 blockboard
10.3 hard woods
10.4 hardboard
10.5 plywood
10.6 fibreboard (MDF)

Learning outcome

The learner will:

11 Use appropriate measuring equipment and tools to check **all** of the following:

11.1 dimensions
11.2 angles/taper
11.3 profile
11.4 flatness
11.5 alignment
11.6 distortion/straightness
11.7 squareness
11.8 position

Learning outcome

The learner will:

12 Produce components which meet **all** of the following requirements:

12.1 components to be free from false tool cuts, and material defects
12.2 the shape and general tolerances meet the drawing or specification requirements with some dimensional tolerances within +/- 1mm or +/- 0.040”
12.3 flatness and squareness 0.25mm per 25mm or 0.010 per inch
12.4 angles within +/- 2 degrees
12.5 interlocking components (joints) are secure
12.6 components have an appropriate surface texture

Learning outcome

The learner will:

13 Knowledge and understanding - The apprentice must know and understand:

13.1 the health and safety requirements, and safe working practices and procedures required for the pattern, modelmaking or engineering woodworking activities undertaken (including the use of hand tools; working with machinery; operation of machine safety devices; dust extraction, stopping the machine in an emergency; closing the machine down on completion of activities)

13.2 the importance of wearing appropriate protective clothing/equipment (PPE), and of keeping the work area safe and tidy

13.3 the importance of applying the appropriate behaviours in the workplace and the implications for both the apprentice and the business if these are not adhered to

13.4 the hazards associated with cutting and shaping wood and composite materials, and with the tools and equipment that is used, (such as use of hand power tools, trailing leads or hoses, dust inhalation, damaged or badly maintained tools and equipment, using tools with damaged or poor fitting handles, handling long or wide lengths of material), and how they can be minimised

13.5 the procedure for obtaining the required drawings, job instructions and other related specifications

13.6 how to use and extract information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS or ISO standards) in relation to work undertaken

13.7 how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing

13.8 how to identify the materials that are to be used (to include colour, grain structure, size), and the common defects that occur in the wood to be used

13.9 the types of defects that would render the materials unfit for use

13.10 the material characteristics and process considerations to be taken into account when marking out wood (such as the importance of colour matching and grain convention when using wood and wood-based materials)

13.11 the principles of marking out, and the types of equipment used (including the range of operations that the various items of marking out equipment are capable of performing)

13.12 how to prepare the materials in readiness for the marking out activities, in order to enhance clarity, accuracy and safety (such as visually checking for defects, preparing the materials, removing sharp corners and edges)

13.13 the use of marking out conventions when marking out the workpiece (including datums, centre lines, cutting guidelines, square and rectangular profiles, joints, circular and curved profiles, angles, holes which are linearly positioned, boxed and on pitch circles)

13.14 how to select and establish suitable datums; the importance of ensuring that marking out is undertaken from the selected datums; and the possible effects of working from different datums

13.15 the use of geometrical construction methods applied to marking out

13.16 ways of laying out the marking out shapes or patterns to maximise the use of materials

13.17 the various hand tools that are used to cut and shape the materials, and the range of operations they are capable of performing (such as rip saws, tenon saws, fret/bow saws; smoothing planes, jack planes, rebating planes; chisels and gouges; spokeshaves)

13.18 how to check that the hand cutting tools are in a usable and safe condition; and the procedure for sharpening and adjusting these when required

13.19 the various machines that are used in wood machining, and the range of operations they are capable of performing (such as sawing, planing, rebating, profiling)

13.20 the importance of checking that the machinery used is complete and working correctly, that the cutting tools are undamaged and are in a safe and sharp condition, and the procedure for changing, sharpening and adjusting these when required

13.21 the methods of setting up and operating the equipment and machinery, how to set up and use dust extraction equipment, and the importance of ensuring that this equipment is operating correctly

13.22 the importance of ensuring that all machine and portable tools are used correctly, PAT tested and within their permitted operating range

13.23 the various methods used to hold the components that are being shaped, formed or dressed by hand

13.24 why they need to consider grain direction and construction when cutting and shaping wood and composites

13.25 the methods used to cut square, angular and circular/curved profiles

13.26 how different materials require changes to the machining methods (such as roughing and finishing cuts, changes in feed or speeds)

13.27 how to conduct any necessary checks to ensure the accuracy and quality of the components produced, and the type of equipment that is used

13.28 when to act on their own initiative and when to seek help and advice from others

13.29 the importance of leaving the work area in a safe and clean condition on completion of the woodworking activities (such as removing and storing power leads, isolating machines, cleaning the equipment, and removing and disposing of waste)

Unit 221 Using wood for pattern, modelmaking and other engineering applications

Supporting Information

Specific Standard Requirements

In order to prove their ability to combine different pattern, model or woodworking operations, at least **one** of the components produced must be of a significant nature, and must have a minimum of **seven** of the features listed in LO 9 in the skills requirements section.

Unit guidance

Assessment requirements have been developed by employers for the occupational competency units and qualifications for Maritime Defence Engineering Sector.

These assessment requirements are set out in the Maritime Defence Engineering Qualification Assessment Strategy available from Semta. Please contact Customer.Services@semta.org.uk quoting Trailblazer Maritime Defence Engineering Qualification Assessment Strategy.

Although all of the content and assessment requirements must be met in full employers can tailor the training outcomes to ensure that the content of the programme is specific to their requirements in terms of products, processes, procedures, tools, equipment, materials, documentation and information systems.

This will allow each organisation to develop their own specific and tailored apprentice training programme that meets their own business requirements whilst at the same time ensuring that the overall generic content is to a high standard in terms of depth and breadth to enable progression and/or transferability to other employers.

Unit 222 General machining applications (turning and milling)

Unit level:	Level 2
GLH:	60
Unit aim:	Overview This Employer Unit of Competence (EUC) has been developed by employers in the Maritime Defence Sector and is part of an overall development programme designed to meet the requirements of the Sector, the published Apprenticeship Standard and Employer Occupational Brief. This EUC identifies the training and development required in order that the apprentice can demonstrate that they are competent in being able to carry out practical exercises in order to gain an understanding of how the machining activities are undertaken, the types of equipment used, the manufacturing techniques, and the operating and safety procedures that are required. In carrying out the activities, they will select and use the appropriate machine tools and equipment to produce the required components to the required specification. During, and on completion of, the machining operations, they will be expected to check the quality of the component produced, using measuring equipment appropriate to the aspects being checked and the tolerances to be achieved. They will need to be able to recognise when the activities are not meeting the required specification, and to discuss/determine what action needs to be taken to remedy any faults that occur, in order to ensure that the finished component is within the specification requirements. On completion of the activities, they will be expected to return all tools and equipment that they have used to the correct location, and to leave the work area in a safe and tidy condition. Their responsibilities will require them to comply with health and safety requirements and organisational policy and procedures for the activities undertaken. They will need to take account of any potential difficulties or problems that may arise with the activities, and to seek appropriate help and advice in determining and implementing a suitable solution. They will work under a high level of supervision, whilst taking responsibility for their own actions and for the quality and accuracy of the work that they carry out. Their underpinning knowledge will provide an understanding of their work, and will enable them to apply appropriate machining techniques and procedures safely. They will understand the machining processes, and their application, and will know about the equipment, materials and consumables, to the required depth to provide a sound basis for carrying out the activities to the required specification.

	They will be able to apply the appropriate behaviours required in the workplace to meet the job profile and overall company objectives, such as strong work ethic, positive attitude, team player, dependability, responsibility, honesty, integrity, motivation and commitment. They will understand the safety precautions required when carrying out the machining activity and will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace.
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Learning outcome

1 Performance Requirements - The apprentice must be able to:

1.1 work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines

1.2 demonstrate the required behaviours in line with the job role and company objectives

1.3 plan the machining activity before they start working

1.4 obtain the appropriate tools and equipment for the machining operations to be undertaken

1.5 set up the machine, work holding devices and tooling in order to carry out the machining operations

1.6 manufacture machined components to the required specification, using appropriate tools and techniques

1.7 measure and check that all dimensional and geometrical aspects of the component are to the required specification

1.8 deal promptly and effectively with problems within their control, and seek help and guidance from the relevant people if they have problems that they cannot resolve

1.9 leave the work area in a safe and tidy condition on completion of the machining activities

Learning outcome

The learner will:

2 Carry out **all** of the following during the machining activity:

2.1 adhere to procedures or systems in place for risk assessment, COSHH, Personal Protective Equipment (PPE) and other relevant safety regulations
2.2 ensure that all equipment and tools used are in a safe and serviceable condition
2.3 ensure that all machine tools are correctly guarded at all times
2.4 check that all measuring equipment is within calibration date

Learning outcome

The learner will:

3 Machine components from **all** the following materials:

3.1 ferrous
3.2 non ferrous
3.3 non metallic

Learning outcome

The learner will:

4 Mount and secure components to be machined using **both** of the following devices:

4.1 three-jaw chuck (hard jaws)
4.2 machine vice

Plus **two** more from the following:

4.3 collet chuck
4.4 three/four jaw chuck (with soft jaws)
4.5 four-jaw chuck
4.6 drive plate and centres
4.7 face plate
4.8 direct clamping to milling machine table
4.9 universal or swivel vice
4.10 angle plate
4.11 indexing device
4.12 other working holding/securing device to be specified by the employer

Learning outcome

The learner will:

5 Carry out machining operations to include **all** of the following:

Turning operations

5.1 mount cutting tools in tool holders to give the correct centre height
5.2 select and set appropriate feeds and speeds
5.3 facing off
5.4 produce chamfered edges
5.5 produce parallel diameters
5.6 centre drilling and drilling holes
5.7 produce stepped diameters

Milling operations

5.8 mount cutting tools in the appropriate device
5.9 select and set appropriate feeds and speeds
5.10 produce flat faces
5.11 produce parallel faces
5.12 produce stepped faces
5.13 centre drilling and drilling holes

Plus **four** from the following turning and/or milling operations

5.14 produce reamed holes
5.15 produce bored holes
5.16 produce tapered diameters
5.17 produce knurled finishes
5.18 produce external or internal threads using taps and dies
5.19 produce slots, grooves or undercuts
5.20 produce angular milled faces

Learning outcome

The learner will:

6 Carry out the necessary checks for accuracy, to include **all** of the following:

6.1 linear dimensions (such as lengths, depths)
6.2 diameters (such as external, internal)
6.3 flatness
6.4 hole and or thread size and fit
6.5 squareness
6.6 surface finish

Learning outcome

The learner will:

7 Use **all** the following measuring instruments during the checking activities:

7.1 external micrometers
7.2 depth vernier/micrometers
7.3 vernier calliper
7.4 square

Plus **three** more of the following:
7.5 rules
7.6 bore/hole gauges
7.7 slip gauges
7.8 Protractors
7.9 radius/profile gauges
7.10 thread gauges
7.11 Dial Test Indicators (DTI)
7.12 feeler gauges
7.13 surface finish equipment (such as comparison plates, machines)
7.14 Coordinate Measuring Machine (CMM)

Learning outcome

The learner will:

8 Produce components within **all** of the following standards, as applicable to the process:

8.1 components to be free from false tool cuts, burrs and sharp edges
8.2 general dimensional tolerance +/- 0.25mm or +/- 0.010”
8.3 there must be one or more specific dimensional tolerances within +/- 0.10 or +/- 0.004”
8.4 flatness and squareness 0.05mm per 25mm or 0.002 per inch
8.5 angles within +/- 0.5 degree
8.6 screw threads to BS Medium fit
8.7 reamed holes within H8
8.8 surface finish 63µin or 1.6 µm

Learning outcome

The learner will:

9 Knowledge and understanding - The apprentice must know and understand:

9.1 the health and safety requirements, and safe working practices and procedures required for the machining activities undertaken (such as wearing appropriate protective clothing and equipment (PPE), using machine guards, and of keeping the work area safe and tidy

9.2 the hazards associated with the activities (such as using damaged or badly maintained tools and equipment, slipping on spilt coolant, swarf) and how they can be minimised

9.3 the importance of applying the appropriate behaviours in the workplace and the implications for both the apprentice and the business if these are not adhered to

9.4 how to extract and use information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS or ISO standards) in relation to work undertaken

9.5 how to interpret first and third angle drawings, imperial and metric systems of measurement, workpiece reference points and system of tolerancing

9.6 how to prepare the materials in readiness for the machining activities (such as visually checking for defects, cleaning the materials, removing burrs and sharp edges)

9.7 methods of holding the workpiece for the machining activities (such as in a chucks, machine vice, collets or clamped directly to the machine table)

9.8 the various turning operations that can be performed (such as parallel, stepped and tapered external diameters, drilled, bored and reamed holes, internal and external screw threads, special profiles)

9.9 the various milling operations that can be performed (such as flat, parallel, square and angled surfaces; open ended and enclosed slots, special forms, drilled and bored holes)

9.10 how to mount and secure the cutting tools in the tool holding devices (such as front or rear tools posts; mounting cutters on long or stub arbors; mounting drills in chucks or by the use of morse taper sockets; the need to ensure that the tool is sharp and secure)

9.11 the techniques of taking trial cuts and checking dimensional accuracy; the application of roughing and finishing cuts, and the effect on tool life and surface finish

9.12 factors that affect the selection of cutting feeds and speeds, and the depth of cut that can be taken (such as type of material, size of material, operations being performed, workholding method/security of workpiece, condition of machine, finish and tolerance required)

9.13 the application of cutting fluids and compounds with regard to a range of different materials, and why some materials do not require cutting fluids to be used

9.14 how to check the workpiece using the appropriate measuring equipment (such as rules, micrometers, verniers, gauges and surface finish comparison equipment)

9.15 the need to check that the measuring equipment is within current calibration dates, and that the instruments are correctly zeroed; measuring internal and external dimensions (such as lengths, diameters, depths, slots, hole positions, angles, profiles); measuring geometric features (such flatness, squareness, parallelism, concentricity); how to check surface finish (such as by using comparison blocks or instruments)

9.16 when to act on their own initiative and when to seek help and advice from others

9.17 the importance of leaving the work area and equipment in a safe and clean condition on completion of the machining (such as isolating machines, removing and returning cutting tools, cleaning the equipment, and removing and disposing of waste)

Unit 222 General machining applications (turning and milling)

Supporting Information

Unit guidance

Assessment requirements have been developed by employers for the occupational competency units and qualifications for Advanced Manufacturing and Engineering Sector. These assessment requirements are set down in the relevant Qualification Assessment Strategies available from Semta. Please contact Customer.Services@semta.org.uk quoting Advanced Manufacturing and Engineering Trailblazer Qualification Assessment Strategy and specifying the title of the relevant Trailblazer Standard

Although all of the content and assessment requirements must be met in full employers can tailor the training outcomes to ensure that the content of the programme is specific to their requirements in terms of products, processes, procedures, tools, equipment, materials, documentation and information systems.

This will allow each organisation to develop their own specific and tailored apprentice training programme that meets their own business requirements whilst at the same time ensuring that the overall generic content is to a high standard in terms of depth and breadth to enable progression and/or transferability to other employers.

Unit 223 General welding applications

Unit level:	Level 2
GLH:	60
Unit aim:	This Employer Unit of Competence (EUC) has been developed by employers in the Maritime Defence Engineering Sector and is part of an overall development programme designed to meet the requirements of the Sector, the published Apprenticeship Standard and Employer Occupational Brief. This EUC identifies the training and development required in order that the apprentice can demonstrate that they are competent in being able to prepare the welding equipment and to ensure that all the leads/cables, electrode holder, hoses, torches shielding gas system, hoses, wire feed mechanisms and workpiece earthing arrangements are securely connected and free from damage (where applicable). They will also need to obtain and check that all the work holding equipment and manipulating devices are in a safe and usable condition. In preparing to weld, they will need to set and adjust the welding conditions in line with instructions and/or the welding procedure specification. They must operate the equipment safely and correctly, and make any necessary adjustments to settings in line with their permitted authority, in order to produce the welded joints to the required specification. On completion of the welding operations, they will be expected to check the quality of the welds using visual examination, as appropriate to the aspects being checked. They will need to be able to recognise welding defects, to take appropriate action to limit any faults that occur and to ensure that the finished workpiece is within the specification requirements. On completion of the welding activities, they will be expected to return all tools, equipment and workholding devices to their designated location and to leave the welding equipment and work area in a safe and tidy condition. Their responsibilities will require them to comply with health and safety requirements and organisational policy and procedures for the welding activities undertaken. They will need to take account of any potential difficulties or problems that may arise with the activities, and to seek appropriate help and advice in determining and implementing a suitable solution. They will work under a high level of supervision, whilst taking responsibility for their own actions and for the quality and accuracy of the work that they carry out. Their underpinning knowledge will provide an understanding of their work, and will enable them to apply appropriate welding

	techniques and procedures safely. They will understand the welding processes, and their application, and will know about the equipment, materials, consumables and destructive / non-destructive tests, to the required depth to provide a sound basis for carrying out the activities to the required specification. They will understand the safety precautions required when working with welding equipment, and with the associated tools and equipment. They will be required to demonstrate safe working practices throughout, and will understand the responsibility they owe to themselves and others in the workplace. They will be able to apply the appropriate behaviours required in the workplace to meet the job profile and overall company objectives, such as strong work ethic, positive attitude, team player, dependability, responsibility, honesty, integrity, motivation and commitment.
Endorsed by	Semta

Learning outcome

1 Performance Requirements - The apprentice must be able to:

1.1 work safely at all times, complying with health and safety legislation, regulations and other relevant guidelines

1.2 demonstrate the required behaviours in line with the job role and company objectives

1.3 plan the welding activities before they start them

1.4 obtain and prepare the appropriate welding equipment and welding consumables

1.5 prepare and support the joint, using the appropriate methods

1.6 tack weld the joint at appropriate intervals, and check the joint for accuracy before final welding

1.7 weld the joint to the specified quality, dimensions and profile

1.8 use appropriate methods to check the quality, and that all dimensional and geometrical aspects of the weld are to the specification

1.9 deal promptly and effectively with problems within their control, and seek help and guidance from the relevant people if they have problems that they cannot resolve

1.10 shut down and make safe the welding equipment on completion of the welding activities

1.11 leave the work area in a safe and tidy condition on completion of the manufacturing activities

Learning outcome

The learner will:

2 Carry out **all** of the following during the welding activities:

2.1 adhere to procedures or systems in place for risk assessment, COSHH, Personal Protective Equipment (PPE) and other relevant safety regulations

2.2 check the condition of, and correctly connect, welding leads, earthing arrangements, electrode holder, welding gun / torch, hoses, shielding gas, and wire feed mechanisms (where applicable)

2.3 set and adjust the welding conditions/parameters, in accordance with the welding procedure specification

2.4 prepare the work area for the welding activities (such as positioning welding screens and fume extraction)

2.5 prepare the materials and joint in readiness for welding (such as cleaning of joint faces, grinding weld preparations, setting up the joint, supporting the joint)

2.6 make sure that the work area is maintained and left in a safe and tidy condition

Learning outcome

The learner will:

3 Use manual welding and related equipment, for **one** of the following welding processes:

3.1 Manual Metal-Arc (MMA)

3.2 MIG/MAG/Flux Cored Arc

3.3 TIG /Plasma Arc

Learning outcome

The learner will:

4 Produce **two** of the following welded joints of at least 150mm long, with a minimum of one stop and start included:

4.1 fillet lap joints

4.2 tee fillet joints

4.3 butt joints

Plus the following welded joint

4.4 corner joint

Learning outcome

The learner will:

5 Produce joints as follows:

5.1 **One** type of material from the following

carbon steel

stainless steel

5.2 Plus **one** from of material from the following:

sheet (less than 3mm)
pipe/tube
plate
other forms
section

Learning outcome

The learner will:

6 Weld joints in good access situations, in **three** of the following BS EN ISO 6947 positions:

6.1 Flat (PA)
6.2 Vertical upwards (PF)
6.3 Horizontal vertical (PB)
6.4 Vertical downwards (PG)
6.5 Horizontal (PC).

Learning outcome

The learner will:

7 Identify **all** of the following weld defects:

7.1 lack of continuity of the weld
7.2 uneven and irregular ripple formation
7.3 incorrect weld size or profile
7.4 undercutting
7.5 overlap
7.6 lack of fusion
7.7 porosity
7.8 lack of penetration

Plus **one** from the following
7.9 surface cracks
7.10 internal cracks
7.11 inclusions

Learning outcome

The learner will:

8 Produce welded joints which meet **all** of the following (with reference to BS 4872 Part 1 Weld test requirements):

8.1 welds are adequately fused and have a uniform profile, free from excessive undulations, with regular and even ripple formation

8.2 the weld surface is free from cracks and substantially free from porosity, shrinkage cavities and trapped slag

8.3 joins at stop/start positions merge smoothly, with no pronounced hump or crater in the weld surface

8.4 tack welds are blended in to form part of the finished weld, without excessive hump

Learning outcome

The learner will:

9 Knowledge and understanding - The apprentice must know and understand:

9.1 the health and safety requirements, and safe working practices and procedures required for the welding activities undertaken (such as general workshop safety; appropriate Personal Protective Equipment (PPE); fire prevention; protecting other workers from the effects of the welding arc; safety in enclosed/confined spaces; fume extraction/control)

9.2 the personal protective clothing and equipment (PPE) to be worn when carrying out the welding activities (such as leather gloves/gauntlets, leather aprons, eye protection (head/eye shield with correct shade of filter), ear protection, safety boots), and the importance of keeping the work area safe and tidy

9.3 the hazards associated with welding activities (such as live electrical components; poor earthing; the electric arc; fumes and gases; hot metal; welding in enclosed spaces; slips, trips and falls), and how they can be minimised

9.4 the correct handling and storage of gas cylinders (such as manual handling and use of cylinder trolley, leak detection procedures, relevant BCGA codes of practice, cylinder identification, gas pressures, cylinder and equipment safety features)

9.5 the importance of applying the appropriate behaviours in the workplace and the implications for both the apprentice and the business if these are not adhered to

9.6 how to extract and use information from engineering drawings and related specifications (to include symbols and conventions to appropriate BS or ISO standards) in relation to work undertaken

9.7 the manual welding process (such as basic principles of fusion welding, the major parts of their welding equipment and their function)

9.8 the types of welded joints to be produced (such as lap joints, corner joints, tee joints, butt, single and multi-run welds)

9.9 types, selection and application of filler wires and welding electrodes

9.10 reasons for using shielding gases, the types and application of the various gases (include the importance of ensuring correct gas pressures and flow rates)

9.11 terminology used for the appropriate welding positions

9.12 how to prepare the materials in readiness for the welding activity by ensuring that they are free from excessive surface contamination (such as rust, scale, paint, oil/grease and moisture)

9.13 why the edges to be welded need to be correctly prepared (such as made flat, square or bevelled)

9.14 how to set up and restrain the joint, and the tools and techniques to be used (such as the use of jigs and fixtures, restraining devices such as clamps and weights/blocks; setting up the joint in the correct position and alignment)

9.15 checks to be made prior to welding (such as confirming the correct set-up of the joint; the condition of electrical connections, welding return and earthing arrangements; operating parameters)

9.16 tack welding size and spacing (in relationship to material thickness)

9.17 the techniques of operating the welding equipment to produce a range of joints in the various joint positions (such as fine adjustment of parameters; correct manipulation of the torch or welding gun; striking and initiating the arc; correct manipulation and welding speed of electrode; blending in stops/starts and tack welds)

9.18 methods/modes of metal transfer and their uses (such as dip, globular, free flight, spray and pulsed)

9.19 how to control distortion (such as welding sequence; deposition technique)

9.20 problems that can occur with the welding activities (such as causes of distortion and methods of control; effects of welding on materials and sources of weld defects), and how these can be overcome

9.21 how to close down the welding equipment safely and correctly

9.22 the safe working practices and procedures to be adopted when preparing the welds for examination (such as handling hot materials, using chemicals for cleaning and etching, using equipment to fracture welds)

9.23 how to prepare the welds for examination (such as removing surface irregularities; cleaning the weld, polishing and making saw cuts on welds to be fracture tested)

9.24 how to check the welded joints for uniformity, alignment, position, weld size and profile

9.25 the various procedures for visual examination of the welds for cracks, porosity and slag inclusions (such as dye penetrant, fluorescent penetrant; magnetic particle testing)

9.26 the various procedures for carrying out destructive tests on the welds (such as macroscopic examination, bend tests, nick break tests)

9.27 methods of removing a specimen of weld from a suitable position in the joint (such as a stop/start position) using a non-thermal process (such as hand saws, power saws, abrasive discs)

9.28 how to examine the welds after the tests and how to check for such defects as the degree of penetration and fusion, inclusions, porosity, cracks, undercut and overlap, uneven and irregular ripple formation

9.29 when to act on their own initiative and when to seek help and advice from others

9.30 the importance of leaving the work area and equipment in a safe condition on completion of the welding activities (such as isolation of electrical supplies, safely storing equipment and consumables, removing and disposing of waste)

Unit 223 General welding applications

Supporting Information

Unit guidance

Assessment requirements have been developed by employers for the occupational competency units and qualifications for Advanced Manufacturing and Engineering Sector. These assessment requirements are set down in the relevant Qualification Assessment Strategies available from Semta. Please contact Customer.Services@semta.org.uk quoting Advanced Manufacturing and Engineering Trailblazer Qualification Assessment Strategy and specifying the title of the relevant Trailblazer Standard.

Although all of the content and assessment requirements must be met in full employers can tailor the training outcomes to ensure that the content of the programme is specific to their requirements in terms of products, processes, procedures, tools, equipment, materials, documentation and information systems.

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Appendix 1 Sources of general information

The following documents contain essential information for centres delivering City & Guilds qualifications. They should be referred to in conjunction with this handbook. To download the documents and to find other useful documents, go to the Centres and Training Providers homepage on www.cityandguilds.com.

Centre Manual - Supporting Customer Excellence 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, as well as updates and good practice exemplars for City & Guilds assessment and policy issues.

Specifically, the document includes sections on:

- The centre and qualification approval process
- Assessment, internal quality assurance and examination roles at the centre
- Registration and certification of candidates
- Non-compliance
- Complaints and appeals
- Equal opportunities
- Data protection
- Management systems
- Maintaining records
- Assessment
- Internal quality assurance
- External quality assurance.

Our Quality Assurance Requirements encompasses all of the relevant requirements of key regulatory documents such as:

- SQA Awarding Body Criteria (2007)
- NVQ Code of Practice (2006)

and sets out the criteria that centres should adhere to pre and post centre and qualification approval.

Access to Assessment & Qualifications provides full details of the arrangements that may be made to facilitate access to assessments and qualifications for candidates who are eligible for adjustments in assessment.

The **centre homepage** section of the City & Guilds website also contains useful information on such things as:

- **Walled Garden**: how to register and certificate candidates on line
- **Events:** dates and information on the latest Centre events
- **Online assessment**: how to register for e-assessments.

Centre Guide – Delivering International Qualifications 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.

Specifically, the document includes sections on:

- The centre and qualification approval process and forms

- Assessment, verification and examination roles at the centre
- Registration and certification of candidates
- Non-compliance
- Complaints and appeals
- Equal opportunities
- Data protection
- Frequently asked questions.

Appendix 2 Useful contacts

UK learners General qualification information	**E: learnersupport@cityandguilds.com**
International learners General qualification information	F: +44 (0)20 7294 2413 **E: intcg@cityandguilds.com**
Centres Exam entries, Certificates, Registrations/enrolment, Invoices, Missing or late exam materials, Nominal roll reports, Results	F: +44 (0)20 7294 2413 **E: centresupport@cityandguilds.com**
Single subject qualifications Exam entries, Results, Certification, Missing or late exam materials, Incorrect exam papers, Forms request (BB, results entry), Exam date and time change	F: +44 (0)20 7294 2413 F: +44 (0)20 7294 2404 (BB forms) **E: singlesubjects@cityandguilds.com**
International awards Results, Entries, Enrolments, Invoices, Missing or late exam materials, Nominal roll reports	F: +44 (0)20 7294 2413 **E: intops@cityandguilds.com**
Walled Garden Re-issue of password or username, Technical problems, Entries, Results, e-assessment, Navigation, User/menu option, Problems	F: +44 (0)20 7294 2413 **E: walledgarden@cityandguilds.com**
Employer Employer solutions, Mapping, Accreditation, Development Skills, Consultancy	T: +44 (0)121 503 8993 **E: business@cityandguilds.com**
Publications Logbooks, Centre documents, Forms, Free literature	F: +44 (0)20 7294 2413

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